Agenda-setting the unknown

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A STUDY OF LOCAL AND REGIONAL GOVERNANCE OF CLIMATE CHANGE ADAPTATION IN NORWAY

BY
HALVOR DANNEVIG

DISSERTATION SUBMITTED 2015

AALBORG UNIVERSITY
DENMARK

WESTERN NORWAY RESEARCH INSTITUTE
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A STUDY OF LOCAL AND REGIONAL GOVERNANCE OF CLIMATE CHANGE ADAPTATION IN NORWAY

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Dissertation submitted

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Front cover photo: Summer evening in Lofoten. By the author
Back cover photo: Hammerfest, exposed to avalanches and a rising sea level at the same time. By the author

CV

Halvor Dannevig is currently a research fellow at the Western Norway Research Institute in Sogndal, Norway. He holds a masters degree in Human Geography from the University of Bergen from 2006. In his thesis he studied how farmers in Himalaya, Nepal, adapted their water management system to disappearing glaciers and new technology. From 2008 to 2011 he worked as a research fellow at CICERO (Center for International Climate and Environmental Research- Oslo). Here he worked on adaptation and vulnerability to climate change in Arctic communities. He has also studied adaptation to climate change in Norwegian municipalities and counties, and has given numerous lectures on the above mentioned topics on scientific conferences, to students at the University in Bergen and the University in Oslo and to professionals in the government. Halvor is also a certified mountain guide and has been involved in tourism research at Western Norway Research Institute. He have also been teaching nature based tourism at the University College in Sogn og Fjordane. In addition to the articles that are included in his PhD-thesis, he has co-authored a number of peer reviewed journal articles and book chapters. Currently he is a member of the working group for social science and humanities at the International Arctic Science Council (IASC) and is a member of the board for the research program for polar research (POLARPROG) at the Norwegian Research Council.

PREFACE

This thesis is the results of seven years working as a researcher in the field of climate change adaptation, though the PhD-project itself lasted for just over two years. I did, however, get into the climate change topic at an even earlier stage: The final year at the Steiner highschoolin Hamar, Norway, where I had to write a thesis over the course of a year on a topic of my choice. I wrote about how to solve the problem of increased greenhouse gas emissions, and chose windmills as an example. This was in 1997. Then, when choosing a project for my master thesis at Department of Geography at the University of Bergen, my supervisor professor, Tor Halfdan Aase, asked if I wanted to look into how retreating glaciers impacted the water supply in a dry Himalayan region in Nepal. Thus my studies returned to the climate issue, but now from the impact side. The master thesis concluded that technological and cultural factors had a more salient impact on the water management system than the retreating (and also disappearing glaciers). Similar conclusions have been drawn from a number of other studies of vulnerability and adaptation to climate change. Climate change cannot be viewed in isolation from other drivers of change. Similarly social, political and cultural factors matters shape how we respond to climate change. With the fourth assessment report of the Intergovernmental Panel on Climate Change (2007), adaptation really got on the agenda in Norway. It resulted in several research projects investigating the local consequences of climate change in Norway and in the Arctic. I was employed by CICERO in Oslo, in order to work on these projects with dr. Grete K. Hovelsrud. We focused in particular on community vulnerability and adaptation in northern Norway, in addition to local adaptation governance. Then in 2011, I chose to continue this work at the Western Norway Research Institute as part of dr. Carlo Aall's research group. I continued to work on local adaptation governance, but in addition began to focus on natural hazard mitigation and spatial planning through the project Spatial Planning for a Changing Climate, AREALKLIM (2012-2014), which provided further insights into adaptation work at the regional level. This PhD-project is based on the research projects I have worked on the last seven years (see table below). It is rooted in the research question and informed by experiences from working with applied research to understand the need for,and the means to implement, adaptation.

ACKNOWLEDGEMENTS

The pursuit of this PhD-project has been an enriching challenge, and I have been dependent on support and guidance from many people and institutions. It would not have been possible without the support and hours from Western Norway Research Institute (WNRI), where I have my research post. Neither would it have been possible without the interest and engagement of officials at the municipalities and counties where the case studies were conducted. The research for this PhD-project has been funded through several research projects. The projects, funding programs and people engaged in the data collection and analysis that I have utilized in this PhD-project, are outlined in the table below.

My supervisor Matthew Cashmore at Aalborg University has provided excellent advice and guidance throughout the project period, thank you! I would also like to thank my co-supervisor Carlo Aall at WNRI for good cooperation and advice. My other co-supervisor, Grete K. Hovelsrud, needs to be thanked for offering me to start working on adaptation to climate change at CICERO in 2008, and also for help and advice during the PhD-project. I would also like to thank my colleagues who have worked with me on these projects or with similar research questions for all the good discussions and their cooperation: Helene Amundsen, Trude Rauken, Bob van Oort, Kyrre Groven, Anja Wejs, Erlend A. T. Hermansen and Idun Husabø. Thanks to Deborah Davies for proof reading. Finally I would also like to thank my family and my dear Ingrid B. Hynne for support during the more intense periods of writing.

Research projects that have contributed to the PhD project.

Research project	**Acronym**	**Year**	**Funding agency**	**Researchers that contributed with data collection**
Community Adaptation and Vulnerability in the Arctic Region	CAVIAR	2007-2010	Norwegian Research Council. IPY-program	Grete K. Hovelsrud
Potentials and limitations for Adaptation in Norway	PLAN	2007-2009	Norwegian Research Council, NORKLIMA	Grete K. Hovelsrud
Critical aspects of adaptive capacity in Norther Regions	CAVIAR II	2012-2014	Norwegian Research Council, NORKLIMA	
Community Vulnerability and adaptation in Norwegian municipalities	NORADAPT	2008-2011	Norwegian Research Council, NORKLIMA	Grete K. Hovelsrud, Helene Amundsen, Stine Rybråten, Kyrre Groven, Idun Husabø, Eli Heiberg
Community Vulnerability and adaptation in Norwegian municipalities	NORADAPT	2008-2011	Norwegian Research Council, NORKLIMA	Grete K. Hovelsrud, Helene Amundsen, Stine Rybråten, Kyrre Groven, Idun Husabø, Eli Heiberg
Spatial planning for a changing climate	AREALKLIM	2012-2014	Regional Research Fund of Western Norway, The directorate of agriculture, NVE, County councils of Sogn og Fjordane and Hordaland.	Carlo Aall, Kyrre Groven, Ragnar Brevik
Primary industries and transformational change	PITCH	2014-2017	Norwegian Research Council, KLIMAFORSK	

SUMMARY

This thesis seeks to explain the emergence of adaptation to climate change governance at the local and regional level in Norway. Adaptation to climate change has received increased attention among scholars in recent decades, as it has become evident that unprecedented climate change is inevitable, irrespective of the success of measures to reduce emissions of greenhouse gases. In Norway, the municipalities have been assigned a particularly important role in this work, but with support from regional government. The causes and effects of climate change are distributed temporally and spatially in such a way that in the short term it is not comprehensible without the methods and devices of science. This poses challenges for agenda-setting adaptation as a policy issue, when it has to compete with more immediate and familiar concerns. This thesis builds on research conducted through a suite of case studies carried out in nine municipalities and four counties in Norway between 2008 and 2014. Eight of the cases focus on agenda-setting and implementation of adaptation to climate change in the planning department in local and regional government across Norway. One extensive case focuses on the relation between knowledge and the perceived need for adaptation in the coastal fishery sector, agricultural sector and local government in Vestvågøy municipality in Lofoten, northern Norway. A third set of cases in western Norway, investigate attempts by regional government to coordinate adaptation at the local level, and the application and effect of boundary work in this effort.

The research results show that adaptation to climate change is not readily seen as a salient issue in climate change sensitive sectors or in municipalities. By integrating insights from cultural theory, science and technology studies and policy formation theory, it is concluded that agenda-setting of climate change adaptation requires human agency in providing local legitimacy and salience for the issue. This agency is manifested in the "engaged municipal official" that are able to agenda-set and implement adaptation. Three other drivers are also identified: real-world indicators of climate change, extreme weather events and involvement with researchers. The latter points to the learning, networking and boundary work that occurred when engaged officials interacted with researchers and have shed light on the challenge of making the science-policy interface work for adaptation. In this respect, it is concluded that the boundary work required to produce knowledge for climate change policies must be tailored to the policy actors cultural preferences in order to resonate with their perceptions of risks and problem recognition which, to a high degree, are rooted in past experiences, and historical and political developments. Policies to tackle climate change cannot solely rely on translations of natural science; they also also require knowledge produced by social science and local users. Agenda-setting theories need to be supplied with additional perspectives in order to explain how policies for solving issues dependent principally or solely on

scientific knowledge, can be developed. I have demonstrated that STS-scholarship on boundary work and cultural theory, which often are conducted within a relativist ontology, can be used for explaining causal mechanisms: that of the emergence of adaptation governance at the local level.

DANSK RESUMÉ

Målet for denne PhD afhandling er at forklare tilblivelsen af det lokal- og regionalpolitiske og forvaltningsmæssige temaet tilpasning til klimaforandringer. Tilpasning til klimaforandringer har i øgende grad havnet på dagsordenen, som en følge av en erkendelse av at der vil udvikles klimaforandringer uafhængig af hvor succesfulde tiltag og aftaler om at reducere udslip af drivhusgasser der bliver gjort. Samfundets tilpasninger til klimaforandringer må ske på flere niveau, men det er særlig på det lokale niveau at behovet for tilpasninger må undersøges og tilpasningstiltag bør iværksattes. Derfor er det kommunerne som har fået et specielt ansvar i klimatilpasningsarbejdet, dog understøttet av det regionale niveauet. Årsagerne og virkningerne af klimaforandringerne er spredt i tid og rom, sådan at det kun er ved hjælp av videnskaben at klimaforandringerne bliver begribelige. Dette skaber udfordringer i forhold til at sætte tilpasning til klimaforandringer på den politiske dagsorden, hvor der til enhver tid er en række akutte udfordringer som konkurrerer om opmærksomheden. Denne afhandling bygger på forskning udført som case studier i ni kommuner og fire regioner i Norge i perioden mellem 2008-2014. Resultaterne og analyserne er præsenteret i fire videnskabelige artikler.

Afhandlingens resultater viser, at tilpasning til klimaforandringer ikke uden videre er set på som et vigtig tema hverken i næringer, der er sensitive for klimaforandringerne, eller i kommunerne. Ved at integrere indsigter fra kulturteori, science and technology studier (STS) og agenda-settings teorier, fremgår det at vigtigheden af klimatilpasningstemaet og muligheden for at placere klimatilpasning på den lokale politiske dagsorden afhænger af aktørskab, samt evne til at give temaet legitimitet lokalt. Betydningen av aktørernes handlinger og motivationen for at handle er så langt forsømt i agenda-settings litteraturen. Aktørskabet i dette studie er manifisteret gennem ”ildsjælene” i den kommunale administration, som evner at både sætte dagsordenen for-, og implementere tilpasninger til klimaforandringer. Dog er dette også afhængig av andre medvirkende faktorer: blandt flere kan her nævnes observationer af ”ægte” indikatorer, ekstreme vejr hændelser samt involvering i forskningsprojekter. Den sidste medvirkende faktor peger på udfordringen med at få koblingerne mellem videnskab og politik til at fungere for klimatilpasning. Kundskab for klimatilpasning må fremskaffes igennem bevidst arbejde på tværs av grensene mellem videnskab og politik, og arbejdet må således også tager hensyn til aktørernes kulturelle præferencer og måder at forstå problemerne på. Jeg finder derfor, at agenda-setting teorier må suppleres med supplerende perspektiver for at kunne forklare hvordan politikske temaer som afhænger af videnskabelig kundskab kan udvikles. I denne afhandlingen har jeg derfor udviklet et sådan teoretisk perspektiv ved at kombinere STS-litteratur om samproduktion av kundskab sammen med kulturteori til at forklare den lokale klimatilpasningspolitik.

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1. INTRODUCTION

As the world gets warmer and attempts to craft an international treaty to curb carbon emissions flounder, adaptation to climate change has become an increasingly more salient issue. This is partly a realization of the fact that even if attempts to curb the emission of greenhouse gases (GHG) through an international agreement take place, the world will still face serious and challenging impacts from climate change, such as increased frequency and magnitude of floods, severe droughts, wild fires and storm surges (IPCC, 2014). Climate policy as a whole deals with actions to reduce both the causes and impacts of anthropogenic climate change, and these two sub themes are usually referred to as mitigation and adaptation respectively. Mitigation refers to actions taken to reduce emissions of GHGs, encompassing such sub fields as energy policy, negotiation over a global climate treaty and tax- or quota schemes for GHG emissions. Adaptation can be broadly defined as actions taken to reduce the negative impacts of climate change or to benefit from the opportunities provided by such change. It is commonly distinguished as reactive or autonomous adaptation on one hand and planned adaptation on the other, where the former pertains to actions taken in order to cope with current and historical climate variability and the latter is planned as a consequence of anticipated climate change impacts (Fankhauser et al., 1999; IPCC, 2007). Initially, mitigation dominated the climate policy agenda, but both the third (in 2001) and the fourth (in 2007) assessments reports of the Intergovernmental Panel on Climate Change (IPCC) stated that mitigation alone would not be sufficient to combat climate change (IPCC, 2007), and since then both policy makers and researchers alike have increasingly paid more attention to adaptation.

1.1 ADAPTATION TO CLIMATE CHANGE AS A POLICY AREA

Adaptation policy usually has the dual aim of reducing vulnerability to climate change and increasing the capacity to cope with the consequences (Smit and Wandel, 2006; Vogel and Henstra, 2015). It is widely acknowledged that adaptation to climate change would have to take place at multiple scales and levels, and across various sectors (Berrang-Ford et al., 2014; Biesbroek et al., 2010; IPCC, 2014). As governments, NGOs and private enterprises are starting to plan for a changing climate, it also means that we are speaking of a new area for public policy and a new subject for governance, which involves both public, private and civil society actors (Berrang-Ford et al., 2011; IPCC, 2014). A myriad of definitions of the concept of governance exists, but broadly speaking it refers to the process of governing in a wide-ranging sense that includes modes of coordination and steering

that are associated with, and involve market organizations and other-non state actors (Kooiman, 2003). Most countries in Europe have carried out national adaptation and vulnerability assessments and thereby indicated that the national government has a role to play in adaptation (Keskitalo, 2010; Swart et al., 2009). Keskitalo (2010) also notes that adaptation is likely to be implemented in a similarly as other environmental policies. Research has tended to focus at the local level, because this is were the consequences of climate change are felt (IPCC, 2007; Vogel and Henstra, 2015). Despite an increasing body of literature, the study of adaptation as a policy area is still an immature field and there is no agreement over the precise meaning and content of adaptation policy and adaptation governance, and therefore framework and methods for assessing performance are largely lacking (Vogel and Henstra, 2015). The capacity of local governments to adapt to climate change is found to be determined by institutional factors, such as organizational structure, legitimacy and administrative routines (Amundsen et al., 2010; Cashmore and Wejs, 2014; Keskitalo et al., 2010). Despite the "institutional" awareness of the need for adaptation, manifested in policy documents and not the least in research literature, there is a "deficit" in implementing planned adaptation measures (Berrang-Ford et al., 2014, 2011; Klein and Juhola, 2014). In the Nordic countries, few municipalities have considered the need for adaptation. Those that do, with a few exceptions such as in Stavanger (see article three,) and Vestvågøy (article one), demonstrate mainly a reactive response to natural hazards events (Amundsen et al., 2010; Glaas et al., 2010; Groven et al., 2012; Juhola, 2010; Rauken et al., 2014). The challenges in developing and implementing adaptation policies have been attributed to a lack of urgency and salience compared to other policy issues (Hjerpe et al., 2014; Nilsson et al., 2012), as well as limited attention from the public (Hjerpe et al., 2014), and weak support at the national level (Wejs et al., 2013). The infancy of the issue, the relatively weak central coordination and the importance of the local governance level makes it an interesting case for studying local level agenda-setting and policy coordination. The policy agenda refers to the list of issues to which the policy-makers are paying serious attention (Kingdon, 2003), and agenda-setting of a new issue is the initial phase of policy change (e.g Baumgartner and Jones, 2009). The governance of an issue in horizontal and vertical policy networks requires *coordination* between public and private organizations in order to ensure that service is delivered and that gaps are avoided (Peters, 1998). The study of multi-level adaptation governance thus proves an interesting case for theory development in the broader field of environmental governance.

1.2 THE CHALLENGE OF COUPLING SCIENCE TO POLICY FOR CLIMATE CHANGE ADAPTATION

Adaptation research was initially dominated by attempts to asses vulnerability at various levels of society or sectors by the use of downscaled scenarios for climate change (Biesbroek et al., 2010; e.g Dessai et al., 2005). Despite the inevitable uncertainty that is inherent in climate model projections, the knowledge of the expected impacts and consequences of climate change has increased substantially (IPCC, 2014). This information gain has been matched by more recent efforts on the policy side of adaptation, through development of adaptation strategies and policies, as mentioned in the previous section (Klein and Juhola, 2014). Nevertheless, as noted, actual implementation of adaptation policies is still limited. Notwithstanding this increased knowledge both of the impacts of climate change and the policy side of adaptation, challenges remain in coupling science to policy in the field of adaptation (André and Jonsson, 2013; Corfee-Morlot et al., 2011; Hoppe and Wesselink, 2014; Klein and Juhola, 2014).

Most policy areas in industrialized countries look to be based on scientific knowledge (Beck, 1992; Yearley, 2005). Climate change is a global risk produced by the modern society, by the inventions and gains delivered to us by the progress of science and technological development. It is thus similar to other global risks, such as those posed by nuclear energy, toxins from industrial production, and ozone layer depletion, as Ulrick Beck has explained in his "Risk Society" (Beck, 1992). What these global risks have in common is that they "(…) completely escape human powers of direct perception" (Beck, 1992, p. 27). These risks can only be identified with the devices of science and are made visible through the use of abstract models (Beck, 1992; Latour, 1993). The causes of the risk are distributed both temporally and spatially, and the consequences are often felt in places other than where the causes originated. In addition, climate change risk has a third feature that makes it even less likely to be identified as a threat by lay people– the most harmful consequences of climate change are likely to take place in the distant future, a future where many of the current decision-makers may no longer be alive.

Because the link between cause and effect of modern risks is not apparent, attempts to add a causal explanation inevitably add both a theoretical and normative dimension to what constitutes risk (Beck, 1992). How common-sense comprehension and understanding of climate differs widely from the way climate is understood by science, has been well documented (Hulme, 2008; Jasanoff, 2010). The apparent disconnect between the abundance of scientific knowledge about the problem of climate change and the general lack of societal response and political commitment to deal with the challenges relating to climate change has also been widely commented upon by scholars (Hulme, 2009; Hulme et al., 2009; Jasanoff,

2010; Szerszynski and Urry, 2010). That the lack of action on climate change is not caused by a lack of knowledge, but rather a lack of policy (Sarewitz and Pielke, 2007; Tøsse, 2013) is a recognition that undermines the "linear knowledge to action" model underlying contemporary climate policy (Hoppe and Wesselink, 2014). It is a major challenge that the climate change message and the need for societal change does not resonate well with many parts of society. As Hulme notes (2009), the *idea* of climate change alters our social worlds, and this provokes resistance of those that feel that their interests and values are threatened, including powerful businesses (e.g Oreskes and Conway, 2010). While this part of the explanation for the lack of action on climate change mostly focuses on mitigation, it is also found to be of relevance for adaptation (e.g O'Brien and Wolf, 2010). If climate change is not perceived as sufficiently salient to warrant action, resilience may decrease because of a lack of planned adaptation (Amundsen, 2012).

As we only can be aware of future climate change through abstract scientific knowledge, the study of agenda-setting of adaptation necessitates an investigation of the agenda-setting powers of scientific knowledge and the arrangements needed to successfully harness scientific knowledge for policy. Furthermore, it is also necessary to investigate what it takes for this knowledge to turn adaptation into a salient issue among policy makers, industry actors, the civic society and the general public. Clearly, science and technology studies (STS) literature has a lot to offer on this topic, and the climate change field of study has seen increased attention from STS-scholars (e.g (Jasanoff, 2010; Miller, 2001; Sundqvist et al., 2015; Wynne, 2010). In particular there has been an emphasis on boundary organizations that can strengthen the science-policy interface (Hoppe and Wesselink, 2014; Mahony, 2013). However, despite a few exceptions (Corfee-Morlot et al., 2011; Tøsse, 2013) such work has not focused on adaptation to climate change. In addition, STS work tends to underplay the subjective and cultural dimension included in sense-making in the field of climate change. Perceptions of climate change risk are found to be determined by the individuals' risk perception, norms, values, culture and livelihood (Corner et al., 2014; O'Brien and Hochachka, 2010; O'Brien and Wolf, 2010; O'Riordan and Jordan, 1999). Thus, in order to better understand how adaptation can be set on the agenda and implemented at various governance levels, there is a need to make generalizations on how salient, legitimate and credible climate change knowledge can be tailored to fit with actors world views and values.

1.3 AIMS AND OBJECTIVES

New issues are, at a regular intervals, brought forward on to the policy agenda, and in governance studies and political science the study of agenda-setting and integration of new policy areas is a reoccurring theme. Adaptation to climate

change is an emerging policy area. The question is whether it has features that warrant new concepts and theory development within the broader field of governance studies? In this PhD-project it is argued that it does. The main aim of the project is therefore to:

Explain how adaptation to climate change has emerged on the political agenda as a governance issue at multiple levels of government and in a Nordic context.

In order to meet this aim I have formulated four objectives:

1) To study how livelihood and perceptions of climate change risks affect the salience of adaptation to climate change among actors in natural resource industries and local government.

By comparing the perceived need to adapt among various occupational groups and through the application of a cultural theory of risk framework (e.g Thompson and Wildavsky, 1990) it is possible to identify the factors and processes that determine whether adaptation is viewed as a salient issue. In order to meet this objective, the following research question is asked: How and to what extent do livelihood, values and worldviews affect the perceived need to adapt to climate change?

2) To investigate the performance of boundary work within multi-level adaptation governance.

Adaptation governance is a policy area that is dependent on a well-functioning science-policy interface. Scientific climate change knowledge needs to be translated, communicated and mediated in order to result in policy measures. In order to meet the second research objective, the following research question must be asked: How do actors at multiple governance levels position themselves, and (re)configure, boundary arrangements between science and policy realms in relation to knowledge for adaptation planning?

3) To examine how adaptation has been set on the governance agenda at the local level in Norway.

This objective addresses the following questions: What are the drivers for and factors that are setting adaptation on the local policy agenda? What makes adaptation go from being recognized as a problem to being an institutionalized component of the policy agenda? And: how well are agenda-setting theories able to explain agenda-setting of adaptation at the local level?

4) To apply the research findings and build a theory for explaining the emergence of adaptation planning at local and regional levels.

The last objective concerns the main theoretical contribution of the thesis. It will be met by combining the results from objectives 1, 2 and 3 in order to further develop both the theoretical dimensions of climate change governance and theories on policy formation and agenda-setting. The theory building will draw upon the empirical insights gained from applying the cultural theory of risk, theories of boundary work, and theories of agenda-setting to examine adaptation governance.

The first article corresponds to objective one and focuses upon individuals and industries, but it has implications for the other objectives as it concludes that in order for knowledge to have agenda-setting properties, it must be co-produced according to the knowledge users' world views and values. The following two articles correspond to objective two as they investigate the role of local government in adapting society to climate change: the first of these two articles focuses on agenda-setting and applies agenda-setting theory, while the latter focuses on implementation, using local level governance theories. The fourth article addresses the third objective as it investigates the role of regional government in adaptation governance with an emphasis on the importance of boundary organizations and work. All the journal articles are based on the afore-mentioned definitions of adaptation, adaptation planning and adaptation governance. However, they also apply different frameworks and theories that are drawn from multiple disciplines, including political science, STS and anthropology. Together these perspectives provide a coherent and unique insight in to processes shaping adaptation planning. See also table 1, chapter 3, for an overview of the theoretical approach used in the articles. A comprehensive introduction to the four articles that integrates the various theoretical perspectives applied in them is therefore provided in section 5.1.

1.4 THE STRUCTURE OF THE THESIS

This thesis is based primarily on four scientific articles of which two are published and two are submitted. These articles are included in the final section of the thesis. The purpose of the other chapters of this thesis are to provide a broader, more comprehensive and integrated presentation of the background, theoretical and methodological perspectives than is possible in individual articles, as well as demonstrating the interlinkages between the articles and presenting the thesis' overall theoretical contribution.

The former sections have provided a review of state-of-the art adaptation governance research, identified knowledge gaps and stated the aim and objective for this thesis. The next chapter (number 2) provides a brief overview of projected climate change impacts in Norway, the Norwegian governance system and Norwegian adaptation policy. Then follows the theory chapter (number 3) which is

split into five sections: the first (section 3.1) presents key concepts used in social dimensions of climate change research, in particular adaptation and adaptive capacity. Section 3.2 presents key concepts in agenda-setting and governance research. Section 3.3 presents the cultural theory of risk (CTR), while section 3.4 provides an introduction to boundary work theory. Linkages between the theoretical perspectives are provided in each section, and summarized in section 3.5. Then follows a chapter on research design, which starts with a section on the philosophy of science (section 4.1) that provides the ontological and epistemological assumptions for the research presented in this thesis. Section 4.2 outlines the methodological approach taken in the thesis, and connects this with the philosophy of science assumptions. The methodology section has sub-sections on case study selection, data collection methods and data analysis. The results are presented through the four research articles, which are attached. Article one is submitted, article two and three is published, and article four is resubmitted after minor revisions. The outlines and key argument of each article, as well as interlinkages between these, are presented in section 5.1. Section 5.2 draws out the theoretical contribution from the articles and demonstrates how they meet objective four of the thesis. Chapter 6 presents the overall conclusions of the research as a whole.

Stockfish production is a highly climate sensitive industry. Here are cod on drying racks in Lofoten. Photo: Halvor Dannevig.

2. BACKGROUND AND CONTEXT

2.1 PROJECTED CLIMATE CHANGE AND IMPACTS IN NORWAY

Adaptation to climate change research has become particularly relevant in the high North, as this part of the world is already experiencing more rapidly increasing temperatures than the global average (AMAP, 2011; IPCC, 2013). Norway has experienced a recorded increase in temperature and precipitation over the last decades. Temperatures are projected to increase by up to 2 degrees Celsius by 2050 and up towards 4,6 degrees by year 2100 (Hanssen-Bauer et al., 2009). Projections for precipitation are more uncertain, with the estimates ranging from a 5 % to 20 % increase in annual precipitation by 2050 and up to 30% by the year 2100 (Hanssen-Bauer et al., 2009). There are large seasonal and geographical variations within these projections, as displayed in Figure 1. It is the extreme precipitation events that pose the greatest challenge for society, but they are hard to model. Extreme precipitation events have increased during the last decades (IPCC, 2012), and are expected to further increase as a consequence of a warmer climate (Benestad, 2013; Benestad et al., 2012). Extreme precipitation events are a trigger of several forms of natural hazards, such as flash floods, mud slides and avalanches (Dyrdal et al., 2013), and projected climate change is expected to lead to an increase in these (Jaedicke et al., 2008). Another potential driver of natural hazards is sea level rise, which will lead to higher storm surges. The sea level is projected to increase up to 75 centimeters by 2100 in the coastal areas in northern and western Norway (Hanssen-Bauer et al., 2009).

The growing season is also extending as a consequence of increasing temperatures. According to model projections, large areas of Norway will get up to a two month increase in the growing season by 2050 (Hanssen-Bauer et al., 2009). Improved growing conditions could increase yields in the agricultural sector, but also increase the risk of pests, diseases and invasive species (Buanes et al., 2009), and wetter conditions in summer and early autumn could lead to challenges in securing the harvest (Kvalvik et al., 2011).

As a consequences of climate change, the ocean is warming. This again alters the population size, composition and distribution of several important fish stocks, first and foremost leading to a northward shift (Sundby and Nakken, 2008), including the economically important cod (Drinkwater, 2011).

Ocean acidification is also happening as a consequence of anthropogenic emissions of CO_2, with the global ocean pH value already down by 0,1 since the beginning of the industrial era (IPCC, 2013).

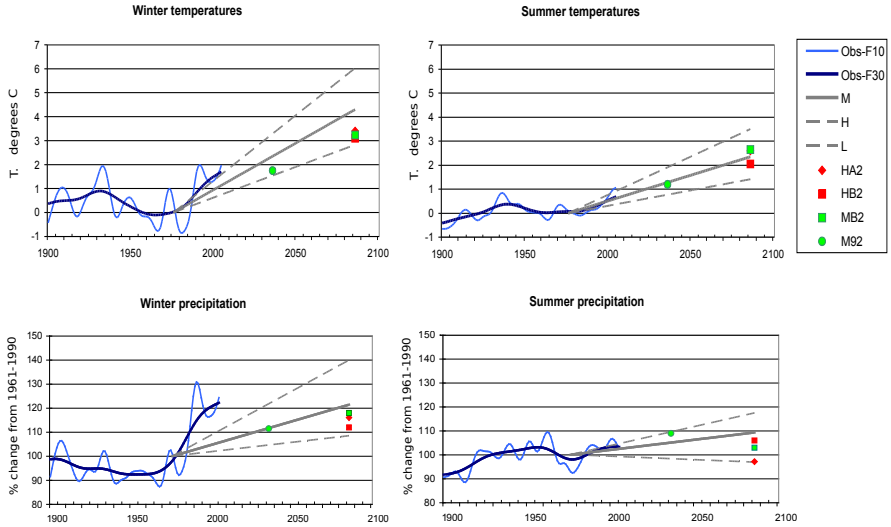

Figure 1. Downscaled climate model projections for temperature (above) and precipitation development and historical records in Norway 1900-2100. The winter figures are for the December-February and the summer figures are for June-August. The blue lines are historical records (dark blue is the 30 year mean and the light blue are the 10 year mean). The grey lines are projections from an ensemble of model runs taken from (Hanssen-Bauer et al., 2009)*, the lower dotted line showing the 10% percentile and the upper the 90% percentile. The SRES A2 and B2 scenarios from the IPCC 2007 reports are included for reference. The 92 scenario from the IPCC 2001 report is included in order to provide projections for 2021-2050 (the prefix H and M in the legend indicate the climate models applied for the downscaling). The figure is obtained from* (Hanssen-Bauer et al., 2009)*. Translation: Halvor Dannevig (2015)*

Ocean acidification happens more rapidly in cold waters, because cold water can store more CO_2, and this may have severe implications for marine life and could alter the composition of marine ecosystems significantly (Harvey et al., 2013).

2.1.1 SOCIAL VULNERABILITY TO CLIMATE CHANGE

How vulnerable a society is to the projected climate changes is often defined as a function of exposure and sensitivity to the projected changes and the capacity to adapt (Smit and Pilifosova, 2001; Smit and Wandel, 2006). Thus, the losses, damages and stress caused by climate change are partly determined by the exposure and sensitivity of buildings, infrastructure, industries and resources. To reduce climate change risk involves reducing the exposure and sensitivity of society, for instance by means of spatial planning that avoids development in hazard prone areas (MoE, 2010). Adaptation measures taken to reduce exposure and sensitivity of communities to current as well as projected climate change related risks could likewise reduce vulnerability (Smit and Pilifosova, 2001). Therefore climate change

itself does not directly translate into stress, damages and loss to society. Vulnerability to climate change is dependent upon policy choices, values and human behavior, which illustrates that adaptation is also a social process, as pointed out by O'Brien and Wolf (2010) and numerous other scholars (e.g Adger et al., 2012). This also help explains the surge in research on adaptation, vulnerability, resilience and adaptive capacity to climate change. Adaptation policies in Norway are outlined in section 2.3, while literature on adaptation governance is reviewed in section 1.1.

2.2 THE NORWEGIAN GOVERNANCE SYSTEM

Norway is a three-tier unitary state, with a governance system that includes the national government, elected county councils at the regional level, and municipalities with elected councils at the local level. In addition, there are regional branches of the national sector authorities (see Figure 2). The Norwegian governance system can be said to be characterized as having a strong unitary state, weak regional level governance, and strong, autonomous municipalities at the local level (Sandberg and Ståhlberg, 2001). The municipalities are funded by local taxes and the transfer of funds from the national government. Most of the transfer of funds from the national government is earmarked or tied up to legally binding obligations. Municipalities provide a number of important functions such as social services, elementary schools, water provision, fire protection, local roads, waste collection, land management, and land-use planning. Municipal services are strongly regulated by national legislation and the bulk of the municipal budget is spent on mandatory tasks to ensure cross-national equality. Governmental regulations and economic incentives ensure that the municipalities implement national policies. There are, however, few if any incentives for carrying out tasks not regulated by law. In spite of this centralized system, significant discrepancies exist between municipalities.

The 2010 reform gave the county councils a stronger mandate for regional planning and cross municipal coordination of planning (MoMM, 2007). The national government has a regional representative at the county level, namely the county governor (Fylkesmannen), 19 in total. They oversee the legality of municipal governance arrangements, coordinate the various regional state actors and govern certain state affairs at the regional level, such as environmental governance and agricultural policy. The county governor has the power to reject a municipal spatial plan if it does not adhere to national laws and regulations, by entering a formal objection when the municipal spatial plan is submitted to a public hearing.

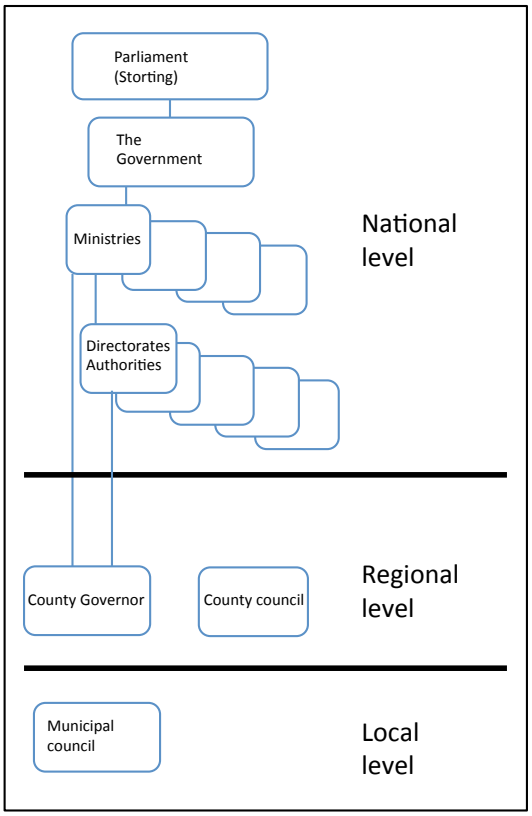

Figure 2. A simplified model of the Norwegian three-tier governance system. The lines between boxes indicate the official chain of command.

The county council also makes regional plans that are supposed to guide the content of municipal spatial plans. The National Water and Energy Directorate (NVE) has responsibility for providing knowledge and supporting preventive measures to counter flood- and avalanche risks. NVEs regional branches also check that municipal spatial plans take these risks into account.

2.3 NORWEGIAN ADAPTATION POLICY

In a global context, Norway, is projected to experience quite dramatic changes in climate, in terms of changes in temperature and precipitation, as outlined in section 2.1. But it is also among the countries in the world with the highest adaptive

capacity (IPCC, 2001). The latter is based on a high score in assessments using quantitative vulnerability indicators and adaptive capacity indicators (Juhola et al., 2012; O'Brien et al., 2004). This is a consequence of the high performance of governmental institutions, the high level of education in the population, the high level of income and so forth (O'Brien et al., 2004). The establishment of a secretariat for the coordination of national level adaptation in 2008, the Governmental Adaptation Secretariat (GAS), and the establishment of a governmental commission on adaptation the same year, marked the arrival of adaptation to climate change at the national policy level. The government also issued a policy statement, which is still the official doctrine, that each sector and level of government has an independent responsibility to assess vulnerability and develop adaptation strategies (MoE 2010). These initiatives followed a period of extensive media attention on the fourth assessment report of the IPCC in 2007, while it emerged on the research agenda several years ahead of that (Aall, 2012). Despite this policy statement, the Norwegian Emergency and Civil protection directorate (DSB) took on a coordinating role for adaptation, and the GAS was placed within DSB. The DSB saw adaptation as a logical extension of their work, as they already had a role in coordinating responses to extreme weather events and natural disasters (Groven et al., 2012). The government commission published its green paper on adaptation in 2010 (MoE 2010), which was later than the other Nordic countries (Finland published a national adaptation strategy in 2008 and Sweden in 2009). The green paper recommended, among other things, a stronger division of responsibilities between the various government sectors and levels, a national guideline for adaptation concerns in spatial planning and a strengthening of planning capacity at the municipal level (MoE, 2010). It took a few years before the green paper was followed up by the parliament through a white paper (MoE, 2013), but very few of the recommendations from the green paper have to date been implemented. So while municipalities have been deemed the key actors for implementing adaptation measures, few municipalities have, so far, taken on the task (Amundsen et al., 2010).

However, some national level policy measures for adaptation did take place before the 2013-report: in the revision of the planning and building act in 2010, the use of risk and vulnerability assessment was made mandatory in relation to spatial planning, and climate change impacts on natural hazards now need to be taken into account. Specific measures for avalanches, river floods and storm surges are specified in a separate regulation, TEK 10. The activities of GAS have primarily consisted of providing information about adaptation. In addition, efforts to mitigate natural hazards have been strengthened through assignment of responsibility for avalanches, rock falls and mud slides to the Norwegian Energy and Water directorate (NVE) which already had responsibility for floods. Their responsibility includes: conducting flood and avalanche risk mapping and producing hazard zone maps, assessing measures to mitigate risks, funding and constructing protection measures and providing guidance to municipalities. Changes in the planning

legislation have made it mandatory to take sea level rise and changes in river flood regimes into account in municipal spatial planning. However, no national agency has been given responsibility for urban flooding, inundation and sea level rise. Nevertheless, larger cities have started to prepare their urban water management infrastructure for increased precipitation and urban flooding (e.g Rauken and Kelman, 2010). Groven (2013) has shown that the municipality of Bergen used the "window of opportunity" provided by the focus on climate change to implement a new policy for urban water management.

There has been several studies of adaptation measures in Norway, some of which have been referred to in section 1.1, and also in the context and literature review sections in the articles.

3. THEORY

This chapter presents an overview of the theoretical positioning and analytical framework of the thesis. Governance of adaptation to climate change is a complex policy issue for several reasons: reported adaptation often takes place as a response to multiple and interlinked challenges, which mirrors the fact that adaptation is not viewed as a sufficiently salient or urgent issue to warrant specific policy response measures (Amundsen et al., 2010; Berrang-Ford et al., 2011). In order to explain the conditions required to agenda-set and develop local adaptation policies, I develop a framework that draws on three distinctive and disparate theoretical perspectives (see *Figure 3*): 1) theories of agenda-setting and policy formation; 2) cultural theory of risk and 3) boundary work and co-production of knowledge. The agenda-setting and policy formation literature (Baumgartner and Jones, 2009; Dearing and Rogers, 1996; e.g Kingdon, 2003) are used to inform a discussion of how adaptation is set on the local policy agenda and why it is or isn't implemented through various policy measures. Cultural theory of risk (CTR) (e.g Thompson and Wildavsky, 1990) expands the focus to industry (specifically, fisheries and agriculture) to explain why the salience of adaptation to climate change is particularly important. Boundary work theories (e.g Cash et al., 2003) and theories about the co-production of knowledge (Jasanoff, 2004) are applied to explain the relation between knowledge production and the governance of adaptation planning at the regional level, which also sheds light on what it takes for scientific knowledge to obtain agenda-setting properties. I will start the chapter by clarifying the central concepts applied in the adaptation governance literature, in particular the concept of *adaptive capacity*, where I also relate this concept to the theoretical perspectives outlined above.

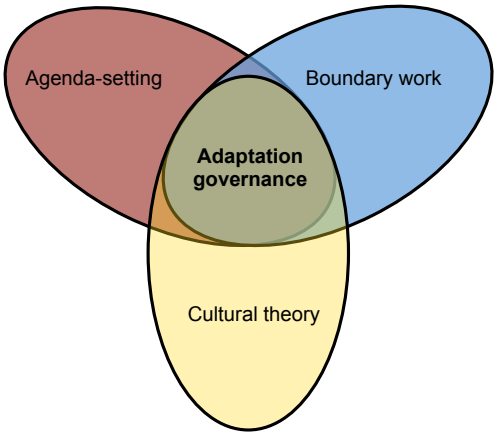

Figure 3. The theoretical framework of the thesis.

The theoretical perspectives are thoroughly discussed individually in the four articles, as indicated in table 1. There is a certain degree of overlap between the articles, in order to aid the bridging of the theoretical perspectives. This chapter will not provide an in-depth overview of the theories, but instead will show how the research in its totality integrates them. The articles presented in this thesis apply frameworks inspired by the above mentioned theories, but these frameworks are also original and thus represent my own and my co-authors contributions to the field of knowledge. Also the findings reported in the articles include generalizations that could be used in further research. I will outline the specifics of these contributions in section 5.2.

Table 1. Theoretical approaches in the articles. Blue shading indicates application of theoretical approach.

Theoretical approach	**Article 1**	**Article 2**	**Article 3**	**Article 4**
Agenda-setting & policy formation				
Boundary work & co-production of knowledge				
Cultural theory & issue salience				

3.1 ADAPTATION AND ADAPTIVE CAPACITY

The concepts of *adaptation* and *adaptive capacity* are naturally crucial in any study of adaptation to climate change. The application of the concepts remains contested as their precise use and meaning varies, requiring careful definitions and delimitations in each case. However, I will argue that the definitions laid out in the IPCC third assessment report (AR3) from 2001 (IPCC, 2001) and the fourth assessment report (AR4) from 2007 (IPCC, 2007) have established an adequate common understanding making them usable as analytical concepts. In this strand of the literature, *adaptation* to climate change is referred to as processes, activities and adjustments made to mitigate the negative consequences of climate change, but it also includes measures to take advantage of opportunities associated with climate change (IPCC 2001). However, this definition needs further refinement, as it is not self evident if "adaptation" refers to planning, preparations or other measures to reduce harm or risk from projected climate change, or if it refers to measures taken as a response to climate variability related events. The first definition is often termed "proactive" or "planned" adaptation, while the latter is termed "reactive" or

"autonomous" adaptation (Füssel, 2007; IPCC, 2007). As it rarely is possible to tie single weather- and natural hazard events to climate change (IPCC, 2012), this distinction is important, as it is not necessarily the case that all reactive adaptations are adaptations to climate change impacts. In the thesis, I will therefore use the first definition. Adaptation is closely related to *adaptive capacity*, which reflects an individual's, an industry's or a community's ability to cope with, or adjust to, changing conditions. It is reflected in an the actor's management of current and past stresses, their ability to anticipate and plan for future change, and their resilience to perturbations (Smit et al., 2010) Adaptive capacity is, in turn, contingent upon a number of factors. The IPCC fourth assessment report from 2007 distinguishes between generic adaptive capacity and specific adaptive capacity. Specific adaptive capacity relates to the previously mentioned definition by Smit and colleagues (2010), while generic adaptive capacity refers to the unit in question's general socio-economic status, level of education, health services, competence, etc. (IPCC, 2007). It assumes for example that if the population in a region is well educated and the socio-economic conditions are good, then the region will have high adaptive capacity (Juhola et al., 2012). Specific adaptive capacity on the other hand refers to the unit in question's ability to respond to a specific situation or an event. This can only be assessed by evaluating the responses to something that has already happened, for instance a flood or heat wave (IPCC, 2007; Juhola et al., 2012). Thus, experiences with reactive adaptation can tell us something about the adaptive capacity to climate change. In order to clarify this potential paradox: when discussing adaptation governance or adaptation measures in this thesis, it is in relation to climate change. As single events can not be explicitly linked to climate change, measures to cope with existing weather related events are not the same as adaptation to climate change. However, looking at experiences with past and current weather can help us to assess the ability and capacity to adapt to climate change, and climate related challenges, stresses or shocks.

A prerequisite for planned adaptation, and in that sense a vital component of adaptive capacity, is an awareness of climate change coupled with the prioritization of adaptation against other demands competing for attention and resources. In article one, I elaborate on this aspect of adaptive capacity through the development of the concept of issue salience. I would also argue that the ability to agenda-set and implement adaptation, which I outline in articles two and three, are salient determinants of the adaptive capacity of a governance system. Even though institutional factors are recognized as a determinant of adaptive capacity (Keskitalo et al., 2010; Smit and Pilifosova, 2001), awareness of the need to adapt and agenda-setting of adaptation has not been included in the most widely cited frameworks.

In the adaptation literature (e.g IPCC 2007), particularly the strand that has sought to identify vulnerability indictors, adaptation measures and determinants of adaptive capacity have been criticized for paying too little attention to human agency (O'Brien et al., 2006; Wejs et al., 2013; Westley et al., 2013). Social learning and

leadership has been found to advance adaptive agency in organizations (Pelling, 2011). Social learning in adaptive organizations is also said to be fostered by the interaction between stakeholders in the organization and experts (Pelling et al., 2008), which points to the importance of boundary work and co-production of knowledge for achieving adaptation.

Even the church needs protection from avalanches in Hammerfest. Photo: H. Dannevig

3.2 AGENDA-SETTING AND POLICY MAKING IN A MULTILEVEL GOVERNANCE CONTEXT

The absence of clear and strong signals from the national government on adaptation in the case of Norway has made this an interesting case for studying local approaches to development of adaptation policies. That some municipalities are developing their own adaptation policies, contradicts the notion that Norwegian municipalities are mere "executioners" of national policies, as suggested by Fimreite and Lægreid (Fimreite and Lægreid, 2005). It is an empirical question whether the general theories of agenda-setting and policy formation hold explanatory power for local level agenda-setting and policy formation, and if the

issue of planned adaptation is something that it is likely to emerge on any agenda. Agenda-setting theory is concerned with why some issues get on the agenda while others are neglected (Baumgartner and Jones, 2009; Kingdon, 2003). In addition, agenda-setting scholars are trying to explain why problems rise and fall on the agenda, irrespective of the real-world state of the problem (Baumgartner and Jones, 2009; Kingdon, 2003). The agenda-setting *model* is also one of many approaches to the understanding of the policy process and several competing and overlapping models exists (Baumgartner and Jones, 2009).

A policy agenda can be defined as the set of issues that are most salient to citizens and are up for discussion in the government (Pralle, 2009). Some scholars also distinguish between the public and a government agenda, the former being issues that the general public, or voters, are most concerned about, while the latter are the "set list of subjects or problems to which government officials pay serious attention" (Kingdon, 2003, p. 3). Both the public and the government are said to have a limited capability for having multiple issues on the agenda, hence issues must compete over one-another for the attention of the public and policymakers (Hilgartner and Bosk, 1988).

How an issue can be placed on the policy agenda is one of the key questions in agenda-setting literature. Several authors note the importance of focusing events that act as a "window of opportunity" for setting a problem on the agenda (Birkland, 1998; Kingdon, 2003). Focusing events are "(...) rare, harmful, sudden events that become known to the mass public and policy elites virtually simultaneously" (Birkland, 1998, p. 83), and as such hold a potential for advancing topics on the agenda or triggering policy change (Baumgartner and Jones, 2009). Dearing and Rogers (1996) find that there are generally three preconditions that need to be in place for a topic to be placed on the policy agenda – "real-world" indicators, public opinion, and mass media coverage. 1) Real-world indicators refer to measurable signs of a social problem, but it need not be communicated through mass media. It pertains to quantifiable indicators that are monitored and conveyed to policy makers. However, real-world indicators alone are neither necessary nor sufficient for a problem to come on the agenda (Dearing and Rogers 1996). Additionally, 2) mass media coverage and 3) public opinion must provide the necessary pressure for policy-makers to address the problem. During such a window of opportunity, a policy entrepreneur can match a policy problem with a suitable solution (Kingdon, 2003).

The agenda-setting of an issue is a necessary part of the policy formation process, according to the stages model of policy formation (Sabatier, 2007). A policy formation, according to this model, consists of four stages: The (1) problem definition; (2) agenda-setting; (3) policy formation; and (4) implementation (Sabatier 2007). This model of the policy process has received criticism for not providing an accurate explanation for federal policies in the US (e.g Baumgartner

and Jones, 2009), mainly because each of these steps may take place in a different order and may be partly independent of each other (Sabatier, 2007). However, it still is an ideal model for how policy-making is perceived to take place within the multilevel-governance context of Norway. The implementation of environmental policies, including adaptation to climate change, is commonly sought through mainstreaming or policy integration, which means to integrate objectives from the new policy area into existing overarching policy documents, and horizontally and vertically in the governance architecture (e.g Nunan et al., 2012; Rauken et al., 2014). In the case of Norway, adaptation is supposed to be a concern within all relevant policy fields, with an emphasis on spatial planning at the local level (MoE, 2013). Implementation of new policies can be measured in terms of indicators, based on reporting from governmental institutions at various levels. The Norwegian Directorate for Emergency Provision and Preparedness (DSB), for instance, conducts an annual survey on the extent and degree of implementation of systematic risk and vulnerability assessments (RVA) within local level governance. In article three, an indicator for the implementation of adaptation measures is employed, and is inspired by the UK government's (LRAP, 2009) and the Finnish government's indicators for adaptation (Juhola, 2010).

The first stage in the formation of public policy is problem recognition. How issues are framed, or problems are defined, are found to have implications for the likelihood that they will get on an agenda (Baumgartner and Jones, 2009; Rochefort and Cobb, 1994). Complex problems without a clear solution would often not get on the agenda, despite real-world indicators and focusing events (Rochefort and Cobb, 1994). Therefore, political actors spend a lot of effort in trying to frame a problem in such a way that it is likely to obtain salience among both the public and get on the agenda (Baumgartner and Jones, 2009). Hoppe (2002) has shown that an actor's cultural bias, or way of life, according to the cultural theory grid group typology outlined in the next section, influences what kind of problem framing an actor prefers (see the next section). This coupling between agenda-setting and cultural theory of risk (CTR) is a key contribution of this thesis, and is the focus of article one.

These broad generalisations about agenda-setting and policy formation outlined above are based on US federal politics, and cannot easily be transferred to the local governance level in a Nordic context. As the municipalities in Nordic countries enjoy a high degree of autonomy, they are a relevant unit for studying agenda-setting within the broader field of environmental governance. In a Nordic context, environmental policies have, in several instances, been developed at the local level, and then later implemented at the national level, such as the development of a local environmental governance system as part of the follow-up on the Local Agenda 21 process (Aall, 2012; Aall et al., 2007). Inferences about policy process can also be drawn from the systematic comparison of local level policy processes (Vogel and Henstra, 2015). Kingdon's "policy entrepreneur" shares some similarities with the

"engaged" individual that we encounter in article two and three. The importance of individuals is crucial for getting an issue on the agenda at the local level. In addition, involvement with researchers emerged as a crucial factor in the studies reported in article three, pointing to the relation between boundary work and policy formation, which largely is lacking in both the literature on boundary work and in the agenda-setting literature. The topic of boundary work will be discussed in section 3.4 in this chapter.

3.3 CULTURAL THEORY OF RISK AND ISSUE SALIENCE

The degree, extent and nature of how actors choose to respond to climate change is mediated by culture (Adger et al., 2012; O'Brien and Wolf, 2010). However, I argue that the adaptation research in general suffers from a lack of focus on the role of human agency. In the IPCC definition (IPCC, 2007), human responses to impacts are determined in the same way as responses by other components of an ecosystem. This approach misses the potential of, and for, human agency in terms of creativity, motivation and skills (Kofinas et al., 2013). The subjective dimension of adaptation has received increased attention lately (Adger et al., 2012; O'Brien and Wolf, 2010), but it still remains to tie these subjective dimensions to the formation of adaptation policies. That culture influences risk perception and problem recognition, and the importance of this relation for public policy has been noted by several scholars, as "cultural perspectives help to explain differences in response across populations to the same environmental risks" (Adger et al., 2012, p. 113). Culture can be defined as a system for meaning making, creation of world views, and ways to create conceptual order through labels and categories (Bourdieu, 1991), and it defines how we develop strategies to solve problems (Hays, 1994). That culture affects risk perception is something psychologists and sociologist have known for a long time, like the difference in how "lay" people and scientists assess risk (Fischhoff et al., 1978), or how gender, nationality or political preferences impinge on risk perceptions (Slovic, 1997). The fundamentally different way in how uncertainty and risk is understood in various part of society, namely between scientists and the rest, is also explained by Beck (1992), Funtowicz & Ravetz (1994) and others. Scientists tend to define risk as a function of the likelihood of an event and the size or magnitude of its consequenses, where likelihood is given in probalalistic terms, while lay people tend to focus on impact and consequences, fearing risks with a near zero likelihood, but with catastrophic consequences (e.g nuclear energy accidents) (Beck, 1992; Petersen et al., 2011).

An approach to the study of the relationship between culture, risk perception and public policy that still influences contemporary research in the interface between political science, anthropology and sociology is Mary Douglas and Aaron

Wildavsky's Cultural Theory of Risk (CTR) (1982), and as later refined by Thompson and Wildavsky (1990). This theory is based on a group-grid typology that outlines four archetypes of social solidarities or ways of life found in any social unit that is typically distinguish based on their culture (nations, firms, etc): the *individualist, the fatalist, the egalitarian and the hierarchist* (Thompson and Wildavsky, 1990). These ways of life produce particular cultural biases and justifications for social order (Hoppe, 2002; Marris et al., 1998). The *individualist* is characterized by a low degree of social regulation and social contact, a combination that produces an opportunistic attitude (Thompson and Wildavsky, 1990), where knowledge is trusted and used only if it is useful to achieve the individualist's goal (Hoppe, 2002), and knowledge about climate change is viewed with suspicion if it is believed to restrict freedom (Kahan et al., 2012). *Egalitarians* on the other hand are characterized by a strong group involvement and a low degree of social regulation, and therefore tend to have strong internal norms. For egalitarians, any decisions needs consent in order to have legitimacy (Thompson et al., 1999). Egalitarians are concerned over climate change when it is framed as a problem that requires collective action in order to be solved (Kahan et al., 2012; O'Riordan and Jordan, 1999). *Hierarchists* are defined by a high degree of social contact and social regulations. They typically find themselves bound by prescription and defined roles (Thompson et al., 1999). They trust knowledge that comes from an authoritative source, and credible science is such a source, and are willing to take on climate change if they can frame it as a structured problem with clear goals and clear means (Hoppe, 2002). *Fatalists* are subject to strong social regulation, but have a low degree of social contact, they lack group membership and therefore exercise little control over their own situation (Thompson et al., 1999). A fatalist does not trust any knowledge and views all problems as unstructured and without agreements on means and aims (Hoppe, 2002).

The CTR framework has received criticism for making the assumption that cultural bias is determined by social relations (Marris et al., 1998), and the ambiguity on the question of the stability of an individuals adherence to a certain way of life (Marris et al., 1998). If a way of life is stable irrespective of the organisations, institutions and other social relations a person moves between through a life time, then this again implies that cultural bias is an innate attribute; a somewhat problematic assertion (Marris et al., 1998).

Nevertheless, the CTR framework is a useful approach to use to study the salience of adaptation and why different actors view climate change knowledge differently, because way of life can yield insights into how risk is understood and how knowledge is interpreted among various groups of actors and in various types of organizations. CTR has been employed in analyses of policy making in general (Hoppe, 2002; Thompson et al., 1999) and of attitudes towards anthropogenic climate change (Kahan et al., 2012; O'Riordan and Jordan, 1999), but so far attempts to apply CTR to studies of adaptation are lacking. In order to contribute to

theoretical development within the field of adaptation governance, CTR can be employed as one approach for explaining issue salience. I argue that in order to get an issue on the policy agenda, it needs to be viewed as a salient issue. In article one I explain the relation between CTR and issue salience by drawing on Hoppes work (2002) on the relation between policy problem preferences and way of life:

- Hierarchists: Focus on structured problems, agreement on aims and type.
- Individualist: Focused on means, not aims.
- Egalitarian: Focused on aims, not means.
- Fatalist: Focus on unstructured, wicked problems without means or aims.

The different ways of life are also found to view knowledge differently, as mentioned above (Hoppe, 2002; Kahan et al., 2012), which again indicate that boundary work needs to take cultural bias into account in order to be effective.

3.4 THE AGENDA-SETTING PROPERTIES OF SCIENTIFIC KNOWLEDGE

Scientific knowledge is not easily transformed into action. According to Jasanoff (2004), the "reality" of scientific knowledge does not originate solely from science itself, but from the legitimacy gained through social practices and organizations (Jasanoff 2004). The ontological and epistemological implications of Jasanoff's work are explained in further detail in the theory of science section (4.1). In addition to legitimacy, knowledge produced in efforts to move from knowledge to action for sustainable development needs to be salient and credible (Cash et al. 2003). These efforts need to include institutional mechanisms that facilitate communication, translation and mediation on the science-policy interface. The deliberate facilitating of these processes is labeled "boundary work" (Cash et al. 2003). Communication needs to take place between users and/or policymakers and experts, and must go both ways. Translation of expert scientific knowledge into something comprehensible for the users is also a necessity, but it is not a sufficient condition for science based policy development and governance. In order to ensure legitimacy and salience, the users' knowledge must also be included in the co-produced knowledge (Cash et al., 2003). Finally, mediation is needed to ensure that the boundaries between the social worlds of science and policy are open at the right places, and to determine where science stops and the policy starts (Cash et al., 2003; White et al., 2010). Table 2 summarize the relationship between the means and outcome of boundary work.

Table 2. The means (coloumns) and outcome (rows) of boundary work

Outcome of boundary work	**Means of boundary work**		
	Communication	**Translation**	**Mediation**
Salience Knowledge that is relevant, solves a problem	x		
Credibility knowledge that is truthful	x	x	
Legitimacy knowledge that is unbiased in treatment of diverse interest	x		x

Boundary work also necessitates the creation of boundary *objects*. Boundary objects are devices that aid interaction across the boundaries between science and policy (Guston, 2001). One example in the field of adaptation is flood hazard maps for spatial planning that include climate change effects on floods. Boundary work is typically facilitated through stakeholder involvement in the development of science based governance tools or formalized through dedicated organizations that aim to provide policy advice: so-called boundary organizations (Hoppe and Wesselink, 2014). In order to mediate and negotiate the boundary between science and policy, they require accountability to both social worlds (Guston, 2001)

The literature on boundary organizations has been criticized for overlooking that boundary arrangements and organizations can be very different from each other depending on what purpose they serve and what disciplines they include (Clark et al., 2011; White et al., 2010) and thence must be tailored to the policy network they are supposed to be applied within (Hoppe and Wesselink, 2014). The latter are in line with the insights from the former section, because it is apparent that the way salience, credibility and legitimacy is ensured depends on the involved actor's way of life, or cultural biases. Even though boundary work theory is often conducted within a sociology of scientific knowledge (SSK) tradition with clear relativist, or conventionalist assumptions about ontology, I will argue that it also can be used for explanatory purposes when analyzing adaptation governance. As adaptation is a policy field that owes its existence to scientific knowledge, I find it self-evident that boundary work theory is important in explaining the agenda-setting and formation of adaptation policies. Article four assesses the use of boundary work in adaptation governance at the regional level in Norway.

3.5 SUMMING UP

Viewed as a whole, the theoretical framework for this thesis is an amalgamation of aspects of the theories of agenda-setting, boundary work theory and the CTR. The key theme concerns the conditions for getting planned adaptation to climate change on the local policy agenda and the contribution, which each theoretical perspective provides, in explaining planning practices. Agenda-setting theories can shed light on the conditions needed to get an issue set on the policy agenda and result in the formation of a new policy. Research presented in article two shows that in the cases examined, agenda-setting of adaptation depends upon the efforts of engaged individuals and involvement with researchers, in addition to focusing events and real-world indicators. Thus the mainstream agenda-setting theories can not fully explain local agenda-setting of adaptation. The importance of engaged invididuals points to the importance of understanding why some actors see adaptation as a salient issue and others do not. There is thus a need to supplement agenda-setting theories with perspectives that can help explain this difference in salience. The CTR framework has proven useful for this. The CTR framework also points to the different uses of knowledge among the different ways of life. The problem with climate change is that it is based on abstract scientific knowledge, and the consequences are felt in the future. Knowledge about the link between knowledge and policy formation is thereby a necesarry component in any analysis of the conditions needed to agenda-set adaptation, and boundary work theory serve as this link.

Racks for drying stockfish in Lofoten. Photo: Halvor Dannevig

4. RESEARCH DESIGN

A research design is a framework that outlines how the data that is required for meeting the research projects goal is to be collected and analyzed, and how validity and replicability of the research is assured (Bryman, 2012). This thesis is based on a case study research design. The next section outlines the ontological and epistemological foundations of the thesis. There then follows a section on methodology that outlines the linkages between case study research design and the thesis with a detailed explanation of case selection, data gathering methods, and how the data were analyzed.

4.1 THEORY OF SCIENCE

The study of adaptation governance is driven by "real-world " problems and has a basis in natural science. But climate change is also a cultural phenomenon, and any response to it is shaped by social, cultural, economic and political conditions. A number of assumptions and philosophies can thereby underpin research on adaptation, such as questions about what is irreducibly real (ontology) and how valid knowledge about this reality can be produced (epistemology). Epistemological and ontological questions are not discussed in the articles presented in this thesis as is normal practice for most articles of this kind. Still the theories and methods employed are based on assumptions about ontology and epistemology, which to varying extents, are stated in, or at least underpin, the various theoretical and methodological perspectives employed in the research.

There are a two fundamentally opposing epistemological positions in social science, *positivism* and *interpretativism*, and a suite of positions in between. Positivism is based on the assumption that objective knowledge and causal explanations can be derived from observation and measurements of an external reality (Asdal, 2005). In the social sciences, the dominant position in this epistemological strand is now most commonly referred to as post-positivism, which acknowledges that an objective reality can only be imperfectly observed, due to limitations in methods and analysis. Post-positivism is associated with quantitative studies, models and experiments and the natural sciences in general (Bryman, 2012). *Realism* is a position in the philosophy of science that shares certain resemblances with positivism, except that it is most commonly understood as an ontology (Sayer, 2000). Conventional realism, or empirical realism, is based on the belief that there is an external reality outside our description and comprehension, and that this should be studied with the

same methods and theories whether we speak of social science or natural science (Bryman, 2012).

Scholars from the social sciences and the humanities also often employ an *interpretativist* epistemology, which is often contrasted with positivism. Interpretativism is most commonly associated with the philosophical positions of *hermeneutics* and *phenomenology* as well as qualitative methods (Bryman, 2012). Common for these positions is the insistence on the fundamental difference between natural science and social realities – of people and institutions, and physical matters. As a consequence, different research methods and validity claims are needed within the social sciences and humanities than for the natural sciences (Asdal, 2005; Bryman, 2012). Interpretativists often reject that law-like theories of causality can be made about social processes and human behavior (Sayer, 2000). The aim of interpretative research is to generate understanding, rather than causal explanation, for human behavior (Sayer, 2000). The philosophy of phenomenology is concerned with how people make sense of the world, and sees the fundamental tasks of the social scientist to reveal and understand that sense-making (Bryman, 2012). But in order to do so, the social scientist must also understand and take into account how their biases, values and world views are shaping the research (Bryman, 2012). The situatedness of social research and the reflexivity of the study matter – people and institutions – thus warrants a different epistemology for social science than for natural science, according to adherents to interpretativism (Asdal, 2005; Bryman, 2012; Sayer, 2000). However, this insight is not exclusive to interpretativist philosophies of science.

Interpretativist epistemology is mostly associated with a constructivist ontology, which sees the social world as socially constructed. According to constructivist ontology, knowledge about the social world is dependent on the researchers conception of it; thus, the social world does not exist independently of our understanding of it. The constructivist position is therefore antithetical to the position of realism (Sayer, 2000). Some constructivist positions do also argue that because knowledge too is socially constructed and shaped by the scientists' choices, beliefs and values, objective and true knowledge about the physical world cannot exist (Bryman, 2012; Yearley, 2005). Truth is based on human perception and determined by those with the power to define it (Foucault, 1977), and is not a reflection of an external reality. The distinction between the subjective experience and the material reality therefore vanishes (Ingold, 2000). This position is also labeled relativism and is a feature of post-modernism (Bryman, 2012).

While many social scientists are willing to be labeled either realists or interpretativists, a great deal of those that do empirically based research (opposed to being concerned mainly with ideas, theories or philosophy, that is), find themselves in a middle ground (Sayer, 2000). In particular, interdisciplinary research fields, such as climate change, invariably do not comfortably conform to a simplistic division between a purely interpretativist or positivist position (Forsyth, 2001).

Those who occupy the middle ground agree that the social world is socially constructed, that the reflexivity of the study object and situatedness of the scientist has consequences for knowledge production, but similarly agreeing that it is an external reality that can be accessed through observation (Cornell and Parker, 2010; Danermark et al., 2002). Critical realism has been proposed as an ontological position that addresses the needs of interdisciplinary research (Cornell and Parker, 2010). Critical realism purports to occupy a middle ground between a constructivist and realist ontology. It acknowledges that social structures, relations and actions are socially constructed, but also claims that an external reality exists independently of our knowledge about it. This knowledge, however will always be mediated by the researcher and is thus subjective (Sayer, 2000). Critical realism views the primary task of social science as being to reveal causal mechanism behind social phenomena (Bryman, 2012). The latter proposition is not exclusive to critical realism, as George and Bennett (2005) note, but a mainstream position in social science. However, according to Bhaskar (2010), critical realism has a distinct understanding of causal mechanisms as a real entity, which are only discernible to us through their effects. A mechanism in this sense can be defined as "(…) that which can cause something in the world to happen, and in this respect mechanisms can be of many different kinds" (Danermark et al., 2002, p. 55). Causality "is not understood on the model of regular succession of events, and hence explanation need not depend on finding them, or searching for putative social laws" (Sayer, 2000, p. 14). Explaining causal mechanism instead involves an investigation of "the nature of the structure or object which possesses that mechanism or power (..)" (Sayer, 2000, p. 14) (see Figure 4). Critical realism also recognizes that causal mechanisms in social systems do not operate in a vacuum, they are open systems, and causal mechanisms can produce different outcomes, depending on context and conditions (Sayer, 2000).

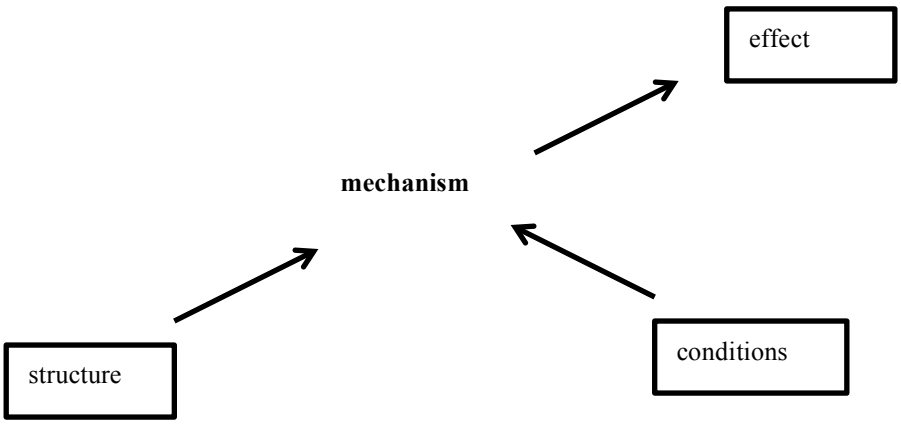

Figure 4. Critical realist view of causation. Adapted from (Sayer, 2000, p. 15)

The research presented in this thesis is based upon these ontological and epistemological assumptions about causal mechanisms. Causal mechanisms are at the core of the three empirical research questions in this thesis. The thesis aims to make inferences about causal mechanisms that can explain real-world patterns of agenda-setting for climate change adaptation. The next section (4.2) will deal more closely with how this is done.

It is important to note that critical realism has been criticized for paying too little attention to epistemology and the social consequences of knowledge production (Yearley, 2005). Neither is critical realism the sole philosophy of science that allows for interdisciplinary research, the writings of Latour on Actor Network Theory (ANT) is frequently applied as theoretical foundation in studies of natural resource governance and environmental politics (Forsyth, 2001), as well as in the field of STS (Jasanoff, 2004). Like critical realism, ANT is an attempt to draw on insights from the post-modern turn in philosophy of science (Asdal, 2005), without being relativistic. It is also an attempt to overcome the dichotomy between natural science and social science (Forsyth, 2001).

This thesis also draws upon theories with a clear interpretativist and constructivist influence - such as cultural theory, and the concept of boundary work and co-production of knowledge. The latter tend to treat truth as something that is constructed as a negotiated outcome between science and policy (Yearley, 2005). While such a conventionalist position tends to be ridiculed by realist scholars (e.g. by asking post-modernists to try to socially construct gravity) (Danermark et al., 2002), STS scholars have shown that the production of scientific knowledge also produces social order and has social consequences (Jasanoff, 2004; Latour, 1993; Yearley, 2005). STS scholars have also put forward powerful criticisms of the claims made by realist philosophers concerning the unique and exclusive ability of science to produce objective and true knowledge about an external reality (Yearley, 2005). As Mjøset writes “the basic fact that we study something that we are (or could be) ourselves, implies that there must be some relationship between the way that we gather knowledge and the ways in which people learn. Research may pursue knowledge more systematically, but not in a qualitatively different way” (2009, p. 50). A core argument for STS scholars that have been engaged in environmental policy research has been to show that the positivist idea of a linear relation between scientific progress and political action is misguided (Asdal, 2005; McNie, 2007). Furthermore, the ecological crisis has also been initiated by science and technology, and an important project for scholars such as Latour has been to show that natural science is also political (Asdal, 2005; Latour, 2004).

The relationship between action (or policy) and knowledge (or science) in the case of climate change is inevitably a part of this study as it studies the responses - both at an industry-actor level and at governance levels - to a problem that, first and foremost, is defined scientifically. Co-produced knowledge is defined as “knowledge and its material embodiment of social work and constituents of forces

in social life" (Jasanoff 2010:2). This means that when new knowledge and technologies are being accepted as facts among the public and supporting institutions are evolving around it, social order is also inevitably being produced. This co-production takes place through "ordering instruments" of institutions, identities and discourses. Thus, the "reality" in scientific knowledge does not originate solely from science itself, but through the legitimacy it gains through social organization.

An example from the field of climate change is instructive: the establishment of the climate sensitivity estimate. As Van Der Slujs and colleagues (1998) have noted, the climate sensitivity estimate, namely the effect on the global sea surface temperature of a given increase of GHG, measured as an effect of a doubling of atmospheric concentrations of CO_2, has remained stable at between 1.5 C and 4.5 C, despite changes in the underlying scientific understanding of the phenomena. Wynne finds that "(…) this informal ambiguity, or hermeneutic flexibility, allowed it to be an 'anchoring device' in stabilizing an otherwise unstable and potentially incoherent policy-scientific community" (Wynne, 2002, p. 461). The climate sensitivity estimate has thus served as a boundary object between the various social worlds involved in the climate change negotiations – climate science, politics and mitigation economics, and is in itself a result of co-production. The two degree target that has been endorsed in the international climate change negotiations through the Copenhagen Accord of 2009, has since then taken over as an "anchoring point" and the most significant boundary object in climate change negotiations (Randalls, 2010).

How climate change knowledge is co-produced by science and policy, I argue, will be filtered through current perceptions and values, influencing their potential for adaptive responses (see also O'Brien 2011:2). While this strand of literature rarely employs the concept of causal mechanisms, I argue that these theoretical perspectives of cultural theory and co-production of knowledge indeed can be used to explain adaptation governance. Thus, I seek to combine a (critical) realist understanding of causality with insights provided from STS scholarship on the social (and non-social) consequences of knowledge production through case studies. This is also reflected in the positioning within a *contextual approach to social science methodology* (see Mjøset, 2009), outlined in the next section (4.2).

The main differences between critical realism and STS theory arises from the fact that critical realism is an explicit philosophy of science (although it comes in several varieties) that does not say much about epistemology, while STS is an applied field of theory with an integrated epistemology. Realists (or critical realists) are mostly concerned about ontology, and are very careful to distinguish between the "facts of states of affairs and discourses about them" (Sayer, 2000, p. 62). STS-scholars on the other hand are most concerned about the societal consequences of scientific conduct. Philosophers that have exercised influence in theorizing STS, such as Latour, do not reject the existence of an external reality (Latour, 1993).

Critical realism also recognizes that scientific knowledge is socially constructed, so I see these positions as complementary rather than competing.

Epistemology has importance for how scientific knowledge can be produced. Positivism is associated with deduction, which means that data is collected for the purpose of testing theories, with the aid of hypotheses. According to Popper (1954), scientific knowledge proceeds through the falsification of theories. However, this way of generating knowledge is alien to interpretativist social scientists, who prefer the inductive approach to theory development. Again, the empirically driven, case study dependent, social scientist often find themselves occupying the middle ground (Mjøset, 2009). The middle ground consists of combining induction and deduction, for instance by testing a theory with qualitative data, or constructing a theory on the basis of the empirical findings that includes causal mechanisms that are not directly observable (Bryman, 2012). This approach to scientific generalization is called *abduction* (Bryman, 2012; e.g Danermark et al., 2002). In empirically driven social sciences, this is a common approach to making scientific generalizations (Danermark et al., 2002). Abduction is closely linked to how theories are related to observation. More specifically, new knowledge is a result of how an observation or an interpretation is framed in a set of ideas (Danermark et al., 2002). This also implies that new knowledge can be a result of old observation, or existing knowledge, being re-framed or re-contextualized by new theories (Danermark et al., 2002). In this thesis, existing theories have both been tested and new ones have been developed and applied, both using new empirical observations, and thus it is an abductive approach to scientific inferences that has been employed.

4.2 METHODOLOGY

The purpose of this thesis is both to describe how adaptation gets on to the political agenda, and explain it through an investigation of how different actors experience environmental change and the role of co-production of knowledge in the process. This deals with how individual actors act, perceive and construct meaning in relation to specific phenomena, as well as making inferences about causal mechanisms that can explain how adaptation is set on the agenda and implemented through local governance initiatives. It thus fits very well within what Mjøset (2009) have coined the contextualist methodological framework of social science It implies that the study of cases is the fundamental research activity, more precisely: "The common feature is that we isolate sequences of events towards an outcome as a case because we also have an interest in the process" (Mjøset, 2009, p. 47). The study of the process that leads to an outcome is thus crucial, because that is where the explanation of the outcome is to be found. Tracing of processes is a well-tested approach to the identification of causal mechanisms (George and Bennett, 2005). The context that the process unfolds within is also a necessary part of the study

matter, as it constitutes the environment of the process (Mjøset, 2009). This is antidotal to the experiment, where the environment needs to be fixed and controlled, and replicabillity is a fundamental requirement. The explicit aim of explaining an outcome is also at odds with interpretativism and relativism, and Mjøset (2009) argues that because case studies do not sit well in methodological communities being based solely on either on a positivist or interpretativist philosophy of science, it constitutes a distinct "third approach" to methodology solely associated with the social sciences.

As the field of study is still quite novel, there are a high number of potential explanatory variables, which do not easily lend them selves to statistical tests. The units of analysis in the case studies, which are outlined below, also mandate a small-n approach. These two features of the project, small-n and many explanatory variables, calls for qualitative methods (Brady and Collier, 2010; George and Bennett, 2005; King et al., 1994). While qualitative case studies have been criticized for not lending themselves to generalization (Flyvbjerg, 2006), George and Bennett finds that they offer valuable opportunities for "examining [the] operation of causal mechanism in detail" (2005, p 21), through within-case analysis and process tracing and also because they offer the opportunity to analyze a multitude of explanatory variables. However, as Mjøset notes, this generalization is valid only within specified contexts (2009).

A case study research design allows for several case studies that seek to answer the same research questions employing a mix of methods, both quantitative and qualitative, as well as different approaches and concepts that can be synthesized in the same study (Yin, 2009). This thesis consists of four articles, which can be said to constitute four units of analysis, of which two report from the same set of data. Three of these units of analysis also include several within-cases. This design is necessary in order to explore the main research question from several theoretical angles (i.e. agenda-setting, risk perception and cultural theory of risk, and boundary work), and also in line with Yin (2009).

The research undertaken for this thesis has been conducted as part of a number of research projects. This is reflected in the co-authorship of the articles that the thesis is based upon. It also means that the research objectives of this thesis had to fit within the scope provided by the frameworks of these projects. See Smit and colleagues 2010 for a comprehensive introduction to such a framework. Furthermore, several researchers, other than those included as co-authors, have been involved in the research. This is mentioned in the acknowledgement and in the section on data collection (section 4.2.2).

The thesis is based on (critical) realist assumptions about causal mechanisms (Sayer, 2000), but draws on theories with a clear interpretativist foundation for explaining how knowledge, world views and culture affect perceptions and the

salience of climate change risk. Such a combination corresponds well with the contextualist methodological framework outlined above. It implies that the informants' meanings, the informants' subjective interpretations, (which again are interpreted by me and thus constitute a *double hermeneutic*) and observations are used to trace processes that constitute the causal mechanisms behind the issue salience of adaptation and agenda-setting, and implementation of adaptation in local governance arenas. In addition do also assessment of policy documents and grey papers account of the processes behind these causal mechanisms.

The point of departure for this thesis include references to existing theories: agenda-setting (e.g Kingdon, 2003), cultural theory (Thompson and Wildavsky, 1990) and boundary work (e.g Cash et al., 2003). However, these have only to a limited extent been employed and tested in previous studies of adaptation planning at the local and regional level. This means that an exploratory research design was required. Building on these and in line with an abductive approach to scientific inference (Danermark et al., 2002), frameworks have been developed and presented in the four articles that aim to contribute to a theory for sub-national level adaptation governance, which would have to be tested in further studies. This contribution is elaborated further in the articles and chapter 5.

4.2.1 SELECTION OF CASES AND INFORMANTS

As George and Bennett note (2005), it is paramount that the selected cases allow for the variance and control that the research questions require. The research questions calls for three categories of cases: One for the importance of risk perception and knowledge for explaining salience of adaptation; a second for the study of implementation and agenda-setting in municipalities; and, a third set for the importance of boundary work for adaptation governance. These categories of case studies are: 1) One in-depth case study of natural resource industries and the local government in Vestvågøy in Lofoten, northern Norway, 2) eight comparative case studies of local municipalities and 3) four cases studies focusing on the regional level of government in western Norway.

The first case study site, reported in article one, was selected because the study of perceptions of climate change risk and the salience of adaptation requires that the area presumably is exposed and sensitive to climate change, both in terms of climate change natural hazards and a dependency on climate sensitive primary industries (Hovelsrud et al., 2010). The unit of study in this case is individual fishers, fish industry actors, farmers and municipal officers. One case was deemed sufficient as explanation for salience making can be sought through a comparison of the three types of actors. This case is an "extreme case" because it is considered "prototypical (…) of some phenomena of interest" (Gerring 2008:653), in the sense

that the case study site's exposure and sensitivity to climate change would make us assume that adaptation would be a salient issue.

The second set of cases, reported in articles two and tree, reflect the diversity of Norwegian municipalities. These are heterogeneous along a number of dimensions: in terms of number of inhabitants (from around 300 to around 250,000); location (Northern vs. Southern Norway); and in terms of the industries which predominate within the areas they govern (primary, secondary or tertiary industries). The cases selected for the study should therefore represent this diversity of municipalities. The combination of the desire for representativeness, and the potentially high number of potentially independent variables, calls for a selection technique for *diverse case studies* according to Gerring (Gerring, 2008). Research has indicated that the majority of Norwegian municipalities are still a long way from implementing adaptation measures. This has been explained by a lack of administrative capacity, competence and knowledge, combined with a pressure to prioritize mandatory tasks (Amundsen et al., 2010). The current situation automatically excludes methodological options such as a randomized selection of municipalities or a study including all Norwegian municipalities. Rather, it has proven necessary to seek out the exceptions; municipalities that have signalled an interest in adaptation to climate change or taken their first steps. The first criteria is, therefore, that in order to be selected, a municipality would have to be in the process of, or planning to, undertake a vulnerability analysis and develop an adaptation strategy within one or more sectors. Secondly, as the study aims to make inferences with validity for all Norwegian municipalities, the cases should be representative of the broad variety and diversity that exists. For the purpose of getting a representative selection of these municipalities, a typology based on four criteria was developed: 1) Commercial structure, according to Statistics Norway's classification (SSB, 1985)[1]. This classification includes the dominant source of employment, main economic sector and location according to centre-periphery in its region; 2) Population size; 3) Physical geography type, according nature and landscape features such as inland, coast, forests and mountains; 4) Location in Norway, as all the major regions in Norway (north, middle, east and west Norway) should be represented.

The third set of cases, reported in article four, consists of the regional governance actors found in the four counties in western Norway. The regional governance level in Norway consists of an elected county council and its administration, and the county governors' office (see Figure 2). Furthermore, there are regional branches of national agencies, which tend to have different geographical boundaries than the

[1] The current classification was updated in 1994, but the categories are still the same: http://stabas.ssb.no/ItemsFrames.asp?ID=4124101&Language=nb

counties. Being a part of a country in which a range of weather related natural hazards are projected to be amplified by climate change, the four counties of western Norway provide good opportunities for finding answers to the second research question. In this respect the selection strategy resembles that of Gerring's (2008) "extreme case" method.

4.2.2 DATA COLLECTION

A case study research design allows for several methods, which can be both qualitative and quantitative. The combination of several methods and techniques, usually termed "triangulation", produces stronger and more valid results that are less prone to bias (Yin, 2009). This thesis mainly relies on a suite of qualitative methods that include document content analysis, observations and conversations in 'the field', semi-structured interviews, group interviews, as well as records from workshops, seminars, and town hall meeting with stakeholders. The methods applied are explained in detail in each of the articles.

Through an effort to seek long-term involvement with the case communities, trust between the researcher and informants can be established, increasing the likelihood of receiving honest, open and trustworthy information in interviews. This section presents the method employed in the set of cases that are included in this thesis, as well as reflections around implications, benefits and limitations of these methods.

4.2.2.1 Document content analysis

All case studies involved document analysis of grey papers, the textual parts of the municipal spatial plans and municipal climate plans (see Table 3). All articles except number one, include document analysis of regional climate and energy plans, municipal and regional risk and vulnerability assessments (RVAs) and records from meetings in municipal councils. Most of these are available at the relevant institution's web pages, while informants also provided some in print or as an electronic file. The content analysis was carried out in order to assess the extent and degree of climate change risk assessments and adaptation measures. This was done by establishing separate categories of the degree and extent of adaptation measures, including risk assessments and awareness of climate change impacts. Article two, three and four do utilize document analyses in which co-authors and other colleagues, the latter as mentioned in the acknowledgement, were involved.

4.2.2.2 Semi-structured Interviews

Semi structured, open-ended interviews were carried out across all cases (see table 3). Interview guides were used to ensure that all topics were addressed across the interviews within a case. There were separate interview guides for the three main units of study. The interview guide used in article one was continuously updated between the fieldwork trips, based on experiences from the completed fieldwork.

For the case study reported in article one, interviews were carried out with 10 fishers, five stockfish producers, seven farmers and four municipal officers. They were interviewed individually. There were also four group interviews with each of the categories of informants (fishers, fishbuyers, farmers and municipal officers). Some of the results from the case studies in Lofoten are reported in Hovelsrud et al. 2010.

For the study of agenda-setting (article two) and implementation (article three) at the local level, and how this is influenced by other levels of government, eight case study municipalities were selected in order to represent the variety found among Norwegian municipalities. 28 semi-structured interviews with municipal officers' were carried out, and three workshops with group interviews. Co-authors and some additional colleagues conducted interviews. The latter one are mentioned in the acknowledgements of this thesis. In the case study reported in article four, six semi-structured telephone interviews with municipal planners and seven semi-structured telephone interviews at the regional- and county level were carried out. These informants also participated in four annual project workshops, and were familiar with both the research topic and the researcher.

As the interviews hold a prominent position among the methods applied in the project, more reflections on this method are warranted. This is particularly relevant for the interviews carried out in the case study reported in article one, which dealt with perceptions of climate change risk and adaptive strategies. During the fieldwork, I deliberately did not ask interviewees questions about climate change from the outset, in order to get observations of changes in weather, physical conditions and ecosystems (see Smit et al., 2010). But the very inclusion of "climate change" in the research project title provoked certain connotations and reactions among respondents. Often I encountered respondents that viewed climate change as politically constructed hype or an outright hoax, they held a hostile attitude towards climate change related research. Other respondents were certain that climate change means the end of the world, which again framed what they said in the interviews. This sensitivity of the climate change subject warrants a focus on interaction and resistance in interview situations.

Table 3. Data collection methods applied in the articles

	Article 1	**Article 2+3**	**Article 4**
Semi structured interviews	Vestvågøy: 26	Stavanger: 5 Nesseby: 3 Høylandet: 4 Fredrikstad: 5 Bergen: 4 Flora: 3 Voss: 4	Stavanger: 1 Naustdal: 1 Eid: 2 Fjell: 1 Leikanger:1 County governors Western Norway: 4 County Councils Western Norway: 3
Group interviews	3	1	
Workshops	-	3	3
Townhall meeting	1	-	-

According to Vitus (2008) and King (2004), the prevailing assumption of the "ideal" interview situation is when there is a consensus between the interviewer and the respondents, the interviewer is the active participant, and the respondents reply passively to the questions asked. But some interview situations are not like that. When interviewing respondents that hold strong opinions on a controversial issue, or interviewing where the respondent belongs to an elite or are themselves an expert, a social asymmetry between the interviewer and the respondent is created and this shapes the context for the interview and the content of what being said (Vitus, 2008). The interview statements should, therefore, not be viewed as the sole source of data, consideration should also be given thee context of the interview and the topic itself. Interactions in interviewing outside the exchange of questions and answers are inevitable (Holstein and Gubrium, 1995). However, mainstream literature on interviewing seems to assume that the goal of a scientific interview is "maximizing the flow of valid, reliable information minimizing the distortions of what the respondents know" (Gorden 1987 cf. Holstein and Gubrium, 1995:4). By expanding the focus to also include the interactionistic aspects of the interview, the meaning production that the interview situation creates are as important to understand as "prospecting" for the information conveyed (Holstein and Gubrium, 1995). Resistance and paradoxes do not constitute "data gaps" and cause scientific flaws, but instead allow for insights into local discourses, practices, cultural understandings and power relations, in other words more empirical material.

4.2.2.3 Other methods and reflections over these

In addition to interviews, case study visits enabled informal contact with informants. By doing multiple trips, a relationship with some key informants was established, that eased access to local know-how and additional informants through 'snow ball' sampling (Yin, 2009). The fieldwork trips also involved visits to farms and landing facilities for fish fleets, providing opportunities for direct observations and conversations in the field, both valuable methods when the purpose is to document the informants world views and cultural biases (Halkier, 2010). The cases reported in article two and three involved visits to all the case municipalities and meetings with key informants in the municipal administration. However, as the empirical work in these cases involved co-authors of the articles and some additional colleagues, I myself only visited three out of eight case study sites.

The case study reported in article two and three involved annual workshops with group assignments, which included tasks on interpreting downscaled projections, brain storming on potential impacts and how to implement adaptation in municipal planning. The minutes from these group assignments were also included as data in the case study analysis.

The case study reported in articles two and three utilized data from three surveys from the eight municipalities where the status of adaptation planning was reported. This was not a sufficient number to warrant quantitative analysis. The case study reported in article four utilized one survey that provided quantifiable data on the use of objections in relation to a lack of adaptation in municipal spatial plans.

4.2.3 INTERPRETING DATA

Analyzing case study data is less straight-forward than many other research methods, and has to be tailored specifically to each study (Yin, 2009). The interviews were transcribed, and then categorized in tables according to the interview guide. Material emerging from document reviews was also analyzed in this manner. Observations and conversations in the field was documented in fieldwork reports, that later were analyzed using the same tables and categories. New categories were also defined based on initial interpretation of the material. The categories found in the tables used for articles two, three and four reflect the explanatory variables defined in the analytical framework for each of the articles, and the content of the tables reflects the measurements of these variables. For example, in article two, agenda-setting of adaptation at the local level is analyzed in terms of drivers. Four drivers are identified and used to categorize the empirical material: Engaged municipal officials, extreme weather events, real-world indicators and researcher involvement. These explanatory variables are an outcome of the research and thus a result of an iterative process moving between the initial

theoretical framework based on literature and the empirical material, in line with the logic of abduction (Danermark et al., 2002). This is also the approach used in article three, which utilizes some of the same empirical material as article two. Article four also applied this approach to data interpretation. Article one relied on a more interpretative approach, where the researcher needed to code expressions and statements in order to categorize them, without key words necessarily emerging in the statements. For example, perceptions of climate change risk were categorized based on statements on how the informant perceived he would be impacted by climate change. In all the articles, direct quotes are used to illustrate salient points.

In all the cases, preliminary or intermediate results were presented to the case study communities. In the cases reported in article two, three and four, this was done through an annual workshop. In article one this was done through an open town hall meeting, as well through one public lecture. These feedback rounds contributed to enhancing the objectivity of the data.

4.3 ETHICS IN RESEARCH

Ethics in social science research deals with questions about how we treat the people on whom we conduct research, on how we treat the information we have on these people and on what kind of activities we as researchers should or should not engage in with these people (Bryman, 2012). In addition, social science research should be conducted according to good scientific standards or an appropriate code of conduct. This includes paying respect to the intellectual work of colleagues, honoring co-authors, and being transparent in choices of methods and the funding of the research. In general then it concerns my integrity as a researcher. Breaches of the generally accepted scientific code of conduct include plagiarism, use of other researchers work without including them as researchers and concealing funders of the research (see footnote for examples of such guidelines). These ethical standards are, in my case, obligations that are required by both my employer, the Western Norway Research Institute, and Aalborg University[1]. Also when publishing the research in scientific journals, you have to declare that you have followed appropriate scientific conduct.

When it comes to the relation to informants and other people that are subjects in the research, there are also guidelines and obligations to follow. It is necessary to take

[1] http://www.tek-nat.aau.dk/forskning/god-videnskabelig-praksis/

ethical considerations into account when data collection that involves informants are conducted and consider how the information is treated, both in the published research, and in any other possible circumstance (e.g re-use in new research, storage of transcripts, etc). In Norway, most research institutions involved in research on people are a member of the Social Science Data Service (NSD). Conductiing interviews, recording statements during workshops, town hall meetings, etc., for the purpose of research that results in written information that makes interviewees identifiable by name, or through background information, are subject to approval by the Norwegian Data Protection Official (NDPO) for Research at the NSD[1]. The NDPO ensures that the rules and legislation concerning the privacy of citizens are followed in research. They mandate that informants shall be informed about their rights and must give explicit consent to the use of their statements. NDPO also requires that interview transcripts shall not be published or shared unless the anonymity of the informant is ensured. The research conducted for this thesis has all been reported and approved by the NDPO. This involves the following:

- Ahead of all interviews, informants have been asked to provide informed consent.
- Informants are not identified in the published research. However, in some instances it is impossible to ensure anonymity, despite the omission of name, gender or title, because of the contextual information provided. If anonymity is hard to achieve because of context, this is a condition that is included in the informed consent.
- Interview transcripts that identify informants are not shared or published, and after its use personal identifiers are removed from the transcripts.

In addition to the privacy concerns of the informants, good scientific conduct requires that the researcher does not treat people who participate in the research unethically. Unethical behavior includes concealing the purpose of the research from informants, conducting the research in covert fashion or pretending to occupy another role than that of a researcher (Bryman, 2012).

In a politically sensitive field such as climate change, and in particular when studying the interface between science and policy, knowledge and action, I would argue that good scientific conduct also involves presenting you preliminary research

[1] http://www.nsd.uib.no/personvern/en/index.html

findings to the people whose opinions and statements the research is based on for feedback and validation. This has been done through town hall meetings and workshops throughout the research conducted for this thesis (see section 4.2.2.2 for an overview of the feedback events).

5. SUMMARY OF THE ARTICLES

5.1 INTRODUCING THE FOUR ARTICLES

This section presents the results and analysis in the thesis through the four research articles. Each article contributes to answering the aims and research questions of the thesis, and provides various ways with reflections on the theoretical perspectives outlined in the conceptual framework (see table 4). The articles include separate sections on methods, conceptual frameworks and analytical discussions.

Table 4. Overview of the articles

Level of unit of study	**Adaptation governance**	**Article**	**Research objective**
Individual and sectorial	Problem recognition and issue salience	Article 1: Understanding the need for adaptation in a natural resource dependent community in Northern Norway: Issue salience, knowledge and values	1+4
Local	Agenda-setting	Article 2: “Driving the agenda for climate change adaptation in Norwegian municipalities.”	3+4
Local	Implementation	Article 3: “Implementing adaptation to climate change at the local level.”	3+4
Regional	Coordination of local level through boundary work	Article 4: "The regional level as boundary organization? An analysis of climate change adaptation governance in Norway"	2+4

The first article deals with the preconditions for getting the adaptation issue on the local policy agenda and addresses the first and fourth research objective of the PhD-project (see section 1.3). It does not discuss the local policy agenda, but focuses on how the issue acquires salience among three occupational groups. The article presents how actors in a natural resource dependent community in Northern Norway perceive and respond to changes in weather and resource conditions, as

well as projections of future climate. The article concludes that there is a discrepancy between the urgency of the climate change issue as it is portrayed in in research literature, policy documents and statements on one hand, and in the narratives about climate change, weather variability and local impacts at the local level, on the other. This discrepancy is also documented in other studies (e.g Amundsen, 2012; Tøsse, 2013). By applying a cultural theory of risk framework (Thompson and Wildavsky, 1990), we conclude that actors that fit within an "individualist" *way of life* tend to downplay the urgency of climate change, while actors that fit within an "hierarchists" *way of life* accept the need for adaptation to climate change based on climate science. The discrepancy of the salience of adaptation both within a natural resource based community, and between the community and the science and policy arenas, highlights a knowledge gap in the adaptation governance literature. This article contributes to a theory of adaptation governance through the development of a specific understanding of issue salience. Building on the work of Hoppe (2002), issue salience is interpreted as being produced by an individual's ways of life, preference for policy problems, and experience with professional uses of scientific knowledge. We find that an *individualist* way of life, which according to Hoppe would prefer medium structured problems with agreement on aim, but disagreement on means, and little professional experience, results in adaptation been interpreted as an issue of limited salience. While a *hierarchical* way of life, in which individuals prefer structured, easy to agree on, problems, and professional experience with the application of scientific knowledge, produces a high issue salience of adaptation.

The second and third article address the third research objective (see section 1.3.). The *second* article focuses on agenda-setting of adaptation and the third on implementation. The second article shows that adaptation to climate change has been added to the municipal agenda in eight Norwegian municipalities to a varying degree. Four significant drivers are identified that have contributed to adding climate change adaptation to the agenda:

1. Engaged officials: individuals that consider the topic important enough to warrant a change to the municipality's agenda;
2. Focusing events: recent extreme weather events opening a window of opportunity for addressing adaptation;
3. Real-world indicators: municipal officials reacting to changes in a desired state or condition on infrastructure or services that are the responsibility of the municipality.
4. Interaction with researchers.

Fishboats at the quay in Stamsund, Lofoten. Photo: Halvor Dannevig

The engaged official constitutes the driver most frequently found across the cases and is therefore a salient category. In addition, the interaction of several drivers must be in place for adaption to reach the municipal agenda. Furthermore, the study revealed that when moving from agenda-setting to implementation, two of the same factors apply: the engaged individuals in the municipal administration and involvement of external expertize. In addition the study found that the size of the municipality mattered, the smallest municipalities in the study lacked administrative capacity to work with other issues than those strictly mandated by law, which prohibits them to develop measures in plans and municipal regulations.

The case municipalities used in the second and third articles signify bellwethers for adaptation to climate change among Norwegian municipalities. It is concluded that the drivers identified are not sufficient for Norwegian municipalities to address adaptation to climate change properly. As such, without clear guidance and incentives from the national level, adaptation to climate change in municipalities will continue to be treated in a haphazard manner. The findings contradict conventional agenda-setting theories (e.g Kingdon, 2003) by finding that agenda-setting and implementation can take place without public engagement and mass media coverage. It also points to the importance of human agency, exemplified by the engaged official, which is of little prominence in mainstream theories of the policy process. The importance of external expertise in agenda-setting adaptation,

points to the second research objective on the importance of boundary work in adaptation governance, which is addressed in the fourth article.

The *third* article follows up on the second article and contributes to meeting the first objective of the PhD project (see section 1.3), by investigating how adaptation has been implemented in the same case municipalities. At the local level of government, adaptation has to compete with other non-mandatory issues. This raises the question to what degree adaptation can and will be implemented. This article examines how implementation of climate adaptation measures has proceeded in the eight case municipalities. In order to measure the degree of implementation a set of indicators were developed and the eight case municipalities were analyzed according to these indicators. We find that seven out of eight municipalities have implemented or have specific plans to implement adaptation measures. These findings show that municipalities are able to implement adaptation policies that are not initiated at the central level, but that it is contingent upon a number of factors which somewhat overlap with the drivers of agenda-setting identified in the second article: the efforts of individuals within the municipal organization, municipal size, and the use of external expertise. In the literature on the Nordic municipal model after the New Public Management reforms of the 1990s, the idea of "executive municipality" was introduced – portraying municipalities as passive agents merely executing targets from the national government. Our research contradicts this notion by showing that municipalities can set their own agendas and develop policy fields without clear signals from the national government.

The *fourth* article investigates the role of the regional governance level in facilitating adaptation at the local level through a range of case studies in western Norway, with a focus on climate change related natural hazards, as natural hazards are the main concern relating to climate change adaptation at the regional level. The article contributes to existing research on climate change governance by examining how regional government in Norway has interpreted its role in coordinating climate change adaptation in spatial planning policy networks. Compared to the other articles in the thesis it explicitly addresses the multi-scale dimensions of adaptation by focusing on the relation between the regional level and the local level of governance. Drawing on concepts from research on boundary work, the article critically assesses how regional government in western Norway configured boundary arrangements between scientific and policy communities. This is addressed through an analytical focus on the nature and extent of boundary work, i.e. translation, mediation and communication (Cash et al. 2003), that regional government actors engage in through their application of policy coordination instruments. The research involves a review of on-going spatial planning processes in six municipalities from four counties in western Norway. The article concludes that even although adaptation is not treated as a salient issue in most municipalities, coordination of regional adaptation governance is creating a hybrid management space that aids mediation between the local user's knowledge and expert adaptation

knowledge, and thus hold the potential for better local level adaptation planning. The concept of hybrid management space builds on a critique of the commonly used concept of boundary organization. The concept of hybrid management space captures the temporal and fluid character of the boundary arrangement found in the study, which is not found in the way boundary organization is conceptualized in the literature (Mahony, 2013).

5.2 CONTRIBUTIONS TO A THEORY FOR ADAPTATION GOVERNANCE

In this thesis it has been argued that adaptation governance has some features as a governance issue that makes existing theories for explaining agenda-setting and implementation insufficient. This section will summarize the cross-cutting theoretical contribution from the thesis and thus summarize the answer to objective four of the thesis – developing theory for explaining the emergence of adaptation governance at the local and regional level. The thesis contributes to extending theory in two ways: Firstly, through development of the analytical framework, and secondly through the generalizable part of the results. The frameworks applied in the articles are new, but they are based upon, and provide a critique of, well-tested theories. I have shown that it is possible to combine insights from mainstream agenda-setting and policy formation theories with the cultural theory of risk and boundary work theory in order to explain adaptation governance at the local level. The employment of these theoretical perspectives itself represents an innovation, as they have not been applied previously to the study of adaptation governance[1]. The construction of the framework is a result of the iterative process of abduction – that is, moving back and forth between the data collection, analysis and framework development.

Issue salience is a necessary precondition for adaptation governance. As with all other policy issues, in order to get on the policy agenda, adaptation must be recognized as a problem, and compete with other issues for attention from policy makers and governance actors. But, adaptation has some features that make it particularly challenging for it to achieve salience and hence get on the policy agenda. This is because adaptation pertains to problems that are less immediate than

[1] [1] A few articles have been published that uses agenda-setting theories, such as Groven (2013) and Prallé (2009), of these only the latter was published before the relevant article (no. 2) for this thesis where published

other concerns and are based on abstract scientific models (see section 1.2. for a more detailed account of this argument). Therefore, extreme weather events and other signifiers of a changing climate have emerged as an important factor for explaining agenda-setting in municipalities by engaged municipal officials, as they serve to make climate change salient. However, the same type of experiences do not necessarily trigger recognition of a need for adaptation among other occupational groups. The application of CTR has helped to explain why actors interpret real-world events and scientific climate change knowledge differently. I therefore suggest that *issue salience* is a key concept in adaptation governance, and I develop this argument by combining CTR (Thompson and Wildavsky, 1990) and a typology of policy problems preferences (Hoppe, 2002) in order to explain why some actors see adaptation as a salient issue and others not. I also argue that this can constitute a supplementary or new perspective to studies of adaptive capacity. It addresses criticism of the lack of human agency in studies of adaptive capacity (Kofinas et al., 2013).

While CTR has been applied in studies of policy preferences (e.g Thompson et al., 1999) and perception of climate change risks (e.g Kahan et al., 2012), the attempt to tie CTR to local level climate policy issues is new. One main challenge in applying CTR is the assignment of actors into the *way of life* or cultural bias categories. In this thesis, this categorisation was based on occupational characteristics, while other studies have relied on surveys (e.g Marris et al., 1998) or voting behavior (Kahan et al., 2012). In future studies, a mix of these approaches should be applied in order to strengthen the validity of the categorization. While this thesis suggest that the CTR approach to issue salience can help explain agenda-setting, the causal link between the salience of an issue among various group of actors categorized according to CTR and agenda-setting is not explicitly tested, and this remains a task for further research.

The application of issue salience as an analytical concept nevertheless addresses shortcomings in agenda-setting and policy formation theories (Dearing and Rogers, 1996; e.g Kingdon, 2003) in terms of its importance as a prerequisite to expressions of human agency in climate change agenda-setting. While the importance of a policy entrepreneur is acknowledged (e.g Kingdon, 2003), the values and motivations of this actor for championing particular issues are less emphasized. Furthermore, bureaucrats and planners, the "engaged officials" that I have found to be able to agenda-set adaptation, do not fit the characteristics of the policy entrepreneur in the mainstream agenda-setting theories (e.g Birkland, 1998).

The concept of salience as used in this thesis has two separate meanings. It is applied as above in relation to the importance of an issue to various occupational groups. But salience is also found to be a necessary feature of knowledge for policy making, along with legitimacy and credibility (Cash et al., 2003). Obviously, the salience of an issue relates to the salience of the knowledge about this issue.

Likewise, agenda-setting and policy formation will necessarily require legitimation of the issue, and the credibility of the agenda-setters is likely to be a critical factor. While this has not received much focus in this thesis, Cashmore and Wejs (2014) have studied how climate change is institutionalized in local governance in terms of the legitimation of the issue, and finds among other things that in absence of formal legitimacy (rules, legislation etc.), normative legitimacy is key to institutionalization. Further research is needed to investigate the links between credibility, salience and legitimacy in the agenda-setting process of climate change governance in general.

The engaged official in this thesis has much in common with the "institutional entrepreneur", which has received considerable interest in new institutional analysis studies. The institutional entrepreneur is able to create new institutions or change existing ones due to the their social relations and situation in existing institutional environments (Campell, 2004). Institutional entrepreneurs have been found to be crucial in integrating climate policy at the local governance level in Denmark (Wejs, 2014), and a new institutional approach to the study of local level adaptation governance in Norway would likely yield similar results. This is however a topic for further research.

Agenda-setting theories need also to be supplied with additional perspectives in order to explain how policies for solving issues dependent on scientific knowledge can be developed. The learning, networking and boundary work that occurred when engaged officials interacted with researchers in order to develop and implement adaptation policies at the local level, emerged as an important driver. I have demonstrated that STS-scholarship on boundary work and co-production (Cash et al., 2003; Hoppe and Wesselink, 2014; Jasanoff, 2010), which often are conducted within a relativist ontology, can be used for explaining causal mechanisms: that of the emergence of adaptation governance at the local level. STS-scholarship frequently points out that science cannot speak truth to policy (Jasanoff, 2004). While other environmental policy issues are dependent on science in order to be comprehensible, the risks of these are mostly more apparent and immediate in either a spatial or a temporal sense than climate change risks. Climate change is therefore exceptional in an STS-context, because in making policy choices it is impossible to escape the science. Furthermore, as the creation of new scientific knowledge also results in the co-production of social order (Jasanoff, 2004), and because policy is so utterly dependent on science for climate change, democracy demands that those affected by the policy choices need to be involved in the production of knowledge. In addition, as numerous studies shows (see Cash et al., 2003), knowledge-based policies is more likely to be successful when the knowledge they are based on has been developed together with users, as this knowledge is more likely to be viewed as salient, credible and legitimate among these users. However, as I have shown in article four, attempts at boundary work at the regional level in the case of adaptation have not been particularly successful in

actually getting municipalities to set adaptation on the agenda. I argue that the insights provided by my application of the issue salience concept can help explain this: boundary work for producing salient, credible and legitimate knowledge for adaptation governance needs to be tailored to the relevant actors values and world views. But to demonstrate this empirically would require further research.

The subnational level has proven fruitful for capturing the dynamics of agenda-setting which are easily overlooked in studies at the national or international level. The absence of national policy coordination has also made it possible to document the dynamics through which new policy solutions to global problems are developed at the local level. The case of adaptation governance illustrates that the model of the municipality as a mere excecutioner of national policy is not valid for all areas; new policies and solutions can be developed also at the local level.

I surmise that the theoretical framework that ties together cultural theory, boundary work theory and agenda-setting theory, has relevance for other governance issues that rest on scientific knowledge. Obviously, policies to tackle the mitigation side of the climate change problems are facing many of the same difficulties when it comes to agenda-setting and issue-salience. The combined challenge of reaching the two degree target and coping with projected climate change calls for societal transformations, according to academics and policy makers alike (IPCC, 2014; O'Brien, 2011). Thus the framework developed in this thesis can be applied to study the conditions for transformational policy change in the face of climate change.

6. CONCLUSIONS

The goal of my PhD-project has been to explain the emergence of adaptation to climate change as a governance issue in Norway. As this is a novel field, it has a descriptive and explorative component – reflected in the research objectives in terms of describing how issue salience of adaptation is created, how adaptation is set on the agenda and implemented, and how regional governance actors attempt to coordinate adaptation.

I will start with a summary of what actions adaptation to climate change has been found to include based on the results presented in thesis. Most municipalities address adaptation in terms of reducing the risk of natural hazards. However I have also found instances where they are addressing the potential vulnerability of climate sensitive industries, such as coastal fisheries, agriculture, reindeer herding and forestry. The measures for reducing natural hazard risks are based on assessments of current risks, but climate change is also frequently added as a dimension that can enhance the risk. Avalanche protection measures in Hammerfest are one such example. Another example is the development of a checklist for adaptation requirements for new spatials plans for the municipal spatial planning officers as done in Stavanger. To develop designated adaptation measures is still something that the forerunner municipalities do, those that have the capacity, the engaged officers and have experienced real-world indicators, such as repeated and increasing amount of inundation as in Fredrikstad, and extreme events as in Bergen. Other municipalities are barely doing the minimum required by laws and regulations (Article two, tree and four, Amundsen et al., 2010)

The mixed success of agenda-setting adaptation at the local level points to adaptation to climate change not readily being accepted as a salient issue in general. I find that an individualist way of life according to the CTR-typology (Thompson and Wildavsky, 1990) produces an inherently low issue salience for adaptation. It is not a type of policy problem that an individualist is concerned about, probably because the knowledge it rests on is not deemed useful to them. On the other hand, a hierarchical way of life produces a high salience, and knowledge about climate change impacts are seen as pertinent because it can aid adaptation and measures to, for instance, reduce current weather related risks. Thus, as I note above and in line with the findings of Kahan and colleagues (2012, 2011), in order for climate change knowledge to be salient and be able to set an issue on the policy agenda, the knowledge must be conveyed in a way so that it harmonizes with the users' way of life. In other words, knowledge for adaptation needs to be a result of boundary work: communication between experts and policy makers, translation of both expert and user knowledge and mediation of the boundary between policy and science (Cash et al., 2003).

However, making well functioning interfaces between science and policy is easier said than done. Climate scientists and adaptation experts clearly can not engage

personally in boundary work with all municipalities, as there are too many of them, which means that boundary arrangements are needed at the regional level. Attempts to coordinate adaptation governance at the regional level do also, to a large extent, consist of attempts at boundary work: guidance that involves references to adaptation literature and use of boundary objects such as flood maps that include climate change effects; production of regional plans that disseminate knowledge about regional climate change impacts; and organizing of events and seminars that include dissemination of adaptation knowledge. While the forerunner municipalities engage in and utilize this effort, most do not, and their spatial plans needs to be checked and objected to by the county governor for lack of mandatory adaptation measures.

On the practical level, this thesis has illustrated that adaptation can not readily be expected to be taken as a larger concern than it currently is, both at the local and regional governance level and amongst the general public, without a stronger effort to co-produce climate change knowledge for adaptation. Co-production is a process that requires involvement of several types of knowledges and demands challenging mediation over the boundary between these forms of knowledges and policy. This could involve changes in local priorities, but is not likely to happen without stronger support from the national and regional level.

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THE ARTICLES

Understanding the need for adaptation in a natural resource dependent community in Northern Norway: Issue salience, knowledge and values.

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Abstract

For society to effectively manage climate change impacts, the need to adapt must be recognized. At the same time there is a disconnect between knowledge and action on climate change. The salience of adaptation to climate change may be a precondition for action, but this issue has so far been neglected in the adaptation literature. This indicates a missing link between perception, values and world-views, on one side, and policy formation on the other. The article analyses how actors in three occupational groups in a natural resource dependent community in northern Norway perceive and respond to changes in weather and resource conditions, as well as projections for future climate. The results indicate that the need to adapt is perceived differently, if at all, amongst different actors. By drawing on concepts from governance literatures and cultural theory of risks (CTR), the paper seeks to explain this divergence in perceptions and responses amongst different actors, which can help policy-makers understand when and why autonomous actors are willing to adapt. We find that adaptation to climate change cannot readily be expected among actors who fit the *individualist* category of CTR, who do not directly utilize scientific knowledge when in their work.

Key words: Climate change, adaptation to climate change, governance, co-production, cultural theory of risks.

1. Introduction

In the recent years there has been a marked increase in climate adaptation research and adaptation plans made by governments and NGOs, while implementation of adaptation measures has been equally limited (Berrang-Ford et al. 2011; Berrang-Ford et al. 2014). The gap between abundance of adaptation and climate change knowledge and limited policy action is also found in the Arctic, where climate change is projected to substantially impact *inter alia* primary industries and public infrastructure (Øseth 2010; Kvalvik et al. 2011; Arctic Council 2013). However, climate change is not perceived to be an immediate concern among industry actors when compared to other challenges, such as economic viability, access to markets, outmigration, recruitment, flexible livelihoods, regulations and governance (e.g. Hovelsrud et al. 2010). Most primary industry actors have observed changes in weather which they attribute to climate change. Nevertheless, this knowledge does not necessarily trigger adaptation. This provides support for an apparent disconnect, highlighted by numerous scholars, between the abundance of scientific knowledge about climate change, the overwhelming and

clear evidence that such changes are caused by human action (IPCC 2013) and the general lack of societal response and political commitment to deal with the challenges (Hulme 2009; Jasanoff 2010; Szerszynski and Urry 2010).

Public concern about climate change is decreasing in several countries (e.g Norway, UK) (Corner et al. 2014; Hirsti 2014). This raises an interesting paradox: public concern in many countries is decreasing while at the same time scientific knowledge and certainty about cause and effect is increasing. While this paradox was initally observed by Mary Douglas (Douglas 1978; Douglas and Wildavsky 1982) in connection with other forms of risks, mainstream political science and governance theories have to date failed to properly address why people and institutions do not act on climate change (O'Brien & Wolf 2010; O'Riordan & Jordan 1999). Attempts have been made to explain the inertia in society to respond to what has been labeled the greatest threat to humanity in modern times. One explanation for the lack of concern and action is that the media and the climate policy discourses have been influenced by the extensive campaigning by climate change sceptics (Pidgeon 2012). Another explanation for the lack of progress with mitigating greenhouse gases may be the lack of policy or that, where it exists, policy is based on a "linear knowledge to action model" (McNie 2007). This is analogous to the cases in which adaptation measures are developed but not implemented (Preston et al. 2013). Other studies indicate that adaptation is not likely to take place without stronger policy measures (Dannevig et al. 2013; Tøsse 2013). The lack of effective policies for tackling climate change, whether it is adaptation or mitigation, also influences how salient the issue is for the public (Ryghaug et al. 2010; Corner et al. 2014). Salience, understood as the "importance" individuals place on certain issues (Wlezien 2005), is also strongly tied to values and norms, which play a significant role in shaping how people consider a risk or an issue. How lay people define and experience climate change is related to their cultural and social values and norms and have implications for whether they adapt or not (O'Brien & Wolf 2010; O'Brien & Hochachka 2010) . Nevertheless, few empirical studies have to date documented this connection. This points to a weakness in current attempts to establish a theory for adaptation governance where an understanding of social valuation in determining strategies for governing adaptation is largely lacking (O'Brien and Wolf 2010), and more broadly to the limited emphasis in governance literature on the agenda-setting property of scientific knowledge.

This paper contributes to closing this gap by showing that the salience of an issue is a highly relevant and useful variable in explaning political and societal inertia in responding to climate change. This is done through an analysis of empirical material from studies on climate change adapation in northern Norway.

The Arctic is a "hot spot" in that the temperature is projected to increase more and faster than the global average (IPCC 2013; AMAP 2011). Consequences of such changes are already being observed in many communities in the region (ACIA 2005; Ford et al. 2006; Smit and Wandel 2006; Huntington et al. 2007; AMAP 2011), and there is increasing evidence that impacts are attributed directly to anthropogenic climate change (IPCC 2013; 2014). . Our focus in northern Norway is on natural resource-dependent communities, which in general are particularly exposed and sensitive to changes in weather and climatic conditions, through the impacts on physical infrastructure, and the timing, profitability, and viability of various primary production and harvesting activities (e.g. Hovelsrud and Smit 2010). Arctic communities have throughout history adapted to highly variable environmental and socio-economic conditions (Nuttall 2005; Tyler et al. 2007; West and Hovelsrud 2010). The documented ability to cope with past and current environmental variability does not necessarily mean that communities are able to cope equally well with the unprecedented changes projected for the future (Amundsen 2012). Successful future coping will depend on the adaptive capacity of communities, which warrants investigation into the factors and conditions that determine and shape such capacity. We argue that the climate problem has to be seen as salient for adaptation to take place, and that this has consequences for adaptive capacity. We further argue that issue salience is a useful approach for understanding and analyzing how and why climate adaptation is added to the agenda of a municipality or primary industry. To date these perspectives have not been adequately addressed in the literature (e.g. Smit & Pilifosova 2001, Keskitalo et al 2010; Kofinas et al 2013).

To remedy this, the paper applies the cultural theory of risk (CTR) framework to explain the salience of local adaptation. Our findings on the construction of issue salience also challenge mainstream governance and agenda-setting theories. The paper reports on a study carried out in a primary industry dependent community in northern Norway, which according to some definitions (e.g. dependency on climate change sensitive natural resources) can be seen as highly vulnerable to climate change.

2. Theoretical perspectives

In political science, issue salience, though rarely defined and applied analytically, is referred to as the "importance" individuals place on certain issues (Wlezien 2005:557), particularly in the context of voting behavior (Epstein and Segal 2000). It is thus related to the problem-recognition and agenda-setting stages in the "stages heuristic" model of the policy process (Sabatier 2007). Agenda-setting of a policy issue requires, according to mainstream political science theory, that a problem is coupled with a solution by a policy entrepreneur during a window of opportunity (Kingdon 2003). However useful, these perspectives need to be supplied with explanations of how public values and worldviews influence problem-definition. A policy problem can be conceptualized along two dimensions: 1) degree of certainty or agreement over the knowledge base and 2) degree of consent on norms and values. This results in four main types of policy problems: 1) Structured problems with little disagreement over knowledge and values, 2) medium structured problems with disagreements over means, 3) medium structured problems with disagreements over goals and 4) unstructured problems with uncertain knowledge and little agreement over values (Hoppe 2002). According to Hoppe, these four types of policy-problem can be tied to four archetypes, or *ways* of *life* defined by the CTR-framework, originally developed by Mary Douglas (Douglas and Wildavsky 1982).

The four ways of life are also found to be related to perception of climate change risk (O'Riordan and Jordan 1999; Kahan et al. 2012). The four ways of life defined by Douglas and subsequently Thompson and Wildavsky (1990) are: *fatalist, hierarchist, individualist and egalitarian* (see figure 1). According to O' Riordan and Jordan (1999), *hierarchists* tend to trust climate scientists and will accept state intervention as long as it is appropriately legitimized. They also tend to see all problems as structured, or avoid them if they are not. *Individualists* tend to be concerned about problems that impinge on their personal freedom, are more concerned over the means than the goals of a problem, and they evaluate knowledge in terms of its usefulness, not its credibility (Hoppe 2002). *Fatalists* are paralyzed by uncertainties in climate science, and tend to see all problems as unstructured. *Egalitarians* are concerned about climate change, and see problems as conflicts over values and goals (Hoppe 2002). The way of life category someone best fits into thereby influences whether an issue will be viewed as a problem. Kahan and colleagues find that individualists tend to dismiss climate change science, while egalitarians accept it (Kahan et al. 2012). The individualists do not dismiss climate science because they lack science literacy, but because they are skeptical to the solutions to curb climate change, which may restrict their independence. According to Kahan, the cognition of risk based on climate change science is therefore a question of getting the message right, so that it resonates with the recipients' way of life.

Our research indicates that different perceptions of climate change risks also are present in natural resource based industries in northern Norway (see Hovelsrud et al. 2015).This allows for a categorization of respondents according to the ways of life typology: fishermen as individualists and municipal bureaucrats as hierarchists, while farmers straddle the two remaining categories (hierarchists and fatalists). This categorization implies that salience varies between different industries with implications for how an issue is accepted. How knowledge is interpreted and acted upon is closely linked to the way of life. Interpretation shapes whether and how knowledge is framed as a problem, which determines the salience that may then lead to action.

In summary, the concept of issue salience aid our understanding of how problems are considered "important", while the CTR-framework illustrates why this process is linked to different ways of life. Combining the two approaches guide our quest to understand why some consider climate change as a problem requiring adaptive measures while others in the same community do not. We assume that this

analysis is relevant for studies of issue salience and agenda-setting where scientific knowledge and findings call for policy change.

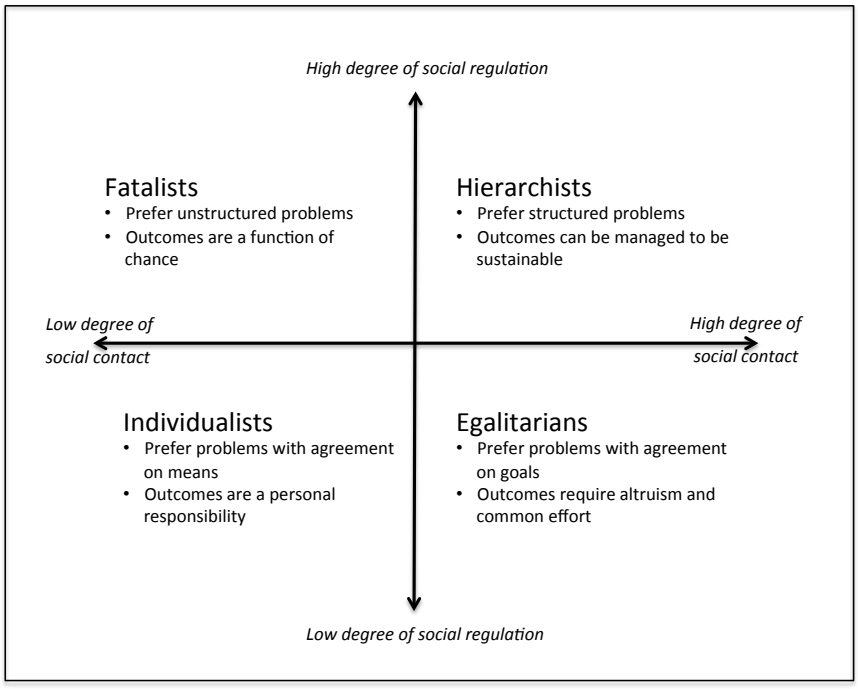

Fig. 1 The cultural theory of risk typology adopted from Thompson & Wildavsky 1990 and Hoppe 2002.

3. Case study site and method

3.1 The case study site

We present a case study from coastal communities in Vestvågøy municipality at 68°N, in the Lofoten Archipelago, in Nordland County in northern Norway (see figure 2). Vestvågøy has 11,000 inhabitants residing in small communities, with the majority settled in the commercial center of Leknes and in the fishing villages of Ballstad and Stamsund.

The main employer in Vestvågøy is the service sector. Fisheries and associated industries are the cornerstone of several of the smaller communities despite the fact that the total share of fisheries employment has decreased in recent decades. Agriculture is also an important sector with the same trend as in fisheries; fewer farmers but with a relatively stable yield. Many farmers hold other part-time jobs, while the fishermen interviewed worked full-time in this sector.

Lofoten is selected as a case study site because of its reliance on climate sensitive natural resources (fishing and farming) that, based on climate change projections and top down vulnerability assessments, would be assumed to be vulnerable to climate change (ACIA 2005). From a scientific point of view, it constitutes a *crucial case* (Gerring 2008); on the basis of the climate projections and local observations of weather changes we would expect the inhabitants to worry about the impacts of climate change (Kvalvik et al. 2011; Hovelsrud et al. 2010).

The occupational groups' "way of life"
The informants selected for this study are associated with livelihoods and occupations that allow for prescreening the "ways of life" outlined in the CTR group-grid typology. Fishermen, fish industry actors and farmers are all small to medium sized firms. They sell their products in a market and their livelihoods and economic profitability are largely dependent on their own effort. They also tend to work independently from others and with a low degree of social contact during work hours; characteristics that correspond to *individualists.* On the other hand, farmers are exposed and sensitive to changes in government subsidies and regulations in addition to weather conditions. These are all factors which the farmer cannot control. Therefore, they can, to some degree, also be categorized as fatalists, which means that this occupational group straddles both ways of life. Municipal planners better match the characteristics of the *hierarchists.* They work in a hierarchical system that provides social control and with a general acceptance of scientific knowledge. The municipal officers require a degree of predictability, and use knowledge from legitimate sources, creating a "culture" in which scientific knowledge is accepted as authoritative. The authoritative status is ensured by the institutionalized use of such knowledge in the municipal administration, for example by using environmental impact assessments for spatial planning.

3.2 Data

The analysis draws on material from research conducted in Vestvågøy municipality over the past seven years. The research is primarily sector-based community studies of adaptation strategies and assessment communities' vulnerability to multiple stresses to climatic and societal changes. The approach involve local participants in defining relevant research foci and in interpreting the results (e.g. Smit et al. 2010).

Downscaled projections for future climate were discussed with the informants along with scientific knowledge about the impact of climate change on agriculture (Hanssen-Bauer et al. 2010) and fisheries (Sundby and Nakken 2008; Drinkwater 2011). After consultations with key actors the projections were tailored to their priorities and needs (e.g. changes in extreme precipitation events for municipal planners). By translating and communicating scientific knowledge for policy the researchers acted as boundary workers (e.g. Guston 2001). Interestingly, of the three occupational groups only the municipal officers found the tailored projections instructive for their work.

Semi-structured interviews were carried out with 37 individuals including fishermen (n=15), stockfish producers and processors (n=5), municipal officers (n=8), and farmers (n=9). In the municipality, the officers responsible for planning, environmental issues, harbors, industries and agriculture, and the chief of development, were interviewed. Field discussions with fishermen were conducted, along with group interviews with municipal planners and industry advisors, and one town hall meeting with approximately 30 participants. Scoping fields visit and key informant interviews took place in June 2008, with four subsequent field trips in September 2008, February 2009, October 2009, and July 2010. Results have previously been reported in Hovelsrud et al. 2010, and in Kvalvik et al. 2011. Interviews with municipal officers in Vestvågøy have not previously been published.

The interview data were analyzed through coding of current challenges, in terms of social and environmental stresses, attribution to climate change, and of other drivers of change. Salience of climate adaptation is indicated by a) attribution of possible future livelihood challenges to climate change b) relative importance (threat to livelihood compared to other exposure-sensitivities) and c) the manifestation or extent of adaptive responses.

4. Findings – different perceptions of the need to adapt

This section presents findings of the degree to which adaptation to climate change was seen as a salient issue among the informants in the three occupational groups. Examples of identified changes, attribution to cause of change, and adaptation measures are given in Table 1.

Fig. 2 The case study site, Vestvågøy municipality, Nordland County, Norway

4.1 Fishery sector

The discussion of vulnerability to climate change in the case of Lofoten is currently accentuated by a recent shift in the distribution of the most important fish stock – cod (*Gadus morhua*). The traditional winter fisheries for spawning cod, one of the largest cod fisheries in the world now takes place further north, which was duly noted in the interviews with the fishermen. The northward shift of cod has had the most notable consequences for the land based industry rather than for the fishermen; they can follow the fish and land their catch further north (Hovelsrud et al. 2010). The cod fisheries are subject to a continuous rationalization process, which recently has been amplified by the introduction of tradable fish quotas. This has led to soaring prices for fishing vessels with quotas and fewer, but larger vessels.

Fishermen pointed to changes in the distribution of commercially important fish stocks, such as the northward shift in the cod fisheries. This shift in the winter fisheries was of limited importance to the fishermen because their vessels are equipped for longer offshore trips. They showed little interest in downscaled scenarios for regional ocean temperature or in the effects on distribution and composition of fish stocks. One coastal fisherman stated: "There have always been periods with a lack of fish, and the weather has always been changing. I believe the reason for why the cod is no longer near Lofoten now is the use of trawlers". The absence of cod was thus blamed on other types of fisheries: the "trawlers". Two of the informants referred to events during the 1860s in order to illustrate the variability of fish stocks: "In the 1860s there were 13 years without cod in the sea. But it came back. It has always been changing, we are used to that" (Fish buyer and stockfish producer in Lofoten). This kind of statement was made by several fishermen and illustrate their perception of high adaptive capacity to a variable resource. The stockfish production is a seasonal activity starting during the winter fishery for spawning cod, but stockfish will be destroyed if it freezes, and the drying normally starts in March. In recent years, however, it has started as early as January, while May, traditionally a

good month for finalizing the production, has been too warm for the drying process needed for a high quality product. Despite what appears to be high climate sensitivity, most of the stockfish producers attribute the earlier onset of favorable conditions for stockfish production to natural variation and are not overly concerned about the prospect of even warmer and wetter conditions.

The northward shift in cod stocks is, according to fisheries scientists, caused by increased ocean temperatures due to climate change (Drinkwater 2011). While none of the fishermen interviewed outright rejected that climate change is happening, they did not attribute the changes they observed to global warming. It is noteworthy that the fishermen do not readily accept the conclusions drawn by marine scientists. This correlates with a general distrust of marine science which delivers advice on fish stocks and quotas to fisheries management, exemplified by the fishermen's opinions about how wrong the stock assessments of the marine scientists were (see also (Dale 2012). The lack of trust may have developed through their experiences of fisheries management sole reliance on marine science for decisions making, with no regard for fishermen's own knowledge. Fishermen reported that they only rely on their own knowledge and that of their peers when making decision on when and where to fish. Additionally, the fishermen expressed little or no interest in receiving better or tailored downscaled climate projections that could inform proactive adaptive measures. Similarly, there was no indication that climate adaptation was on the agenda of the fishermen's organizations. This illustrates that climate change had no salience for the fisheries industry.

4.2 Farmers

Farmers in our studies identified a longer grazing season and wetter autumns as climate related changes currently affecting their livelihood. The increased grazing season is seen as an opportunity and an advantage. Wetter autumns may pose challenges for farmers cultivating bog soils, but the challenges are, first and foremost, related to the fact that farmers use increasingly heavier equipment, which can cause damage to the soil when saturated with water. The increased use of heavier equipment is nested within a suite of interrelated structural and economic factors which will not be addressed here (see Kvalvik et al., 2011). Several farmers speculated that increased bush and tree growth wash an climate change impact, but they primarily related this to fewer grazing animals. Some of the farmers requested more knowledge about new crop varieties that would be better adapted to warmer temperatures and improved growing conditions. Such requests and focus signify a certain level of salience for the climate change issue.

The farmers in our study perceive themselves to be vulnerable to the lack of recruitment to the industry, changing policy conditions and the clear trend towards decreasing economic earnings from farming. While the yield has remained stable, the number of farms has declined in Vestvågøy (Kvalvik et al. 2011). The farmers expressed concern that it will be difficult to maintain a viable farming community if the decline continues. "Without fellow farmers in the neighborhood, it is very hard to keep going", one farmer said. The salience of the problem can in this case be seen as determined by the economic importance and its impact on the ability to continue being a farmer. Unlike the fishermen, the farmers depend on scientific knowledge, provided largely by the agricultural extension service, to guide their decisions. The farmers expressed an interest in the downscaled projections for changes in growing season, but interestingly expressed far more concern over scenarios for future agricultural policies (see also Kvalvik et al., 2011). One farmer said: "I do really worry about climate change, in general I mean. But I can't really see how it will have a big impact on the farming". This indicates that farmers attribute salience to global climate change while also showing confidence in their adaptive capacity.

4.3 Municipal sector

The study results show that the environmental officer, the chief of development and the agricultural advisor are all quite concerned about the consequences of climate change. They are interested in knowing how climate change would impact upon coastal fisheries and whether the favorable drying conditions for producing stockfish would deteriorate as a result of climate change. The agricultural advisor feared the impacts of increasingly wet conditions and invasive species and pests on

agriculture, while also considering longer growing season and improved growing conditions to be beneficial for agriculture. The planners and the harbor officer were concerned about sea-level rise and an increase in extreme weather events, such as storms and snow avalanches. They requested projections for future weather- and climate conditions relevant for local adaptation planning.

At the time of study, no national regulations or policy for adaptation had been developed, which means that the initiative to adapt was taken at the local level. One planner stated: "it is natural for a municipal planner to include climate change adaptation in planning, as we make plans for the future".

The municipal officers consider proactive adaptation measures for reducing the impacts of climate change as being a "natural part of the duties of a planner", implicitly accepting scientific knowledge. During the period of study the municipality implemented regulations that would protect against sea-level rise in the municipal spatial plans and mapped areas susceptible to avalanches, illustrating that climate adaptation was a salient issue, or a structured problem with an uncontested knowledge base and agreement over aim (protection against future natural hazards) and means (spatial planning) (Hoppe 2002).

Table 1: The perceived vulnerabilities across the studied sectors

Actor	**Perceived changes in climate and ecosystems**	**Attribution**	**Adaptation**
Fishermen	Changes in magnitude and distribution in important fish stocks Storminess at sea	Natural climate variability; competing fishermen's fishery activities; fisheries management system.	Follow the fish
Fish buyers	Changes in magnitude and distribution in important fish stocks.	Other fishermen's gear and methods; natural climate variability; fisheries management system affects fish distribution	Attract fishermen by price or other financial agreements; invest in the local fishing fleet to secure landings; attract and market higher quality fish
Farmers	Precipitation in autumn -> difficult to harvest and damage to soil	Increasingly heavier equipment damages wet soil.	Use lighter (but less efficient) equipment; wait for drier periods
Municipal officers	Avalanches and winter floods	Climate variability and change	Additional assessments. stronger focus on natural hazards in spatial planning
Municipal officers	Sea level rise and storm surges	Climate change	Additional assessments; increase minimum distance to sea for new buildings in zoning plans.

5. Discussion

A common denominator for the actors interviewed in this study is that their work is directly or indirectly exposed to weather variability and climate change; fishermen and farmers to the highest degree in directly facing impacts of weather conditions on their livelihoods, and fish buyers and municipal officers to a lesser degree in that they do not have to deal directly with weather conditions during their workday. All three occupations have also identified climate and weather elements, which

contribute to or cause vulnerability. Still, the salience of the adaptation issue, or recognition of the need to adapt differs considerably (see table 1).

The fishermen—perhaps the group of actors that are most affected by weather in their professional life—expresses the least need for adaptation. They show little or no interest in climate projections tailored for their region; such projections do not contain salient information. We surmise that the lack of salience of climate change information has two explanations. First it is a consequence of their distrust of science and it reflects the fishermen's *individualist*, (and arguably somewhat macho), way of life. The expressed distrust towards marine science is extended to that of climate change. It is simply not taken seriously. In addition as independent businessmen they align with the individualist way of life in that they are not likely to trust science or other forms of knowledge-based policies that somehow may restrict their independence (O'Riordan and Jordan 1999) or that are not useful to them (Hoppe 2002). To consider climate change adaptation as salient may be perceived as a threat to the flexibility needed to *inter alia* follow a northward-shifting cod stock, or target new fish species.

Farmers acknowledge that climate change will have consequences for their livelihood, and mainly positive ones. And in this capacity some express more interest in the consequences of future climate change on farming, as projected in the downscaled scenarios. Farmers also rely on scientific knowledge through advice from the agricultural extension service, and none of the farmers reject climate science outright. Nevertheless, few expressed a need for proactive adaptive measures directed towards current and future climate change impacts. The intermediate salience of the adaptation issue, we argue, is a consequence of the acceptance of climate change science and a perception of limited relevance for their livelihood. Agricultural policy changes, lack of recruitment and economic challenges emerged as more significant for their livelihood, and are therefore more salient than climate change.

Of the three occupations, municipal planners were the most concerned about climate change, and acknowledged the necessity to plan for adaptation. Furthermore, municipal officers had already added climate adaptation to their planning agenda, in terms of preparing for sea-level rise and requesting vulnerability assessments for primary industries, treating adaptation as a policy problem and thereby making it salient. The municipal planners were also the only group that actively requested downscaled climate change projections, seeing the relevance for their work. By being engaged in the development of the scenarios they partook in co-producing climate change knowledge (Cash et al. 2003).

Based on the comparison of fishermen and farmers, we conclude that the difference in the salience of adaptation is shaped by the perception of how climate change will affect livelihoods. The fishermen's inclination to dismiss climate change as not being of any greater threat than normal weather variability may originate in their general distrust of scientific knowledge including knowledge of climate change impacts on marine species and weather conditions at sea. Farmers more readily accept such knowledge and therefore consider climate adaptation as more important than fishermen. When comparing fishermen and municipal officials we find similar differences in the salience of adaptation. We conclude that this difference is rooted in their applying a combination of different types of knowledge in their professions and their ways of life. We argue that an individualist way of life combined with limited use and acceptance of scientific knowledge will produce low salience of adaptation as an issue, while a hierarchical way of life combined with professional use of scientific knowledge produces high salience. This corresponds to Hoppe's findings that hierarchists recognize a problem if they can view it as structured, while individualists do not recognize a problem when the means to solve it and the knowledge underlying it cannot be of any use to them. This speaks directly to the challenge of developing policy on the basis of scientific knowledge only. By ignoring why such knowledge is accepted and applied, the policy may fail in developing necessary adaptation measures. Such linkages between knowledge uptake, ways of life and issue salience is neglected in main stream agenda setting theories (Kingdon 2003; Wlezien 2005). Our findings show that under certain conditions, scientific knowledge can indeed have agenda-setting properties, but the reception of scientific knowledge varies between different occupational groups.

6. Conclusion

The results presented infer that the agenda-setting ability of scientific knowledge in occupational groups is highly contingent on the combination of how scientific knowledge is used and seen as salient in the occupational group and the way of life held by the occupational group members.

If it is accepted that climate change impacts require action, and that planned adaptation to the consequences is necessary, then climate change science becomes critical. But in the cases where climate change is not perceived as a risk, adaptation will not be high on the agenda, and it will not receive any human or financial resources in competition with more pressing tasks. The investment in increasingly more expensive, advanced and accurate downscaled projections of future climate change may be of little use for others than municipal officers in aiding adaptation locally. This begs the question of how adaptation as a salient issue can be advanced at the community level. Our findings are in agreement with those of Kahan and colleagues in that climate change science must be conveyed in a way so it harmonizes with peoples values and worldviews (Kahan et al. 2012). The boundary work that is required to produce knowledge for adaptation must be tailored to each way of life in order to resonate with the actors' perceptions of risks and problem recognition, which to a high degree is rooted in past experiences, and historical and political developments. This resonates with the notion that adaptation takes place locally, and therefore requires input of local knowledge to be successful (Armitage et al. 2008). This raises the question of how to integrate different forms of knowledges and how to analyze this in an agenda-setting context. If future adaptation needs can be better understood through climate change science, scientific knowledge as one knowledge source, has a role to play in such boundary work. This presents particular challenges towards occupational groups, such as the fishermen that we have worked with, which do not consider scientific knowledge useful for their profession. If the individualist category is taken at face value, then the perception of high adaptive capacity and independence of fishermen indicates that adaptation has typically been viewed too simplistically.

If scientific climate change knowledge calls for changes at the local level, it is a matter of democracy to involve local stakeholders in both the production and dissemination of such knowledge. This insight is in line with suggestions from Hulme on public engagement with climate science (Hulme 2008). How this is to be achieved at the local level is a matter for further research, which could benefit from combining insights from climatology, political science, cultural theory of risks, and science and technology studies. Furthermore, the finding that ways of life in combination with professional application of knowledge seems to determine the salience of the adaptation issue adds an important dimension to adaptation studies. We conclude that assessments and analyses of adaptive capacity need to take salience of the adaptation issue into account as a determinant of adaptive capacity. More emphasis on the cultural foundation of salience could also inform governance theories in general and in particular on agenda-setting and the policy process.

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Driving the agenda for climate change adaptation in Norwegian municipalities

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Abstract. The absence of clear signals from the Norwegian state concerning climate change adaptation provides an opportunity to investigate why some municipalities have addressed adaptation to climate change while others have not. Although difficulties associated with implementing adaptation to climate change are well documented, less is known about those individuals who take the lead. On the basis of in-depth interviews and interaction with eight Norwegian municipalities that have begun working with climate adaptation, we examine how climate adaptation has been added to the local agenda. We find that adaptation planning has progressed more in those municipalities where officials are engaged and actively seeking external expertise and support. We conclude that, without a clearer national adaptation policy and greater resource allocation and legislation, adaptation to climate change within Norwegian municipalities is unlikely to progress further.

Keywords: climate change, adaptation, agenda setting, municipalities, climate policy

Introduction

It is widely recognised that adaptation to the consequences of climate change is unavoidable and necessary (IPCC, 2007), and in response countries around the world are increasingly addressing the need to adapt to climate change (Berrang-Ford et al, 2011; Urwin and Jordan, 2007). It is also increasingly being acknowledged that adaptation has to take place at all levels of government and across sectors (eg, Adger, 2006; Berrang-Ford et al, 2011; IPCC, 2007). In this paper we focus on one of these governmental levels and ask how climate adaptation is currently manifested in Norwegian municipalities. Multiple frameworks and guidelines, such as the European Commission's white paper on adaptation (EC, 2009) have been developed in recent years. Current research, however, shows that mainstreaming adaptation policies in EU countries is often hampered by a lack of legislation (Juhola 2010; Keskitalo, 2010). While a substantial amount of literature finds that climate-related natural hazards can serve as focusing events for reactive adaptation policies (Amundsen et al, 2009; 2010; Birkland, 1997; 1998; Penning-Rowsell et al, 2006), it is not well understood how adaptation to future climate change, currently a voluntary undertaking, may be a priority for policy makers. A number of studies focus on the importance of institutions, self-organisation, social learning, and social capital for the ability of organisations to adapt to climate change

(eg, Adger, 2003; Armitage et al, 2007; Pelling 2011; Pelling et al, 2008). According to Adger (2003), the ability and effectiveness of local collective action is the most important determinant of adaptive capacity. Collective action on adaptation is related to social learning, which is the "capacity and processes through which new values, ideas and practices are disseminated, popularised and become dominant in society or a subset such as an organisation" (Pelling, 2011, page 60). Social learning for adaptation is facilitated through informal networks between academics, NGO representatives, and officials (Pelling et al, 2008). Organisations where regulations and standards do not reflect climate change, where best practice of adaptation examples are lacking, and the support for the senior management is limited are found to be a principal barrier to adaptation to climate change. While these studies have successfully pointed out how adaptation might take place in organisations, the question still remains why adaptation is becoming a topic of interest in these organisations, and in local government in particular. In line with recent adaptation research literature (eg, Dover and Hezri, 2010; Eriksen and Selboe, 2011; Keskitalo, 2010), we find that adaptation research to date has paid little attention to the development of adaptation as a policy process in an industrialised country context, such as Norway. In particular, there is a need to find out how adaptation may be implemented across policy sectors through public policies and how adaptation as policy raises challenges that are different from other policy areas in terms of the time scale and uncertainties associated with the impact of climate change (Dover and Hezri, 2010). By addressing these issues, this paper will contribute to a growing body of knowledge attempting to resolve such challenges. In Norway some municipalities have started to implement adaptation measures, despite the lack of clear government guidelines. In this paper we examine why and how adaptation to climate change was added to the agenda of some Norwegian municipalities but not others (see figure 1).

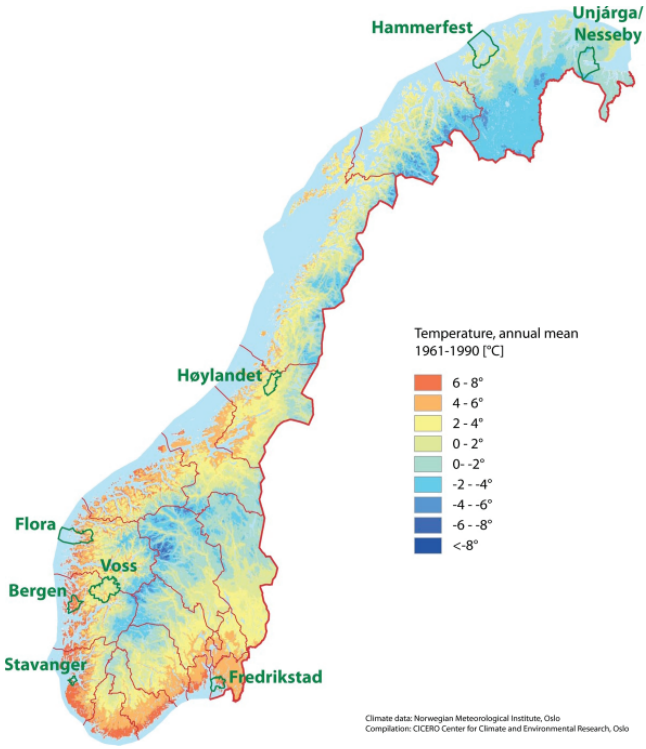

Figure 1. [In colour online.] Map showing the case municipalities in Norway.

We draw on the extensive literature on agenda-setting theory in our analysis of how adaptation is included in the policy agenda of our case municipalities. However, this literature lacks a suitable framework for examining agenda setting at the *local* level. Furthermore, we find that studying agenda setting at the local level warrants a greater emphasis on human agency and institutional factors. We have therefore developed a new set of categories: individual efforts, focusing events, real-world indicators, and external expertise. These are based on a combination of our empirical findings, on adaptation in organisations literature (eg, Adger, 2003; Berkes, 2009; Pelling, 2011; Pelling et al, 2008), and on the agenda-setting literature (eg, Dearing and Rogers, 1996; Kingdon, 1995).

Agenda setting

> "Every social system must have an agenda if it is to prioritize the problems facing it, so that it can decide where to start work."
>
> Dearing and Rogers (1996, page 1)

Adaptation to climate change is emerging as a new policy area in most developed countries (Berrang-Ford et al, 2011). In addition, climate adaptation policies must also deal with new and different challenges for society. In general, municipalities implement policies directed from higher levels of government through regulations, earmarked funding, and information. By the time this study was carried out, the Norwegian government provided information only about climate change adaptation to municipalities. In Norway, therefore, the absence of a national policy for adaptation to climate change leaves the full responsibility to the local government. This means that if the municipalities see the need for addressing adaptation, they must themselves include it in their agenda, where it has to compete with other more pressing and legally binding tasks, such as health, education, and the elderly. In this paper we study the introduction of climate change adaptation in municipalities as an agenda-setting process. We also identify the factors and processes that explain how adaptation arrived on the case municipalities' agenda. Most theories on agenda setting are based on studies of federal politics in the United States (eg, Baumgartner and Jones, 1993; Dearing and Rogers, 1996; Kingdon, 1995), which are not directly applicable to the Norwegian context. Nevertheless, we find that certain generalisations regarding real-world indicators (Dearing and Rogers, 1996) and focusing events (Birkland, 1997; 1998; Kingdon, 1995) for agenda setting are transferable to the Norwegian municipal context. In addition, we have expanded our theoretical perspective to include a greater focus on the role of human agency, enabled or constrained by institutional factors. We argue that the particular dynamics of local-level policy making leave more room for individual efforts than the agenda-setting theories allow for.

A policy agenda may be defined as "the list of subjects or problems to which government officials, and people around them, pay serious attention" (Kingdon, 1995, page 3). The agenda-setting process is often characterised as the first step in policy formation, starting with problem recognition. Public policies are generally the final outcome of an agenda-setting process (Baumgartner and Jones, 1993).

According to Dearing and Rogers (1996), three interlinked preconditions exist for a topic to be placed on a policy agenda—real-world indicators, public opinion, and mass media coverage. Real-world indicators refer to observable and measurable signs of a social problem that are monitored and conveyed to policy makers. This could, for instance, be an increase in number of car accidents, or, as in one of the cases presented in this paper, an increase in inundation episodes. However, real-world indicators alone are not sufficient for a problem to come on the agenda. Additionally, mass media coverage and public opinion must provide the necessary pressure for policy makers to address the problem. If these preconditions are not met, several social problems can exist without being included in the policymakers' agenda (Dearing and Rogers, 1996).

Several authors note the importance of focusing events in providing a window of opportunity for bringing a problem to the agenda. Focusing events are "rare, harmful, sudden events that become known to the mass public and policy elites virtually simultaneously" (Birkland, 1997, page 3), and as such hold a potential for advancing topics to the agenda or triggering policy change (Baumgartner and Jones, 1993; Cobb and Elder, 1983; Kingdon, 1995). Penning-Rowsell and colleagues (Penning-Rowsell et al, 2006) found that natural disasters, such as flood events of a sufficient scale and impact, can create a crisis which opens a window of opportunity to increase the rate of policy change, and to widen the range of actors involved. There are numerous other examples of 'reactive' adaptations, measures, or actions in the wake of extreme events (eg, Næss et al, 2005; Zahran et al, 2008).

The role of human agency—in particular in terms of individuals such as administrative officials and experts—is not emphasised in the agenda-setting literature (Birkland, 1997; Dearing and Rogers, 1996). Some address the policy entrepreneur as someone who is able to couple problems and policies during windows of opportunities and thus get an issue on the political agenda (Kingdon, 1995). According to Kingdon, such policy entrepreneurs are motivated by values, world-views, and self-interest and are more concerned with promoting a solution that they champion than about solving problems. The policy entrepreneur can be an appointed or elected official, a lobbyist, or an expert. Norwegian municipal planners do not fit the category of policy entrepreneurs, and are found to have limited agenda-setting influence. This is because they carry out 'mundane' technical tasks which draw little public and political attention (Birkland, 1997). 'Precrisis planning' in preparation for natural hazards has to compete with other issues to gain the attention of elected officials, the media, and the public. Municipal officials who are involved in budget preparations are, on other hand, found to have great autonomy and agenda-setting powers in Norway (Kalseth and Rattsø, 1998). In our case we found that the municipal officials were central in the agenda setting of adaptation issues in several of the municipalities. However, the engaged official—as we could label the adaptation policy entrepreneur—does not operate in a vacuum but within a broader institutional framework. This framework is created by the municipal organisation, anchored in national legislation, and shaped by the municipalities' financial situation (eg, MoMR, 1997), and it provides support or barriers for the municipal official to forward the issue he or she wants to get on the policy agenda. An individual's ability to get an issue on the municipal agenda resembles what Pelling (2011) has termed 'adaptive agency'. This agency is made reflexive through learning. However, the motives driving individual agency are closely related to values and world-views (see also O'Brien and Wolf, 2010), mirroring Kingdon's findings regarding policy entrepreneurs. Where the organisation provides space and support for individual learning and action, institutional adaptive capacity increases (Adger, 2003; Pelling, 2011). Learning is particularly favored in informal networks across different units within the organisation or between officials, practitioners, and researchers, in what Pelling (2011) calls "shadow spaces for learning". This links to the agenda-setting properties of experts and researchers. In this study, and as an element of the methodology, the researchers have been involved in the adaptation process as providers of knowledge and, thereby, in the agenda-setting process. The role of the researchers in the agenda-setting process is therefore examined. Some argue that specialists and researchers have limited ability to influence an agenda (Birkland, 1997; Dearing and Rogers, 1996). However, in the adaptation literature this is given much larger emphasis. Coproduction of knowledge between local stakeholders and researchers is found to be a key determinant for adaptive agency (Berkes, 2009; Olson et al, 2004). The 'shadow spaces' for social learning build trust and social capital (Pelling, 2011; Pelling et al, 2008). In the case of adaptation, the role of researchers in agenda setting could therefore be central.

Municipalities' role in adaptation

Norway is generally considered resilient to climate change due to economic wealth, strong institutions, high educational level, and social equality (McCarthy et al, 2001; O'Brien et al, 2006; Sygna and O'Brien, 2001). However, climate vulnerability is a question of scale, and some local communities may be more vulnerable than current national assessments predict (O'Brien et al, 2006; West and Hovelsrud, 2008). Despite the seemingly low vulnerability, there is a need for proactive measures on the part of Norwegian municipalities and sectors (Aall et al, 2007; O'Brien et al, 2006). The Norwegian government has not yet issued regulations that require the municipalities to plan for adaptation to climate change. Rather, adaptation has so far been defined as a shared responsibility to be carried out independently by all public and private actors (MoE, 2010; NG, 2008). The local level of government in Norway consists of 430 municipalities. Municipalities represent the local level of government in Norway and serve as a link to national governance institutions and management bodies. As such, they could be described as the state representative that works closest with the public. In Norway municipalities are financed by local taxes and transfer funds from the national government. Most of the funds transferred from the national government are earmarked or tied to legally binding obligations. A municipality provides a number of important functions, such as: social services, elementary schools, water provision, fire protection, local roads, waste collection, land management, and land-use planning. Municipal services are strongly regulated by national legislation, and the bulk of the municipal budget is spent on mandatory tasks to ensure cross-national equality. Regulations and economic incentives are used by the government to ensure municipalities implement national policies. Conversely, there are few if any incentives for carrying out tasks not regulated by law. In spite of this centralised system, significant discrepancies exist between municipalities. Comparison provides an opportunity to identify the factors that influence municipalities' efforts to adapt to climate change.

Local planning is important for preventing or reducing damage from extreme events—for example, a municipal policy instrument prohibiting construction in flood-prone zones (see Næss et al, 2005). In the context of climate change, with the projected increase in extreme precipitation events (Hansen-Bauer, 2009; IPCC, 2012), municipalities may face new and different challenges. A white paper, resulting from a highly publicised green paper on climate adaptation, is being developed by the Norwegian government for release in 2013. It is expected that a national adaptation policy will be included in this report.

Several studies on adaptation to climate change at the local level in Norway have concluded that few municipalities have prioritised a systematic approach to the challenges of climate change (eg, Amundsen et al, 2009; Næss et al, 2005; Vevatne and Westskog, 2007). Hovik and Reitan (2004) point out that new public management reforms with a focus on goals, targets, and result assessments have weakened the municipalities' ability to take greater responsibility for implementing national environmental policy. This is also found to be the case for adaptation (Eakin et al, 2011). Amundsen and colleagues (Amundsen et al, 2009) argue that, at the local level, adaptation receives little attention, which may be explained by the lack of national focus on adaptation (institutions as well as specific targets) and that it competes with more immediate concerns such as education and health.

Methods

The four-year interdisciplinary research project "Community Adaptation and Vulnerability in Norway" (NORADAPT 2007–11) generated the empirical data analysed in this paper. Eight municipalities participated in the project, and we have applied an in-depth case-study approach to each. This method has been inspired by a framework outlined by Smit and colleagues (Smit et al, 2010) and by the principles for empirical community case studies as outlined in Lim and colleagues (Lim et al, 2004) and Berkes and Jolly (2001). The framework acknowledges

the importance of understanding local community stakeholders' own perceptions of exposure sensitivity and resilience to climate change. Through this approach knowledge was coproduced by the local municipal officials and involved scientists. Coproduction of knowledge pertains to a process where different actors such as local stakeholders, government officials and researchers work together to create new knowledge (Berkes, 2009; Olson et al, 2004). Such a bottom-up approach is increasingly being applied in vulnerability and adaptation studies (Dessai and Hulme, 2004). It has been critical for our project to employ a common framework to ensure integration of results across the various cases. It should be noted in this particular study that the local project partners, who are municipal officials, are also the individuals who carry out municipal vulnerability assessments. The role of the researchers, in addition to providing scientific input, has been to facilitate and observe the processes as they have unfolded in the municipalities.

A precondition for participating in the project was that the municipalities intended to pass or had passed a political resolution to start assessing their own vulnerability to climate change within one or more sectors. The majority of Norwegian municipalities are still a long way from passing such resolutions and from implementing adaptation measures. This has been explained by a lack of administrative capacity, competence, and knowledge, creating a pressure to prioritise mandatory tasks (Amundsen et al, 2009; Berglund and Nygård, 2008). Our preselection criteria automatically exclude both a randomised selection of municipalities and a study including all Norwegian municipalities. As such, it has proven necessary to seek out the exceptions: municipalities that have somehow demonstrated an interest in adaptation and vulnerability to climate change or taken their first steps in the direction of developing an adaptation policy.

The NORADAPT team drew on previous research projects when developing the case-study selection criteria. Our previously established contacts and basic knowledge about the selected municipalities also proved useful in the selection process. The study required in-depth fieldwork in each case municipality, requiring extensive human and financial resources. This limited the number of case studies to eight. The municipalities selected represent to some degree the variation that can be found in Norway. This variation can be broken down into the following typologies, shown in table 1. (1) Commercial structure: according to the classification developed by Statistics Norway (SSB, 1985), this includes the dominant source of employment, main economic sector, and location according to centre–periphery

Table 1. Geographical features of the eight case municipalities.

Municipality	Commercial structure	Population size	Physical geography	Region
Fredrikstad	central, mixed services and industry	large	freshwater and coast	Eastern
Hammerfest	less central, services	medium	coast	Northern
Voss	less central, mixed services and industry	medium	inland, agropastoral landscapes, freshwater	Western
Flora	less central, mixed services and industry	medium	coast	Western
Bergen	central, services	large	coast	Western
Stavanger	central, mixed services and industry	large	coast	Western
Unjárga/Nesseby	less central, mixed services and industry	small	coast, mountains	Northern
Høylandet	less central, primary sectors	small	agropastoral landscapes, forest, freshwater	Mid

in its region. (2) Population size: small (fewer than 5000 inhabitants), medium (5000–50 000 inhabitants), or large (50 000 inhabitants or more). (3) Physical geography: based on the basis of the Directorate of Nature Conservation classification (DN, 2007), inland, coast, forests, and mountains. (4) The major geographical regions in Norway: Northern Norway, Mid-Norway, Western Norway, Southern Norway, and Eastern Norway.

The data comprise (a) twenty interviews with municipal officials; (b) three annual surveys mapping the status and progress of the vulnerability assessments and development of adaptation strategies in each of the municipalities; (c) minutes from one to three annual visits to each of the municipalities; (d) minutes and transcribed conversations from three workshops where one or two key employees from each municipality participated. Additional sources of documentation include a communication log of e-mail and phone conversations, minutes and resolutions from municipal meetings, municipal planning documents, and grey literature. The latter two include analysis of municipal land-use plans, climate and energy plans, and risk and vulnerability analyses.

A key input from researchers to the case municipalities was downscaled climate projections based on the climate parameters deemed most relevant by local planners (Engen-Skaugen et al, 2009). For example, Fredrikstad, Stavanger, and Bergen requested projections for extreme precipitation because they already faced problems with water inundation in urban areas during episodes with intense precipitation. Socioeconomic scenarios, in the form of broad narratives on the possible course of local development in the next decades, combined with a set of fixed parameters such as population growth and economic development, were also produced for each of the municipalities. This double scenario approach was chosen to provide useful background information for municipal officials and politicians in planning for adaptation.

At the outset, representatives of the case municipalities responded to a survey concerning how the project would be organised in terms of the sectors involved and associated planning processes. The planned output in each municipality was a vulnerability assessment and an adaptive strategy based on a combination of scientific input and local insights. This interaction between researchers and municipal officials has influenced the local processes through the process of coproduction of knowledge (eg, Armitage et al, 2007; Berkes, 2009). While the empirical results of this project are not transferable to all Norwegian municipalities, they provide insights into how some municipalities have approached adaptation to climate change. Our case-study approach has yielded deep insights into the complex relationships between inter alia perceptions, beliefs, and attitudes held by decision makers and stakeholders within the municipalities. This has been made possible through long-term interaction and trust building with informants, enabling us to gain access to what Goffman (1959) refers to as the 'backstage'. By employing a common research framework and consistent methodologies, NORADAPT is able to compare findings across the case studies (Smit et al, 2010). This allows generalisations to be formulated of a higher validity than if each case were treated in isolation (Aase et al, 1997; Andersen, 1997; Flyvbjerg, 2004; Maxwell, 2005).

Findings: how was climate change adaptation added to the municipal agenda?

In this section we present our findings on how and why adaptation was added to the municipal agenda, and by what processes, events, and actors. We have identified four main drivers in the agenda-setting process within the case municipalities: (1) engaged officials playing a key role through taking the initiative to join a research project; (2) focusing events (extreme weather events functioning as catalysts for action); (3) observation of real-world indicators; and (4) interaction with researchers. In all the eight cases there is some degree of interaction between the different drivers. The drivers are described in greater detail below and summarised in table 2.

Table 2. Drivers in the agenda-setting process in the eight case municipalities.

Municipality	Year	Main driver(s) in agenda setting ('who')	Motivation ('what')
Unjárga/Nesseby	2008	(1) research project; (2) real-world indicators have increased the interest	natural resource use: sheep farming, berry picking, fishing, and hunting
Høylandet	2008	(1) research project; (2) engaged official; (3) focusing events	adaptation has provided an opportunity for positive attention
Flora	2004–05	(1) engaged official; (2) research project	risk assessments
Voss	2008	(1) research project	agriculture
Hammerfest	2007	(1) engaged officials; (2) real-world indicators; (3) focusing events	planning, environment, technology
Bergen	2005	(1) focusing events	risk assessments
Stavanger	2008	(1) engaged officials; (2) focusing events	new municipal plan, climate plan; planning, security
Fredrikstad	2007	(1) engaged officials; (2) real-world indicator (internal planning process)	environment and planning

The first step in the process of policy formation is problem recognition (Kingdon, 1995; Sabatier, 2007). Through drafting a political resolution to work on adaptation, our case municipalities defined adaptation as a relevant topic, and thereby added climate change adaptation to their agenda.

Engaged officials and institutional capacity

For local policy makers, climate change adaptation differs from other socioeconomic challenges by being an issue of future impacts, thus removing some of the pressure to act immediately. This was evident in our study and has also been reported by others (Birkland, 1997; Juhola, 2010). In cases where adaptation has progressed, it is predominantly because administrative employees were engaged in the issues and particularly interested in the consequences of climate change. Our findings show that there are number of reasons why officials are motivated to work with adaptation. Firstly, several officials reasoned that climate change will happen irrespective of mitigation efforts, meaning that adaptation is viewed as inevitable, and that adaptation should therefore be carried out as a part of long-term municipal planning. Secondly, some of the officials explained that they had learned about climate change from the media and deduced that global climate change would have local effects.

Engaged officials have contributed to the agenda-setting process in the following ways (number of municipalities in parentheses: (a) by taking the initiative to get involved in research projects on climate change adaptation, such as NORADAPT (3); (b) by initiating separate projects for assessing the consequences of climate change (eg, avalanche risk assessments, flood risk assessments) (3); (c) by integrating adaptation into municipal plans and planning processes (4).

All these engaged officials were employed by the municipalities as either (number of persons in parentheses): environmental advisors (3), emergency provision officers (2), or planners (2). A common feature shared by the environmental advisors and emergency provision officers is that they tend to work across municipal sectors, departments, and other institutional structures. Furthermore, their positions include tasks beyond those that are mandatory according to laws and regulations, enabling them to work more freely and carry

out project-related tasks. This also explains why we find that, in the smaller municipalities, engaged officials have played a less prominent role in adding adaptation to the agenda. These municipalities are simply too small to be able to afford positions dealing with nonmandatory tasks. Still, engaged officials are found in some smaller municipalities, such as in the planning office or the agriculture department. It should be noted, though, that the institutional framework of these municipalities does not afford officials the same capacity for adaptation available to the environment and emergency planning offices of larger municipalities. We argue that the effort of engaged officials should therefore not be considered in isolation from the administrative capacity or organisational structure of the municipalities in which they work. The ability of an official to make a difference depends on an institutional flexibility that most small municipalities are not able to provide. An official in Flora noted that the realm of planning had "achieved a larger strategic space in Flora than in other municipalities." He therefore considered it obvious that he would reflect on how climate change could affect local planning and which measures would be appropriate to reduce negative impacts. Flora's planners started discussing adaptation as early as 2004, and participated in several research projects that addressed local climate vulnerability. In sum, it was the combination of researcher involvement and enthusiastic planners which paved the way for adaptation to enter the agenda of local politicians.

We also find engaged politicians in the case municipalities, though they have tended to focus on climate change mitigation rather than climate adaptation. Adaptation exists on the administration's agenda, aside from Høylandet and Unjárga/Nesseby, primarily where the issue has also been considered a part of the mayor's and elected officials' agenda. These two municipalities have the smallest populations in this study, and in terms of organisational size and structure the distance between the politicians and municipal officials is small.

The above examples illustrate how the role of engaged officials is central to getting adaptation on the agenda within the case municipalities. Even though adaptation is generally not high on the municipal agenda compared with policy areas such as schools, health care, and even mitigation of greenhouse gases, it is clear that administrative officials were the main proponents in the agenda-setting process.

Focusing events

On 14 September 2005, following several days of heavy rain, a mudslide hit a row of attached houses in a steep residential area in Bergen. Three people were killed, and several were injured. The entire neighborhood was evacuated. On the same day heavy rain caused a river in Bergen to flood parts of the city causing extensive damage. In November the same year another life was lost in a Bergen suburb as a rain-triggered mudslide hit a house under construction. These fatalities spurred a heated national debate regarding natural hazards and land-use planning, thus moving natural hazard prevention higher up on the agenda of local authorities. Since 2005 the municipality of Bergen has carried out several assessments on the vulnerability of residential areas and infrastructure to geohazards (Bergen Municipality, 2011). The municipality has also implemented planning measures for improved surface water treatment in order to reduce the risk of floods and landslides. By way of example, we argue that in the case of Bergen the extreme weather events of 2005 led to a greater focus on adaptation.

These same extreme weather events also had repercussions outside of Bergen. The city of Stavanger is located in a county further south, and has a less challenging topography in terms of climate risks. Even so, the 2005 fatalities in Bergen raised awareness in Stavanger. In the wake of the fatalities the mayor of Stavanger received phone calls from concerned citizens, and the resulting massive public concern eventually led the municipality to produce risk maps of geohazards in Stavanger. Indirectly, the extreme weather events contributed to

the inclusion of adaptation to the agenda in both Bergen and Stavanger. The risk assessments carried out since 2005 have been utilised in planning processes, and are mainly responses to current vulnerabilities. Yet the planners in these municipalities demonstrate an awareness of possible future climate changes. We argue that these cases are focusing events by being instrumental in pushing vulnerability to flooding and geohazards higher up on the local agenda. Responding to these forms of vulnerability is closely linked with responding to climate change through adaptive measures.

Hammerfest was hit by the offshore winter storm *Narve* in 2006. The storm caused a major power failure and made many roads impassable. This event led to a stronger focus on risk and vulnerability assessments for extreme weather in the municipality, although it was secondary to the role of engaged officials and appeared together with real-world indicators in terms of adding adaptation to the agenda according to municipal officials. Our findings show that focusing events were the most important driver for adaptation to move up the municipal agenda in the case of Stavanger and Bergen. In Høylandet focusing events such as the recurrence of major floods have alerted the municipality to the need for proactive adaptation. In this case flood maps have been developed in collaboration with external experts from the Norwegian Water and Energy Directorate (NVE), and the municipalities have subsequently changed their regulations for new building developments in the area.

Real-world indicators

The concept of real-world indicators pertains to quantifiable indicators that are monitored and presented to policy makers, but without receiving mass media attention (Dearing and Rogers, 1996). In the context of this study real-world indicators relate to recurring problematic conditions, such as inundation and minor flood events, being observed by decision makers or conveyed to them through the municipal organisation. Such events include physical evidence of climate change, such as changes in weather patterns; ecosystem changes; or changes in the distribution, magnitude, and frequency of weather events. Real-world indicators may also refer to awareness of unsatisfactory municipal infrastructure, such as insufficient water and sanitation capacity or inadequate flood protection. The following real-world indicators have spurred administrative and political interest in adaptation in the case municipalities. (a) In Unjárga/Nesseby local concern over observed changes in both vegetation and wind direction has increased the general awareness of climate change. In this small municipality there is a high degree of informal contact between politicians, administrative officials, and local inhabitants, and people's observations are readily picked up by the municipality. (b) In Fredrikstad several episodes of unusually intense rain have led to inundation and damage of private basements and infrastructure. Inadequate drainage systems unable to cope with the volume of surface water were the main cause of damage during the storm. The local media raised the issue, fuelling public concern, and the issue was eventually discussed by the administration of Fredrikstad municipality. This motivated the municipality's environmental official to seek advice from researchers, contributing to the municipality's involvement in the NORADAPT project. (c) Hammerfest municipality considers itself to be exposed and sensitive to avalanches and has undertaken extensive adaptation measures to reduce its vulnerability (Hovelsrud et al, 2010). This is a condition that the municipality has been aware of for several decades, and as such we categorise this as a real-world indicator, even though past fatal accidents (the last fatal episode took place in 1957) did serve as focusing events for taking action. The threat of avalanche is also related to the expansion of Hammerfest city. Located between the sea and steep sided mountains, a lack of available land has resulted in new constructions taking place in avalanche-prone areas. As a consequence of climate change, the threat of avalanches has received renewed attention. Major investments have recently been made in avalanche-proofing potentially dangerous sections of this Arctic coastal city.

In collaboration with the Norwegian Geotechnical Institute, the municipalities have mapped the conditions which are most likely to cause an avalanche (eg, strong wind from southwest combined with precipitation), prioritising which areas to protect, restricting new construction, and securing expert and financial assistance from the NVE. By maintaining close contact with the Norwegian Meteorological Institute and avalanche experts, the municipality has been able to anticipate and prepare for potentially dangerous events (Hovelsrud et al, 2010).

Researcher involvement

Municipalities' involvement in research projects also contributes to adding adaptation to the agenda. We have found that in three of the municipalities (Voss, Unjárga/Nesseby, and Høylandet) involvement in a research project was the main reason why adaptation was placed on the agenda. We did not find the same level of engaged officials in these municipalities as in the others. On the other hand, we argue that in these municipalities the initial involvement in the projects was due to engaged and interested officials. We also find that in several of the cases involvement in research projects has provided the necessary push for moving the topic further up on the agenda. In all the municipalities, however, involvement in a research project has ensured that continuous attention is paid to topics on climate adaptation. The interaction, since 2006, between researchers and municipal officials has been both informal and formal, and has resulted in a learning process within the municipalities. This is evident from changes in the terminology used and the level of knowledge of adaptation documented in transcripts from meetings and conversations with municipal officials. One notable example is how municipal officials, in general, have started to discuss climate change mitigation and adaptation as separate topics: during the first meetings in the project officials in two of the municipalities used efforts on mitigation policies and energy-saving projects and adaptation to climate change interchangeably. Additionally, the officials now discuss topics relevant for climate adaptation, whereas when the project started these topics were seen as irrelevant and not interesting.

In several of our cases municipal officials have communicated with researchers in this project asking for assistance in their work on adaptation. We therefore conclude that informal arenas have been created between the researchers and the municipal officers that resemble shadow spaces for social learning.

> "These spaces allow individuals or sub-groups within organisations to experiment, imitate, communicate, learn and reflect on their actions in ways that can surpass formal processes within policy and organisational settings" (Pelling et al, 2008, page 868).

The importance of the researcher involvement appears to be dependent on the municipalities' previous experience with climate policy, in terms of climate mitigation and energy saving policies. As illustrated in table 3, Fredrikstad, Stavanger, and Bergen had all developed plans for mitigation and energy saving for some time prior to being involved in the NORADAPT project, whereas the smaller municipalities had achieved less in terms of developing and implementing climate policy. It is therefore not surprising that a municipality such as Fredrikstad, having already further progressed with mitigation efforts, was more ready to take on adaptation.

Other drivers and factors

Media coverage and popular pressure are two other factors normally associated with agenda setting (Dearing and Rogers, 1996; Kingdon, 1995).These are to a lesser degree present in our cases. The media's role has, first and foremost, contributed to adding general climate change topics to the agenda, particularly in relation to events like the launch of IPCC's fourth assessment report in 2007 and the UNFCC's Convention of the Parties in Copenhagen in 2009, but not climate adaptation in particular. In both Hammerfest and Stavanger articles on climate change adaptation in local newspapers were picked up from municipal web pages.

A planner in Hammerfest municipality explained the sequence of events as follows: "It's not the media that has added adaptation to the agenda. We did, and the newspaper sometimes picks up what we do and writes about it." Another official in Hammerfest used the release of Al Gore's film *An Inconvenient Truth* (2008) to draw attention to adaptation:

> "I gathered people whom I believed should be concerned about the topic, (politicians, planners, and officials in the infrastructural services department) as they are the ones out there in the field and know what is going on."

This exemplifies the importance of an engaged municipal official using a 'window of opportunity' (Kingdon, 1995) created by national and international media events to add climate change to the municipal agenda.

Municipalities are the vehicle for carrying out national policy objectives, through legislation, economic incentives, and information. To date, the national measures have been limited to information and guidance—for example, by the County Governor's offices having informed relevant staff in the municipalities of the need to adapt to climate change. In Finnmark the County Governor's briefing to the municipal staff in Hammerfest on climate adaptation did not spur any activity. In other words, top-down signals from the state did not have a noticeable effect on the municipal agenda. We therefore conclude that the effect of top-down signals has to date been limited. This may change with the green paper on adaptation, which suggests an approach to climate change adaptation in which all sectors, authorities, and levels of government are all responsible for adapting to climate change (MoE, 2010).

In one of our interview sessions the municipal officials were asked to rank the current importance of climate adaptation in their municipality compared with topics such as climate mitigation, environmental policy, health, and education. In all municipalities except for Fredrikstad mitigation was considered to be higher on the agenda than adaptation. In the case of Fredrikstad respondents regarded adaptation and mitigation as equally important, but lower than the other topics.

Discussion

Our study of the agenda-setting process for climate adaptation in the cased municipalities has been inspired by classic works and theories (eg, Dearing and Rogers, 1996; Kingdon, 1995; Sabatier, 2007). We have applied concepts from theories originally designed for analysis of the federal level in the US to the local level in Norway. This presents a number of challenges about societal scale, different political systems, and institutional organisations. Nevertheless, the concepts have proven useful for teasing out the salient factors of the municipal agenda-setting process in Norway. Through our study we find that additional categories of agenda-setting drivers are emerging at the local level, in addition to the broadly recognised drivers of focusing events and real-world indicators, contributing to a refinement and broadening of our understanding. We argue that the new categories of engaged officials and researcher involvement are critical for understanding the process of local agenda-setting. Consistent with the agenda-setting theories (eg, Birkland, 1997; Kingdon, 1995), the importance of focusing events in opening windows of opportunity is clearly recognised in the cases of Bergen and Stavanger. This was also where we found the largest engagement of local politicians. Also, the presence of real-world indicators was found to be a necessary, but not in itself sufficient, factor in getting issues on the agenda. In our cases, real-world indicators—such as repeated damage from floods, inundation, or avalanches—are prominent in four of the eight of the municipalities, while in other municipalities adaptation has been added to the agenda without the obvious presence of real-world indicators. As the effects of climate change are increasingly being felt, we may expect to see new real-world indicators emerging. Our findings are to a degree consistent with other studies, in showing that adaptation has not been placed very high on the agenda in any of the municipalities compared with other issues, such

as public transport, schools, health care, and mitigation policies. On the other hand, we find that the agenda-setting drivers of mass media coverage and public pressure (eg, Dearing and Rogers, 1996; Kingdon, 1995) have not been instrumental in adding adaptation to the agenda in our cases. We surmise that the absence of these two drivers in our cases may provide one explanation for the lack of political attention to adaptation. In general, the agenda-setting literature argues that administrative officials and planners have limited agenda-setting power. Our findings are contrary to such arguments, in that we find engaged officials to have agenda-setting powers through, for example, the planning for emergency provision and extreme events. This responsibility has been moved out of the hands of politicians and into those of municipal officials—in our case, municipalities. We further argue that in our study engaged officials are the most important driver for adding adaptation to the agenda. The importance of individual agency for adaptation in organisations is also emphasised in the adaptation literature (eg, Adger, 2003; Berkes, 2009; Pelling, 2011). By not scaling down the approach, current agenda-setting theories miss this highly relevant and dynamic level of interaction. We argue that studies of processes that unfold at the local level will capture such nuances. Additionally, the importance of involvement with researchers is given little attention in the agenda-setting literature, while in adaptation literature it is widely found that research plays a fundamental role in developing adaptation policies (eg, Berkes, 2009; Berrang-Ford et al, 2011; Juhola, 2010). Our findings support the latter position, and we find that the network created between municipal officials and researchers is crucial in three of our cases, all smaller municipalities, thus supporting the claim that shadow spaces are a crucial factor for facilitating adaptation in organisations. Although our case sample is small and not representative of all municipalities in Norway, the significance of researcher involvement illustrates the need for external expertise to drive processes that are founded on uncertainty, and with a long time frame (ie, future climate change), which may represent new and possibly different challenges. These results point to an emerging challenge for national policy development addressing the need for external expertise in the most vulnerable municipalities.

Another critical aspect emerging from our results is that internal institutional capacity determines a municipality's ability to handle adaptation to climate change. In municipalities which employ officials with cross-sectoral responsibilities, such as emergency provisions or environmental officers, the ability is greater and more open for addressing other cross-sectorial issues such as adaptation. Furthermore, this category of officials, with a broad area of expertise, is likely to have a comparatively greater ability to carry out nonmandatory tasks. In our cases such officials have been able to link adaptation to established policy processes, such as risk and vulnerability assessments related to land-use planning. We find that municipalities with lower institutional capacity have not been as successful in addressing climate change adaptation.

Conclusion

We have found four significant drivers that have contributed to adding climate change adaptation to the agenda—in our case, municipalities. (1) Engaged officials: individuals that consider the topic important enough to warrant a change to the municipality's agenda. (2) Focusing events: recent extreme weather events opening a window of opportunity for addressing adaptation. (3) Real-world indicators: municipal officials reacting to changes in a desired state or condition on infrastructure or services that are the responsibility of the municipality. (4) Interaction with researchers: through research projects on adaptation.

We conclude that engaged officials constitute the driver most frequently found across the cases and are therefore a salient category. We further conclude that the interaction of several drivers must be in place for adaption to reach the municipal agenda. Interaction between these drivers is a topic for future studies. The cases in this study signify bellwethers

for adaptation to climate change among Norwegian municipalities. We conclude that the drivers identified are not sufficient enough for Norwegian municipalities to properly address adaptation to climate change. As such, without clear guidance and incentives from the national level, adaptation to climate change in municipalities will continue to be treated in a haphazard manner.

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Implementing adaptation to climate change at the local level

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Adaptation to climate change has to various degrees been added to the political agenda in all industrialised countries. In most of these countries, adaptation measures are yet to be implemented in legislation and are, therefore, in practice voluntary undertakings. At the local level of the government, this means that adaptation has to compete with other non-mandatory issues. This raises the question as to what degree adaptation can and will be implemented. This paper examines how the implementation of climate adaptation measures has proceeded in eight Norwegian municipalities. These municipalities were among the first movers on adaptation to climate change in Norway. In order to measure the degree of implementation, a set of indicators has been developed and the eight case municipalities have been analysed according to these indicators. We found that seven of eight municipalities have implemented or have specific plans to implement adaptation measures. These findings show that municipalities are able to implement adaptation policies that are not initiated at the central level, but are contingent upon a number of factors: the efforts of individuals within the municipal organisation, municipal size, and the use of external expertise.

Keywords: climate change; adaptation; new public management; policy implementation; municipalities; climate policy

Introduction

Adaptation to climate change is increasingly considered a necessity in countries around the world (Intergovernmental Panel on Climate Change (IPCC) 2007, Urwin and Jordan 2007, Berrang-Ford *et al.* 2011). To varying degrees, governments are developing adaptation strategies at both the local and national levels. When it comes to climate change adaptation, national policies are with a few exceptions in its infancy (Keskitalo 2010a, 2010b, Berrang-Ford *et al*. 2011). Studies of vulnerability and adaptation to climate change have in the recent past focused on the local level (e.g. Amundsen *et al.* 2010, Armitage and Plummer 2010, Hovelsrud *et al*. 2010a). It is now widely recognised that it is at the local level where vulnerabilities unfold and where adaptation takes place (IPCC 2007, Urwin and Jordan 2007), and there has been an increased interest in the role of governance for adaptation (i.e. Urwin and Jordan 2007, Berrang-Ford *et al.* 2011).

The last few years have seen substantial research devoted to understanding the nature of the vulnerabilities and the adaptive capacities of governments at different levels, industries, and communities to adapt (Berrang-Ford *et al.* 2011). Studies on adaptation and vulnerability to climate change at the local level in Nordic countries found that the ability to

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adapt is determined by a range of institutional, economic, and social factors (i.e. Hovelsrud *et al.* 2010a, 2010b, Keskitalo 2010a, Tennberg *et al.* 2010, West and Hovelsrud 2010). Institutional factors, such as organisational structure and administrative routines, were found to be crucial determinants of the local government's adaptive capacity (Næss *et al.* 2005, Crabbé and Robin 2006, Roberts 2008, Amundsen *et al.* 2010, Keskitalo *et al.* 2010). Furthermore, studies have found that few municipalities consider the need for adaptation to climate change, and in those that do, adaptation is mainly a reactive response (Næss *et al.* 2005, Amundsen *et al.* 2010, Glaas *et al.* 2010, Juhola 2010, Keskitalo 2010b).

In the case of Norway, studies have also pointed out that the local–central relationship clearly affects municipalities' actions on climate change adaptation (Amundsen *et al.* 2010, Rauken and Kelman 2010). New public management (NPM) reforms have led to stronger fragmentation of the public sector, which challenges cross-sectorial cooperation (Christensen and Lægreid 2006), and Eakin (2011) has shown how NPM reforms weaken the options for local adaptation governance in the public sector, through eroding organisational memory, technical and economical capacities, and knowledge.

The idea of the *executing municipality*, where the municipality only executes orders from the national level, has been postulated as a viable explanation of the local governments' policy priorities in Norway (cf. Fimreite and Lægreid 2005). This logic states that Norwegian municipalities only implement policies when they are instructed to do so by the national government. However, this is not always the case. There could be drawn parallels between the adaptation issue as a municipal topic and the introduction of environmental policy in the municipalities. The findings of Aall *et al*. (2007) show that the implementation of environmental policies as part of the municipalities' responsibilities in the early 1990s and also display that the municipalities can act as independent policy actors and not merely as executors of national policies.

The national focus on climate change adaptation in Norway has so far been vague. It is a policy area with no clear owners and there are few "orders" for the municipalities to execute. This raises the question about the degree to which we may expect climate change adaptation measures of any sort to be formulated and implemented. Climate change adaptation work at the municipal level may, because of the lack of "orders" or guidelines from the national level, be termed a non-mandatory issue and hence end up in a policy backwater in which little or no activity occurs.

Considering climate change adaptation is not entirely non-mandatory for the municipalities. All Norwegian municipalities have since 2009 been required to conduct *risk and vulnerability assessments* (RVAs) where impacts from climate change constitute one area that the municipalities are required to assess. Still, an RVA is merely an assessment and will not necessarily lead to concrete actions or proactive attempts at adaptation.

Despite the lack of national guidelines and institutional barriers, some municipalities are taking action to adapt to climate change, and this process has so far been poorly understood. Using Norway as a case, we address this issue in this paper. Based on interviews and workshops in the following eight case municipalities, we found that all, to some degree, have placed climate change adaptation on the agenda, and four of the eight had implemented measures. The majority of Norwegian municipalities have not achieved this (Amundsen *et al.* 2010), making this a study of the first movers in local level adaptation.

These observations are contrary to the characteristics of the *executing* municipality. In addition, it is evident that the case municipalities differ in the extent of the implementation work even if they are all presented with the same information. From these observations springs a two-pronged research question: first, what are the reasons for the local level breaking with the characteristics of the *executing* municipality, by implementing climate change

adaptation measures? Second, why have some of the case municipalities implemented adaptation measures to a greater extent than others? The focal point of this paper is, therefore, the degree to which these eight municipalities have implemented climate adaptation policies and how the observed differences can be explained.

This study represents the first attempt at measuring the implementation of local climate change adaptation in Norway. This is done through an assessment using a four-step indicator described below. By applying this set of indicators, we identify factors and conditions that determine which implementation level has been reached by each municipality. The application of the indicator builds on the assumption that adaptation represents a new policy area.

The policy-making processes are found to take place through several stages (Stone 1989, Birkland 1997, Sabatier 2007). A common stage categorisation is as follows: (1) problem definition; (2) agenda setting; (3) policy formation; and (4) implementation (Sabatier 2007). This conceptualisation of the policy process as occurring in fixed stages has received criticism, partly because each of these steps may, in fact, take place in a different order and may be partly independent of each other (Birkland 1997, Sabatier 2007). However, our research shows that the stage categorisation is relevant for understanding the adaptation policy process in Norwegian municipalities. Our indicator, therefore, reflects these stages. Furthermore, the municipalities' score on the indicator provides necessary information for an analysis of why some municipalities have progressed further in their adaptation work than others.

In the following section, we present the Norwegian efforts on adaptation in a European and Nordic context. This is followed by a presentation of the four-step indicator for measuring adaptation implementation and of the empirical findings from our case-study municipalities. Next, we discuss the differences between the municipalities' score and conclude with a few remarks.

Norway in context

Climate adaptation work in Western Europe has commenced at both the national and supranational levels. In 2007, the Commission of the European Union (2007) adopted a green paper on adaptation to climate change in the EU, underlining that also Europe was likely to experience impacts from climate change and that the EU would have to have a role in the matter. From this, it was expected that a white paper would surface before the end of 2008 (EurActiv 2009a). However, it was not until April 2009 that the Commission presented the white paper (Commission of the European Union 2009), stating that the main purpose was to prepare the member states for a more elaborate adaptation strategy to be launched in 2012 (EurActiv 2009b). During the current phase, the EU aims at gathering a comprehensive knowledge base on impacts and consequences, integrating adaptation into EU policies, developing and implementing policy instruments that ensure effective adaptation, and organising international cooperation on climate adaptation (Commission of the European Union 2009).

Beyond this, most European countries have in one way or the other carried out a national vulnerability assessment for climate change. This work is in line with current EU focus on climate adaptation. Norway completed its national climate change adaptation assessment in 2010 (Ministry of Environment 2010). The report suggests a clearer division of responsibilities regarding climate adaptation between various levels of the government and sectors. In Sweden, the situation is similar to that in Norway. Sweden completed its national adaptation assessment in 2007 (Swedish Government 2007), and some of the

recommendations from the assessment were included in the government's bill *An Integrated Climate and Energy Policy: Climate* (2009). For instance, the bill allocates the responsibility for coordination adaptation at the local level to the county administrative boards (Keskitalo 2010b). The 2009 Swedish *National platform for work on natural disasters* requested an assessment of what kind of adaptation work was to be undertaken and at which level of the government (Rydell *et al.* 2010). The assessment found that all levels of the government, central, regional and local, were engaged in climate change adaptation work, although with varying focal points (Rydell *et al.* 2010). The above-mentioned allocation of responsibility for coordination at the county level was questioned in the assessment, and the authors asked whether this coordination should also be done at the central level (Rydell *et al.* 2010).

But the limited central level attention is not the case in all the Nordic countries and Finland is ahead (Keskitalo 2010a, 2010b). Finland adopted its first national adaptation strategy (NAS) in 2005 and is currently revising it. But Finland awaits the EU adaptation strategy before adopting a renewed national strategy. The NAS (Martila *et al*. 2005) is being implemented at the local and regional levels, and adaptation measures are subject to evaluation and monitoring. The Ministry of Agriculture has developed an indicator to evaluate the implementation of the NAS (Juhola 2010). The indicator uses five steps for ranking, where recognition of the need to adapt qualifies for the first step and full implementation of the recommendation in the NAS qualifies for the fifth step.

In addition, legislation with relevance for adaptation has been revised, most notably the Finnish Planning and Building Act (Juhola 2010), somewhat similar to what has been done with the Norwegian Planning and Building Act (Ministry of Environment 2008) as mentioned previously.

Looking beyond the Nordic countries, the UK has been at the forefront in addressing climate adaptation and has passed several pieces of legislation, most importantly the Climate Change Act (2008), which provides directions for climate vulnerability assessments and adaptation measures at different levels. Also, in the UK, like in Finland, adaptation measures are subject to evaluation and monitoring. As part of the central–local coordination of policy areas that are a national priority, the central government tends to monitor the implementation of policy measures through designated indicators. In the UK, adaptation measures in the local government are monitored through a designated indicator (NI 188), as part of a larger set of sustainability monitoring indicators. This indicator uses a scoring system that ranges from one to four, indicating everything from the presence of vulnerability assessments to full implementation and institutionalisation of adaptation. The total has implications for funding from the central level, thereby providing an economic incentive for the local government to implement adaptation (LRAP 2009).

Methods and case-study description

This paper is based on research carried out in the NORADAPT project (2007–2011), funded by the Norwegian Research Council under the NORKLIMA programme. The project is inspired by various frameworks for community vulnerability assessments that recognise the need of local involvement in the research to ensure proper focus (e.g. Berkes and Jolly 2001, Lim *et al.* 2004, Smit *et al*. 2010). Therefore, stakeholders in the municipalities have been involved in the project from the beginning.

The objective of this paper is to investigate *how* climate adaptation measures are adopted and implemented and *why* this is taking place at the local level. For this purpose, a case-study approach (Yin 2003) is appropriate. Through the case-study approach

and an effort to seek long-term involvement with local participants, we have been able to build trust between researchers and the local partners. By considering both exploratory and explanatory elements in the study, we are also in a position to add new knowledge about the processes that drive the implementation of adaptation measures. The sub-national levels of the government in Norway currently consist of 430 municipalities and 18 regional councils. The municipal sector is the most important provider of welfare services, with responsibilities for elementary and secondary schools, basic health care, elderly care, and social security. Land-use planning is, as in the rest of Scandinavia, also a municipal responsibility. The municipalities, therefore, constitute the largest share of the public sector in Norway.

The selection of specific municipalities for a closer study in NORADAPT was based on three criteria: (1) the number of municipalities had to be limited, because the methodology warranted an in-depth case study rather than a broad survey. (2) The municipalities should represent the variety of Norwegian municipalities, urban to rural, central to peripheral, and large to small, and all parts of the country. The classification employed is based on Statistics Norway's (1985) municipal classification criteria. How these features relate to the municipalities selected is outlined in Table 1. (3) The municipalities involved in the study would have to demonstrate some form of commitment towards addressing adaptation to climate change. In some cases, this was expressed through passing a "resolution" in the municipality to be active in the project. The last criterion likely excluded a majority of Norwegian municipalities, because only a few municipalities had considered the need for

Table 1. Key characteristics of the case municipalities.

Municipality	Commercial structure	Approximate population	Population size	Physical geography	Region	Urban/ rural
Fredrikstad	Central, mixed services and industry	72,000	Large	Freshwater and coast	East	Urban
Hammerfest	Less central, services	9500	Medium	Coast	North	Rural
Voss	Less central, mixed services and industry	14,000	Medium	Inland, agro-pastoral landscapes and freshwater	West	Rural
Flora	Less central, mixed services and industry	11,300	Medium	Coast	West	Rural
Bergen	Central services	257,000	Large	Coast	West	Urban
Stavanger	Central, mixed services and industry	93,300	Large	Coast	West	Urban
Unjárga/ Nesseby	Less central, mixed services and industry	900	Small	Coast and mountains	North	Rural
Høylandet	Less central, primary sectors	1300	Small	Agro-pastoral landscapes, forest, and freshwater	Middle	Rural

adapting to climate change at the time the project commenced (see e.g. Berglund and Nergaard 2008).

The location of the municipalities selected is shown in the map in Figure 1.

While the sample is small, the municipalities are representative of the broad variety of sizes and locations found in Norway. Furthermore, these municipalities are exposed to the same type of national regulation and policy as all other municipalities. Given our selection of municipalities that showed commitment to addressing climate adaptation, our findings are not readily applicable to all Norwegian municipalities. Nevertheless, they lend themselves to comparisons of how local authorities implement adaptation both in Norway and in other countries.

In the process of data collection, we carried out 28 individual interviews, 1 group interview with seven participants, annual surveys (over 3 years) mapping the progress in the

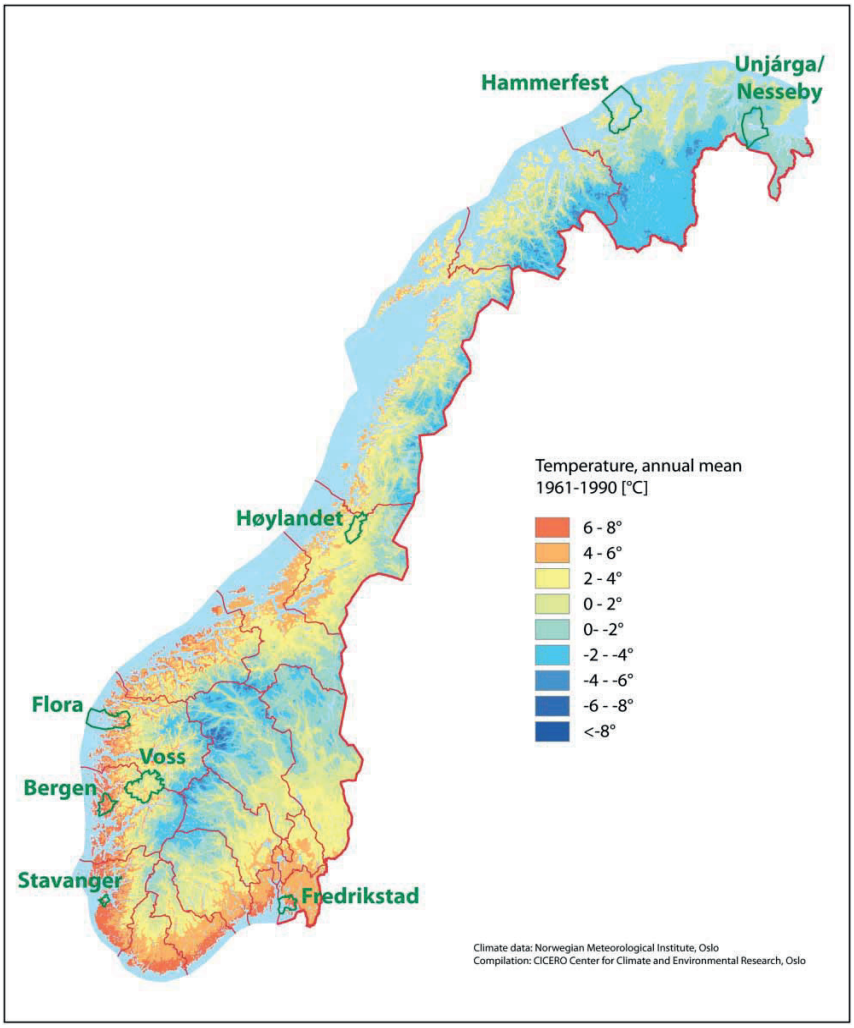

Figure 1. Map showing the case municipalities in Norway.

municipalities, and 3 annual workshops with one to two participants from the case municipalities. In addition, the study included the minutes from the meetings held in the municipalities, logs of email and phone conversations, formal proposals to the municipal councils, council resolutions, and municipal plans for spatial development, climate, energy, and environment.

Climate adaptation measures implemented in the case municipalities

Adaptation to climate change has been added to the agenda in all the municipalities albeit with considerable variation in implementation levels and efforts, as outlined below. They have all passed resolutions for carrying out vulnerability assessments and developing adaptation strategies, or included such measures in strategic documents. But where adaptation actually materialises varies from one municipality to the next. Some municipalities have selected a few of its sectors or geographical areas, while others have tried to cover the entire municipality in terms of both sectors and geography. Some municipalities have commissioned costly assessments for natural hazards and developed tools and methods to assess climate risks, while others have utilised relevant assessments commissioned previously for different aims. In general, our partners in the municipalities expressed a lack of capacity to assess vulnerability to climate change and planning. They also expressed a need for clearer signals from the central government on the extent of municipals' responsibilities for adaptation, in addition to support for assessing physical consequences of climate change, such as estimates of changes in risks for flooding, inundation, mud flows, and storm surges.

Four steps in the implementation of adaptation

Inspired by the UK government's and the Finnish government's indicators for adaptation (NI 188; Juhola 2010), a four-step indicator for measuring the degree of implementation of adaptation was developed. The indicator also reflects the heuristic definition of the stages of policy-making, from problem formulation to implementation (e.g. Sabatier 2007). This indicator allows us to give the municipalities scores and thus compare them in terms of climate adaptation measures. It also allows us to look more closely at factors that offer an explanation for why they score differently. The indicator involves the following four steps:

(1) *Assessment of the need to adapt in some sectors*. Achieving this score requires that the municipality formally decide that it needs to assess its vulnerability to climate change and plan possible adaptation. These decisions could be expressed through a council resolution, declaration from the mayor, or a statement in a municipal plan.
(2) *Qualitative vulnerability assessments and/or adaptation measures identified in plans*. This score could be achieved either by carrying out qualitative vulnerability assessments for climate change and/or by identifying adaptation measures in municipal plans. Qualitative vulnerability assessment refers to an evaluation of information and data (such as climate scenarios and hydrological or geological data) by specialists in the municipality or external experts. A vulnerability assessment can be both for selected natural hazards such as avalanches and floods and for parts of the municipalities or for one covering all weather and climate elements for the whole of the municipality. General RVAs that do not explicitly address climate change do not qualify for this step.

(3) *Quantitative vulnerability assessments, adaptation measures identified in plans, and adaptation measures implemented in regulations*. By quantitative vulnerability assessments, we mean assessments that include modelling of climate change impacts such as flood risks, sea level rise, surface water accumulation, and avalanches. These could also include methods for assessment and quantification of climate change risks. The step requires that adaptation measures be identified in municipal plans and that municipal regulation take adaptation into account.

(4) *Structural measures and/or adaptation mainstreamed into regular planning processes*. To qualify for this score, the municipality must have completed all the other steps as well as mainstreamed adaptation into its planning processes. If reactive measures are to be included in the qualification for this step, the measure also needs to be justified by the expected impacts of climate change.

By applying this set of indicators, the categorisation of adaptation achievements becomes clearer and enables us to better analyse the factors explaining different degrees of implementation. In the following section, we first present the municipalities' adaptation measures separately and then summarise them in Table 2.

Fredrikstad municipality

Fredrikstad has been a forerunner in environmental policies since the early 1990s and has continued in the same vein with adaptation to climate change. By virtue of the following measures, Fredrikstad achieves step 3 on the set of indicators. The municipality has been actively engaged in finding ways to assess impacts of climate change and implement adaptation measures. Fredrikstad has also carried out an extensive vulnerability assessment that outlines adaptation needs and measures. These efforts have mainly been initiated and coordinated by the municipality's environmental advisor. The assessment is based on qualitative interpretation of downscaled climate projections, socio-economic scenarios, and extensive input from the municipal sectors. The result is implemented in the municipal

Table 2. Achievement scores of the case municipalities on adaptation implementation.

	(1) Need to adapt recognised in some sectors and some adaptation measures identified	(2) Qualitative vulnerability assessments and/or adaptation measures identified in plans	(3) Quantitative vulnerability assessments and adaptation measures identified in plans and implemented in regulations	(4) Structural measures (not reactive) and/or adaptation mainstreamed into regular planning processeses
Fredrikstad	X	X	X	
Hammerfest	X	X	X	
Voss	X	X		
Flora	X			
Bergen	X	X	X	
Stavanger	X	X	X	X
Unjárga/ Nesseby	X			
Høylandet	X	X		

Note: 'X' indicates that the municipality has scored on specific step.

plan under the section on societal development. The municipality has not formally implemented regulatory measures, but the municipal plan provides guidelines for assessment and adaptation measures for property development in flood- and inundation-prone areas. Furthermore, the municipality has included climate change considerations in its RVA guidelines. Fredrikstad is taking part in a network of the largest urban municipalities in Norway, "Cities of the Future", led by the Ministry of Environment. In this network, adaptation to climate change is one of the four topics.

Hammerfest municipality

According to municipal officials, Hammerfest has been concerned with impacts of weather since the city was founded and scores a "3" like Fredrikstad. Being concerned about the possible consequences of climate change is an inherent part of long-term city planning. The municipality has an environmental advisor and a head of planning who have been eager to include adaptation in the agenda. Adaptation to climate change is currently included in the land-use planning part of the municipal plan. The plans emphasise the need for taking sea level rise into consideration in oceanfront developments and the need for avalanche protection in steep areas that are prone to such events. The municipality has over the years invested heavily in avalanche protection, mostly as a reactive measure. The municipality has recently decided to raise the minimum distance from the sea level for new building projects, a proactive measure. The municipality has utilised downscaled projections for future conditions for assessing the need to carry out these measures.

Voss municipality

Voss has carried out a qualitative assessment of climate change impacts on the municipality, with emphasis on agriculture. The assessment has utilised downscaled climate projections. The results from this work are included in the municipal plan's section on agriculture. Furthermore, the municipality's RVA guidelines have been updated to include parameters for climate change impact. Voss scores at step 2 on our set of indicators.

Flora municipality

Although Flora has been concerned with adaptation to climate change for a number of years, the municipality only achieves a score of 1. In 2004, Flora started out by addressing the need for adaptation to climate change and became involved in several research projects. It carried out a climate-focused RVA assessment for part of the municipality, which resulted in some restrictions for property development close to the sea in that area. In 2008, the official who was the driving force behind these efforts, left his position, and since then Flora has not taken any further action regarding vulnerability assessments or identifying and implementing adaptation measures.

Bergen municipality

Bergen has its own climate unit and participates in many projects covering sea level rise, water supply and outlet systems, river floods, and surface water handling (Bergen Municipality 2010). The non-structural climate change adaptation measures in Bergen consist of both regulations and tools. A separate chapter on climate change adaptation has been included in the municipality's Climate and Energy Action Plan (Bergen Municipality

2010). Climate change adaptation is also anchored in the two sections in the Municipal plan – land use and civil protection and emergency planning. One example of land-use planning is that Bergen, being a coastal municipality, has raised the allowed altitude under which construction is prohibited. The municipality has also established new routines whereby case workers in the planning sector have mapping tools to assist them when handling applications in order to identify potentially exposed areas.

In addition, Bergen has recognised a need for structural measures. Physical installations are planned in connection with sea level rise and water and sewage. Additionally, one river is particularly exposed to flooding, largely because of human activities (Bergen Municipality 2006, 2008), and thus flood prevention is necessary. Bergen is also taking part in the Cities of the Future network. With the implementation of these measures, Bergen achieves a 3 on our set of indicators.

Stavanger municipality

Stavanger is the only municipality that achieves a score of 4. Adaptation to climate change is an assigned task for the municipality's emergency preparedness section, and one of the officers in this section coordinates adaptation across various municipal departments. This section is responsible for implementing and coordinating emergency preparedness and security strategies across all municipal units and sectors to which adaptation to climate change has been added. Adaptation to climate change is included in the municipal plan, and adaptation measures are outlined in the municipality's economic action plan and water and sanitation plan. The municipality has developed tools and methods for assessing climate change risks and vulnerabilities. Two regulatory measures have been implemented: (1) increased minimum building distance from the sea level and (2) all new property development projects are required to not increase the amount of water in the drainage system, for the drainage system to be able to handle the expected increase in future extreme precipitation events. The municipality has also implemented an organisational measure: it requires that all relevant staff undergo training in climate adaptation GIS tools and climate RVA methods. Stavanger is also taking part in the Cities of the Future network.

Unjárga/Nesseby municipality

The municipality has relied heavily on research project involvement in its efforts to assess its need to adapt to climate change. The municipality has done an informal (not documented) assessment of the downscaled climate projections provided by the NORADAPT project and has decided that it does not need to take any further action. Municipal officials have also noted that it does not have the resources to carry out any more comprehensive climate change vulnerability assessment. Thus, Unjárga/Nesseby is only placed at step 1.

Høylandet municipality

Høylandet is currently revising its municipal plan and climate change adaptation has been included in the section on civil protection. The municipality has used downscaled climate scenarios as input in its climate change adaptation work. It has also carried out flood risk assessment for the municipality. Actual measures have not been implemented yet. So far, the work has consisted of assessing the potential adaptation needs for the different municipal sectors. Some non-structural measures, such as additional mapping of areas exposed to flooding and erosion, better information to land owners, and revision of routines for

construction work, have been suggested. In addition, structural measures such as improved walls along the rivers, increased pipe dimensions, and more robust docking facilities have been considered. But no measures, non-structural or structural, have been implemented. This leaves Høylandet at step 2 on our set of indicators.

The summary of the implemented adaptation measures in these eight municipalities given in Table 2 clearly shows that there are considerable differences in how much the municipalities have achieved when it comes to assessing vulnerability to climate change, developing adaptation strategies, and implementing these in the municipalities.

Explanation for implementation

The results show that a vague approach to climate adaptation at the central level does not automatically exclude the topic from the municipal agenda. We and others (Amundsen *et al.* 2010) found that Norwegian municipalities consider and implement climate change adaptation measures on their own initiative. These results contradict the concept of the executing municipality and show that in some areas or in some municipalities there is room for local initiative.

This begs the question of why we find climate adaptation measures in the absence of clear "orders" from the central level of the government. In general, it has been expressed from all our local project participants that it is challenging to apply climate change projections for making vulnerability assessments, let alone using them as a basis for adaptive measures. The motivation for municipalities to take on adaptation varies. For the municipalities that have reached only step 1 or 2 on our set of indicators, we found that researcher involvement was an important factor. Our partners in these municipalities state that researcher involvement is the main explanation for including adaptation in the agenda in their municipality. This participation has prompted awareness about climate change adaptation in the municipalities and has facilitated the use of scientific knowledge such as climate projections. For these municipalities, we argue that participating in the research project has been decisive. A partner in Unjárga/Nesseby, for example, stated that "without NORADAPT, we would not be working on adaptation", echoing what we have heard in Voss and Høylandet. For Flora, the one decisive variable was an engaged individual driving the adaptation process.

For those municipalities that have reached steps 3 and 4, the researcher involvement has had impact as well, but only as an added factor. In these municipalities, there are several factors that are affecting their work on climate adaptation, leading to a score on the set of indicators. We found that they have sufficient resources, capacity to seek external expertise, involvement in municipal networks related to climate change issues, and engaged individuals with dedicated positions to deal with environmental or security issues. Size emerges as a key determinant. It is the larger municipalities that have more than one "leg to stand on" in their climate adaptation work.

Fredrikstad, for example, commissioned an additional study of socio-economic scenarios beyond what was developed in the project (Sælensminde *et al.* 2010). The environmental advisor in Fredrikstad has been a moving force in engaging the municipality in several research projects on adaptation. Similarly, both Bergen and Stavanger hired external experts to carry out large, quantitative studies of climate vulnerability. In contrast, smaller municipalities, such as Høylandet, Voss, and especially Unjárga/Nesseby, have not had any long-term involvement of experts.

Municipal staff in planning departments who are assigned with the responsibility of handling adaptation in the smaller municipalities mainly devote their capacity to tasks

that they are legally obliged to do. As long as laws and regulations do not require adaptation, it receives less priority than other tasks.

Even if all informants note that their administration lacks both financial and human resources and capacities, the municipalities differ in the resources available to them. Larger municipalities have dedicated environmental officials (Hammerfest, Fredrikstad, and Bergen) or emergency provision officers (Stavanger). These positions open up for devoting time to tasks according to their own priorities and judgements and across municipal sectors and departments.

In addition to having a larger administration and dedicated personnel, the larger urban municipalities are more strongly connected to the central level of the government through various networks, such as Cities for the Future. In this project, climate change adaptation is one of the four topics resulting in a stronger focus in the participating municipalities. Here, they can also exchange experiences with other municipalities that do not necessarily share the same climate change impacts, but face similar "bundles" of challenges such as population growth, demands for densification, and needs for better transport systems – challenges that all have to include the climate change adaptation dimension. That being said, some of the smaller municipalities are involved in inter-municipal networks and cooperate with other municipalities on environmental and climate issues. For example, Høylandet is preparing its climate and energy plan in cooperation with five other small municipalities in the region Indre Namdalen Regional Council.

A factor that has not been given much attention so far in this paper is reactive adaptation measures. We define reactive adaptation as responses to weather- and climate-related events and accidents. Several studies have found that that local level adaptation is to a large degree a reactive phenomenon (Næss *et al.* 2005, Penning-Rowsell *et al.* 2006, Amundsen *et al.* 2010). In Norway, this means that municipalities that have to deal with extreme weather events (i.e. floods) are more likely to have some kind of adaptation policy, more specifically policies aimed at reducing vulnerability to future climate change. In this study, this is the case for Bergen and Hammerfest, both of which have a long history of dealing with extreme weather events. But as our results show, other municipalities with less experience with extreme weather events have implemented as many adaptation measures as these municipalities. From this, we argue that experience with extreme weather events is only one of the factors affecting the implementation of climate adaptation measures.

Conclusion

Adaptation to climate change is still in its infancy in Norway. This study has explored how the first movers at the municipal level have implemented adaptation measures, despite the lack of clear signals from the central level of the government. Our study does not support the notion that municipalities in general only execute central regulations. However, the extent to which municipalities go beyond regulations is closely related to the size of the municipalities and the financial and human capacity. We found that the larger municipalities have moved beyond "the call of duty" with respect to their work on climate adaptation and have taken concrete action beyond what is expected of them within central regulations. We, therefore, argue that the concept of the executing municipality (Fimreite and Lægreid 2005) does not provide a viable explanation for the spectrum of climate adaptation work we have found in the case municipalities.

With this in mind, we have analysed how far the municipalities have taken their climate adaptation work. Among the municipalities, we found that adaptation is only to a lesser degree implemented in planning routines and procedures. By developing an indicator for

the levels of adaptation implementation and using this for ranking the achievements of the case municipalities, we have been able to compare the municipalities and highlight factors that offer an explanation as to why the municipalities are at different levels in their climate adaptation work.

We found that the implementations are determined by a number of factors and participation in research projects emerges as important for those municipalities that only achieve score 1 or less. Additional salient factors include the efforts of individuals within the municipal organisation, network participation, access to resources, use of external expertise, and previous experience with extreme weather events. How many of these factors are present in each case municipality affects how far in the implementation process the municipality has come. Our findings demonstrate that there is more to climate change adaptation than merely reactive responses and raise new questions regarding how scientific knowledge should be used in municipal decision-making and regarding the role of institutional capacity for turning this knowledge into action.

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The regional level as boundary organization? An analysis of climate change adaptation governance in Norway

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Abstract

This paper investigates how a requirement for regional government to coordinate adaptation planning has been interpreted and implemented. Using the theory of boundary organization applied to a multi-level context, and using four counties in Western Norway as a case, the paper develops a framework for assessing how regional level governance actors can support local level implementation of climate change adaptation through boundary work. Even though adaptation is not treated as a salient issue in most of the municipalities studied, regional level coordination efforts are creating a hybrid management space that aids mediation between local knowledge and expert adaptation knowledge. They thus hold the potential for better local level adaptation planning.

Keywords: boundary work, climate change adaptation, regional planning, adaptation governance

1. Introduction

It is increasingly evident that society will have to face the consequences of climate change (IPCC, 2013), and in response most countries are developing policies and measures for adaptation (Berrang-Ford et al., 2014). "Autonomous adaptation" is a response individuals and also private and public actors undertake as a consequence of climate change, while plans, policies and measures developed to make society less vulnerable to the impacts of climate change are "planned adaptation" (Füssel, 2007). In the rest of this article adaptation refers to the latter definition. Adaptation planning is a policy issue resting strongly on climate science and has thus become comprehensible mainly through abstract scientific models (Hoppe and Wesselink, 2014). Adaptation planning has therefore developed to become a very rationalistic form of public policy. Various institutional arrangements for the strengthening of the science-policy interface, or boundary arrangements, in the climate policy field have been developed (Hoppe and Wesselink, 2014; Jasanoff, 2010). The Intergovernmental Panel of Climate Change (IPCC) is itself an example of this.

While it has been widely recognized that planned adaptation is a multi-level governance issue (Biesbroek et al., 2010; Juhola, 2010; Keskitalo, 2010), research on adaptation governance has tended

to focus either on the local or the national governance levels; while regional adaptation governance, with a few exceptions (e. g Hanssen et al., 2013; Termeer et al., 2011), has received limited attention. The local level of government has been deemed a key actor for adaptation (Urwin and Jordan, 2008). This also points to the role of municipalities as principal spatial planners in the Nordic countries. However, the approaches to adaptation vary considerably between municipalities (Rauken et al., 2014), often adaptation garners limited attention from the public (Hjerpe et al., 2014) and it is perceived to compete with other, more pressing planning concerns (Dannevig et al., 2012; Nilsson et al., 2012). Research has also shown that huge discrepancies exist between the extent municipalities in the Nordic countries are able to adapt (Amundsen et al., 2010; Dannevig et al., 2012; Glaas et al., 2010; Wejs et al., 2013), which also points toe weak coordination from the national government (Dannevig et al., 2013; Wejs et al., 2013).

As a response to the mixed success with local adaptation, there has been a call for stronger involvement at the national level (Amundsen et al., 2010; Corfee-Morlot et al., 2011), stronger coordination between levels and across sectors (Hanssen et al., 2013) and a strengthening of knowledge provision through various boundary arrangements that link experts and knowledge users for the purpose of producing knowledge for policy-making (Corfee-Morlot et al., 2011; Hoppe and Wesselink, 2014). Boundary arrangements and work exist in various forms at various levels in society, wherever there is a need to involve experts in the production of knowledge for policy-making or implementation (Hoppe and Wesselink, 2014). There have been few studies discussing the importance of boundary work and arrangements in climate change governance at the regional scale and local scale; critical attention has focused overwhelmingly on the national and/or global scale (e.g Corfee-Morlot et al., 2011; Miller, 2001).

The Norwegian green paper on adaptation called for stronger efforts in supporting local authorities to both carry out vulnerability assessments and develop climate change adaptation strategies, and the various branches that constitute the regional level of governance have been deemed the 'appropriate level' for conducting this support (Hanssen et al., 2013; MoE, 2010). In the context of this paper we apply the meaning of region as a sub-national level of governance.

In Norway, the county councils are investing considerable effort into developing comprehensive plans on renewable energy production, climate change mitigation and climate change adaptation (Aall, 2012), which have the potential to bridge scientific climate change knowledge to the local level of governance. However, little knowledge exists on how regional authorities can support and coordinate adaptation planning at the local level of governance, and the use and effectiveness of different means of coordination (Hanssen et al., 2013). The role of the regional authorities in environmental governance in general has not been a high priority and is hence underdetermined, partly related to the fact that the role of the regional level of governance varies considerably internationally (Lafferty and Narodoslawsky, 2003; Termeer et al., 2011).

This articles contributes to existing research on climate change governance (Bulkeley and Betsill, 2005; Cashmore and Wejs, 2014; Urwin and Jordan, 2008) by examining how regional government in Norway has interpreted its role in coordinating climate change adaptation. Drawing on concepts from research on boundary work, it critically assesses how regional government in Norway have configured boundary arrangements between scientific and policy communities. Our study is addressed by means of analyzing the nature and extent of boundary work (i.e. the translation, mediation and communication) that regional government actors engage in through their efforts in coordinating

adaptation. Empirically, the research involves a review of on-going spatial planning processes in six municipalities from four counties in Western Norway.

The remainder of the article unfolds as follows. Firstly, we develop a conceptual framework and analytical vocabulary for analyzing boundary arrangements in spatial planning policy networks involving representatives of the local and regional levels of governance, drawing upon planning theory and research on boundary work. Secondly, institutional and organization arrangements for spatial planning in Norway are succinctly outlined. The research methodology is then described, followed by an analysis of the nature and extent of boundary work performed by the means of coordination that regional government employs. Finally, we provide a concluding discussion on the usefulness of including concepts of boundary work in studies of adaptation governance and present ideas for further research.

2. Conceptual and analytical framework

2.1 Knowledge utilization in a multi-level governance context

Spatial planning, as manifest in the Nordic countries, is a typical case of *multi-level governance*. The idea of *multi-level* implies the involvement of multiple geographical levels of action (e.g. local, regional and national – in some cases also international). *Governance* is a theoretical concept that emphasizes the changing role of the state in coordination and steering, which involves both state and non-state actors at different levels (Kooiman, 2003; Pierre, 2000). There are several definitions of governance, but they all agree on the blurred boundaries between public and private actors role in the process of governing (Stoker, 1998)

The role of regional government institutions in spatial planning has changed over the last decades, and the move from hierarchical policy implementation to multi-level governance means that spatial development is increasingly shaped by a mixture of actors for the purpose of economic growth and development (Friedmann, 1963; Galland, 2012). As a consequence, the regional level no longer exercises control over the local level (Galland, 2012; Glasson and Marshall, 2007). Experiences with environmental governance has displayed that this is not a one directional process from the national scale through to the regional to the local-scale, but that agendas can emerge at the local scale and end up as national policies (Aall et al., 2007).

The role of scientific knowledge for spatial planning has also been changing. Historically, regional spatial planning was presented as a policy area that should be conducted according to scientific principles, from Walter Christaller's "Central place theory" to Torsten Hägerstrand's space-time accessibility theory implemented by command and control (Haynes and Qian, 2010). But this conception of the role of science in spatial planning has been replaced by the introduction of governance principles that place stronger emphasis on non-state actors and the market as a force for spatial development. On the other hand, regional governance processes do, and perhaps to an increasing extent, involve scientific knowledge: e.g. for carrying out risk assessments and environmental impact assessments. It is still expected that such scientific assessments can deliver the correct answer on conflict ridden policy issues or reduce uncertainty associated with policy choices (Galland, 2012). Also, as part of the reduced power of the regional level, "softer" means of coordination, such as guidance and knowledge provision, are replacing "harder" means of coordination, such as regulations (Hanssen et al., 2013).

The dominant belief has been that clear and true scientific knowledge is sufficient for policy to be effective (Petersen et al., 2011). In developed countries, it is taken for granted that policies are based

on evidence, i.e. science, because it is assumed that science can deliver impartial, value-free and objective advice to policy makers (Wynne, 2002). This has contributed to providing science with an elevated and unique position in modern societies (Latour, 1993; Yearley, 2005). The "linear knowledge to action model" (Petersen et al., 2011; Wynne, 2002), or "technocratic ideal of science advice" (McNie, 2007) assumes that problems can be solved given sufficient reliable knowledge. Climate change is perhaps the clearest example of the failure of this model. This does not mean that scientific knowledge cannot provide directions for policy and governance. But in order for it to do so, care is needed to ensure that the knowledge that is being produced is salient, credible and legitimate (Cash et al., 2003). In this context, *salience* refers to the extent that the co-produced knowledge is viewed as useful and relevant for the users; *credibility* refers to the scientific integrity of the knowledge and *legitimacy* requires that the users values and world views are respected (Cash et al., 2003).

2.2 Boundary arrangements in policy networks

Boundary work as well as various arrangements or the establishment of institutions to carry out this, so called *boundary organizations,* have been viewed as a solution to complex, knowledge dependent governance issues, such as climate change (Corfee-Morlot et al., 2011; Miller, 2001; Pelling, 2011). The term boundary refers, in this context, to the boundary between science and non-science. It is associated with the deliberate mediation, translation and communication between the two social worlds of science and policy in order to produce legitimate, salient and credible knowledge to solve policy problems (Cash et al., 2003; Hoppe and Wesselink, 2014). Purposeful negotiation of the boundaries between science and policy is required in order to produce knowledge fit for policy-making, because scientific knowledge is not conceived as "real" without institutions and social practices legitimizing it (Jasanoff, 2004). When organizations purposely are set up to carry out boundary work, they are deemed *boundary organizations*. In order to mediate and negotiate the boundary between science and policy, they require accountability to both social worlds (Guston, 2001). However, it is evident that boundary work is also carried out outside of dedicated boundary organizations, through various arrangements intended to provide knowledge for policy decisions (Hoppe and Wesselink, 2014).

The concepts of *mediation, translation and communication* are thus central to understanding boundary work and central for achieving mutual accountability for the outcome. Active and inclusive *communication* between experts and policy makers is necessary to mobilize knowledge for action (Cash et al., 2003). Cash and colleagues also found that users that were not communicating with experts tended to reject the information they conveyed. Good, two-way communication is necessary for ensuring both salience, credibility and legitimacy of knowledge among policy makers and other users (Cash et al., 2003). Systems for *translations* of knowledge between users and experts are also vital for ensuring the credibility of the knowledge produced, as a mutual understanding of the issues at stake is paramount. This also requires that the users' knowledge is translated and provided to the experts (Cash et al., 2003). Legitimacy of the knowledge that is produced hinges on successful *mediation* of conflicts that arise from efforts to achieve credibility and salience and that the outcome is respectful to all participants. Mediation is a key component of the management of the boundaries between science and policy, in negotiating the exact position of the boundary and keeping it porous in the right places (Cash et al., 2003; White et al., 2010).

Boundary work also necessitates the creation of *boundary objects* or *hybrids,* entities which are shared between two realms – such as policy and science – or objects that "simultaneously inhabit independent but intersecting social worlds" (Cash et al., 2003; Guston, 2001). Examples of boundary objects pertaining to adaptation include various tools for decision makers and spatial planners, for instance

GIS-tools for natural hazard identification or guides for how to take sea level rise into account for spatial planning in coastal areas.

The concept of boundary organization has been criticized for over-universalizing the social worlds of science and politics and for having failed to capture "hybrids" consisting of elements from both science and politics (Miller, 2001). Literature on boundary organizations has also been criticized for overlooking the fact that boundary arrangements and organizations are very different from each other depending on what purpose they served and what disciplines they include (Clark et al., 2011; White et al., 2010) and must be tailored to the policy network it is to be applied within (Hoppe and Wesselink, 2014). A boundary organization set up to serve agriculture might have to be quite different from a food safety committee that decides threshold values on level of chemicals in food.

In this paper we choose to focus on boundary work in terms of translation, mediation and communication, as it is carried out outside formalized organizations with dual accountability to science and policy in place (see Table 1).

TABLE 1. OUTLINE FOR A FRAMEWORK FOR ASSESSING BOUNDARY WORK

	Boundary work			
	Translation	**Mediation**	**Communication**	**Boundary object employed**
Means of coordination that include knowledge provision or production	Is knowledge translated across the boundary? One or two ways?	Does mediation takes place? Is legitimacy ensured?	Are users involved in knowledge production? Is salience achieved through communication?	Do the means of coordination involve a boundary object?

2.2 Adaptation to climate change as an aspect of regional planning in Norway

Adaptation planning is a relatively new policy area in most countries. Norway published its first green paper on adaptation in 2010 (MoE, 2010), and a white paper to the parliament (Storting) in 2013. There is no designated national adaptation strategy, similar to that we find in for instance the UK (UK Environmental Agency et al., 2008). The Norwegian government's position has been, and still is, that each sector and level of government has an independent responsibility to assess vulnerability and develop adaptation strategies (MoE, 2010). Thus, the Norwegian policy approach is that there is no need to distribute the main responsibility for adaptation to one specific public body. Still, the effort on natural hazard mitigation has been strengthened, and changes in the planning legislation made in order to strengthen work on adaptation; e.g. it is now mandatory to take rising sea levels and changes in river flood regimes into account in municipal spatial planning. Research institutions and designated boundary organizations, such as the Governmental Climate Change Adaptation Secretariat (GAS) and the Norwegian Water and Energy Directorate (NVE), have produced a large amount of tools and guidance material – all of which are made available at a designated website (www.klimatilpassing.no). The guidance has included, for example, downscaled climate change projections, GIS-tools for climate related hazards and step by step guides for taking certain climate related hazards into account in spatial planning (available at www.nve.no).

The Norwegian three-tier system of governance consists of the national government, elected county councils at the regional level, and municipalities with elected councils. The country councils have limited powers, but there is a high degree of agency and autonomy at the local level. The national government has a regional representative, the county governor, in each of the counties, who oversees the legality of municipal governance arrangements and tracks national policy implementation at the regional level. The county governor has the power to reject a municipal spatial plan if it does not adhere to national laws and regulations by entering a formal objection when the municipal spatial plan is submitted to public hearing. The county council also makes regional plans that are supposed to guide the content of municipal spatial plans. The NVE's regional branch provides guidance to municipalities on mitigation of flood and avalanche risks, and also checks that municipal plans are taking these risks into account.

The hard mode of coordination, the power to place an objection, is available to all actors, but in relation to spatial planning and adaptation, is only applied by NVE and the county governor. All actors have soft modes of coordination such as supervision, guidance and information at their disposal.

3. Methods and cases

This paper reports a case study from Western Norway. Western Norway is relevant for studying adaptation to climate change, due to the steepness of the landscape, its rivers and large number of coastal communities and cities that are exposed to various types of landslides, avalanches, flood and storm surges. This makes Western Norway a unique laboratory for studying a broad range of important aspects of the challenges society is facing due to climate change and natural hazards.

The study is carried out on multiple levels: The county councils and county governors in four counties (Rogaland, Hordaland, Sogn og Fjordane and Møre og Romsdal), see figure 1, as well as embedded-case studies of ongoing spatial planning processes in six municipalities in each of these counties, see Table 2.

As there also are a number of embedded cases involving municipalities, the number of counties in the study had to be limited in order to have a manageable number of cases for studying boundary work.

Semi-structured interviews were conducted with spatial planners, environmental officers and emergency provision officials in the municipalities (n=6), the county council administration (n=3) and county governor administration (n=4). Interviews were not carried out in one county council because they did not engage in adaptation related activities at the time. Neither was an interview conducted in Nesset due to changes in personnel and postponement of the planning process.

Furthermore, a detailed review of six ongoing municipal spatial planning processes was carried out in six municipalities (see table 2). The following documents have been analyzed: 1) Review of municipal spatial plans (n=14); 2) regional (county level) plans (n=4) and risk and vulnerability assessments (RVAs) (=4), and 3) review of minutes from bi-monthly, cross-sectorial planning meetings in four counties (from 2008-2013). Finally, the study also compiled a record of objections by the county governors on municipal spatial plans from the five year period from 2008 to 2013.

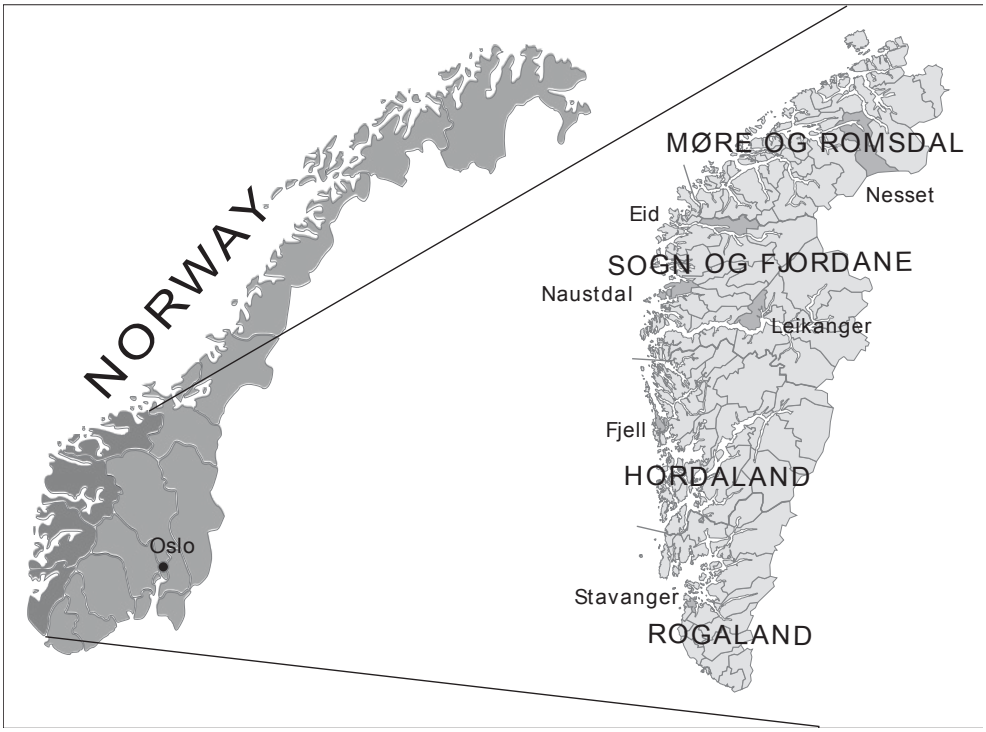

Figure 1: Map of the case study counties and municipalities in Western Norway.

TABLE 2. ONGOING LOCAL PLANNING PROCESSES STUDIED.

County	**Municipalities**	**Type of planning process**	**Principal natural hazards**
Møre og Romsdal	Nesset	Municipal sub-plan	Marine clay slide
Sogn og Fjordane	Naustdal	Municipal sub-plan	Storm surges, slush avalanche, rock fall
Sogn og Fjordane	Leikanger	RVA	Mud slide, flash floods
Sogn og Fjordane	Eid	RVA	Storm surges
Hordaland	Fjell	Private zoning plan	Flash floods
Rogaland	Stavanger	Municipal sub-plan	Flash floods

The data was analysed using a framework for assessing boundary work inspired by Cash and colleagues (2003) and Hoppe and Wesselink (2014). First, applying document analysis and interview data, the means of coordination were assessed in respect to how they included elements of communication, translation and mediation as defined in the framework (see table 1). Interview

transcripts and documents were coded using tables with keywords for activities that corresponded to either: translation, communication and/or mediation and features that qualify as boundary objects. For instance, a dialogue between the county governor and a municipal planner over measures to provide protection against sea level rise and storm surges through regulations in a spatial plan would be deemed mediation.

4. Results

We have analyzed three main categories of regional coordination of adaptation planning, outlined in the subsections below: 1) Checking and guidance of municipal spatial plans; 2) Production of regional reports and plans; and 3) Organize events, seminars and meetings.

4.1 Checking and guidance of municipal spatial plans

Checking a plan refers to the county governor and NVE having a mandate to approve of or object to a local spatial plan. This can be done in the preparatory stages of the plan (formalized by checking the "planning strategy" document) and during the public hearing of the actual plan. A formal comment to the planning strategy can be used to notify the municipality that changes would have to be made to the actual spatial plan in order to avoid an objection. A typical reason for disapproving a plan could be a lack of consideration for the possible effects of climate change on the risks of natural hazard events in mandatory risk- and vulnerability assessment, e.g. not taking notice of the possible impacts of sea level rise on storm surge events (three examples of the latter were identified in our study).

Both our local and regional informants stated that municipal planners rarely consult the regional level on issues concerning adaptation planning. When such consultations happen,it is, in most cases, a result of formal comments from the regional authorities. Thus, it appears that a real dialogue occurs primarily as a result of regional authorities threatening to disapprove the local plan in question. Two of the municipalities, Naustdal and Stavanger, had assessed adaptation needs in the plans reviewed in this study. We found large variations between the four regions as well as between the three regional bodies (the county governor, county council and NVE) with respect to how the involved bodies interpret and conduct their mandate when it comes to checking of, and issuing guidance on, municipal spatial plans.

TABLE 3. OBJECTIONS FROM REGIONAL AUTHOIRITIES PLACED ON MUNICIPAL SPATIAL PLANS FROM 2008 TO 2013.

County	Number of plans (spatial plans and planning strategy documents)	Number of objections due to a lack of adaptation planning policy(ies)	Share of objections compared to total numbers of plans
Sogn og Fjordane	248	10	4 %
Hordaland	571	1	0 %
Rogaland	730	5	1 %
Møre og Romsdal	542	5	1 %

The county governor in Sogn og Fjordane stands out as the regional authority that most frequently utilizes its formal right to issue formal objections towards spatial strategy documents and spatial plans

(almost seven times more frequent than the average for the three other regions). The county governor has previously stated that it wanted to be in the forefront on climate change adaptation in a national context. Hordaland is situated at the opposite end of the scale. According to our informants, this is because the county governor in Hordaland prefers to provide guidance and let the municipality concerned rectify the issue on a voluntarily basis. The municipal spatial planning processes followed in this study, as well as two other spatial planning processes reviewed in Hordaland, confirm the use of this softer approach. The county governor did not make any formal comments on the obvious lack of consideration towards the possible impacts of climate change on urban flooding and sea level rise. However, the county council in Hordaland proved to have the most active engagement in guiding municipalities on adaptation among the studied county councils.

The interviewed representatives from the county governors stated that they preferred to use adaptation related information resources provided by national government agencies (such as NVE and GAS) prior to that of research institutions, even if the latter is more advanced and provides more detailed and customized information. As one informant said: "It is kind of more official if it is NVE that has published it, rather than a research institute." Thus, knowledge provided by national government agencies like NVE and GAS is viewed by the regional authorities as both credible in terms of scientific integrity and legitimate in terms of suitability for use in the policy interactions with local authorities regarding spatial planning. Online tools for downscaling climate change scenarios, presentation of avalanche risk mapping and sea level rise tables provided by theses national government agencies are thus typical boundary objects, as they combine expert knowledge and user knowledge when they are being used.

4.2 Production of regional reports and plans

The county governor and the county council administrations both have a formal mandate to conduct planning at a regional level, in different areas of interest, such as regional risk and vulnerability assessments (RVA, conducted by the county governor) and county plans in accordance with the Planning and building act (county council); all of which has as one of their main aims to provide guidance for municipal planning. For the case of municipal spatial planning and adaptation, regional RVAs and regional adaptation plans are of particular relevance.

The county governors in all of the four counties have made or are making RVAs, which includes climate change risks. A dedicated climate change RVA is made in Sogn og Fjordane (2010), while Hordaland and Rogaland have made separate chapters or attachments on climate change risks in their general RVAs. The latter approach is also underway in Møre and Romsdal. All these documents are submitted to hearings among municipalities in the county. Furthermore, the four county councils produce regional climate and energy plans. The county councils in Sogn og Fjordane and Hordaland have included quite comprehensive chapters on climate change adaptation in these plans. The production of these plans has included adaptation experts from research institutes.

The scope of these plans varies significantly. For instance, the RVAs from the county governor in Rogaland and the county council's climate plan for Sogn of Fjordane include downscaled climate change scenarios and assessments of how climate change will impact various sectors. The remaining plans treat the issue of adaptation in a far more superficial way.

Since the regional plans in question are made with the aid of scientific experts – although to a varying degree – they qualify as boundary objects (White et al., 2010). However, the regional plans vary considerably when it comes to their effort of translating scientific knowledge and that of incorporating regional and local knowledge. The lack of interest in these boundary objects indicates a lack of

relevance and salience among the municipal actors, which again could be related to the regional plans lacking relevant information or right level of detail of information.

4.3 Events, seminars and meetings

The regional authorities are mandated to host a range of different events, seminars end meetings in order to facilitate policy discussions with, and dissemination of information to, local authorities. The most relevant for adaptation knowledge in the four studied counties are:

1. Bi-monthly, mandatory meetings between municipalities and regional planning authorities called "planforums".
2. Ad-hoc conferences, workshops and seminars organized by one or several of the regional authorities. One or two per year per organizer.
3. Meetings in sub-regional planning networks.

The first category is the most frequently occurring meeting, but adaptation planning is rarely brought to the agenda. For the purpose of this study, meeting records from 120 meetings that had taken place during the last five years were examined in all of the four counties. Adaptation was on the agenda (according to the minutes) only at three of these meetings.

In the second category (the ad-hoc conferences), adaptation appears more frequently; but these events are organized much less frequently so the total amount of knowledge transfer might be less than for the former category. The county councils in Sogn og Fjordane and Hordaland organize annual planning conferences, which often have included presentations of climate change impact and adaptation research. The NVE has recently organized a series of workshops for municipalities on natural hazard mitigation, so far one annual workshop in each county, which was well attended by municipal planners.

Møre og Romsdal and Hordaland county councils are also organizing sub-regional planning networks, which according to the informants are well attended among municipal planners. However, adaptation is rarely an issue in these meetings.

The meetings, seminars and networks together constitute a significant arena for communication and translation of climate change knowledge, in the events where experts take part. According to our informants, the events have increased awareness of the adaptation issue, indicating that the salience and credibility of adaptation has increased.

5. Discussion

The regional adaptation plans, the guidance in relation to checking of municipal plans and the meetings and seminar constitute the full toolbox for the regional actors to integrate adaptation at multiple scales (local, intra-local and regional) – see table 4. These means of policy coordination do involve boundary work. Both regional- and municipal spatial plans contain co-produced knowledge – a synthesis of regional or local knowledge and expert knowledge (Cash et al., 2003). A municipal spatial plan that addresses the issue of climate change adaptation is a governance instrument and simultaneously a result of co-produced knowledge. In turn, this means the plan constitutes a boundary object. It is also the regional actors' checking of municipal spatial plans and the dialogue that this results in, that currently is the most effective means of coordinating adaptation, according to the informants.

TABLE 4. THE EXTENT OF BOUNDARY WORK IN REGIONAL MEANS OF COORDINATION OF ADAPTATION

Means of policy coordination	*Boundary work*			
	Translation	**Communication**	**Mediation**	**Boundary object**
Checking and guidance of municipal spatial plans	Not occurring	Drives dialogue between regional and local level in the case of adaptation governance, provides salience to knowledge produced.	Negotiation over interpretation of climate change projection versus legal requirements and local needs.	The approved municipal spatial plan.
Production of regional reports and plans	Involves co-production of knowledge, incl. translation, but are not used by municipalities	Fails in its potential for communication because they are not used by municipalities	Greater involvement of local users could lead to it.	Can serve as boundary objects
Organize events, seminars and meetings	The occasional visit of experts serve as translation	Great potential for communication	Not occurring	Not relevant

The county councils and the county governors are not able to serve as proper boundary organizations, because they do not have a principal agent relationship to scientific institutions, and they are thus not accountable to science (Guston, 2001). They are neither able to facilitate the necessary type of two-way communication, nor the task of translation and mediation directly between municipal users and experts. They do, however, mediate between expert knowledge and users through the checking of plans. Hordaland county council, followed by the smaller Sogn og Fjordane county council, have taken the most active approach of the four counties when it comes to directly involving climate change expert communities, through being actively involved in research and development projects. This illustrates that despite a somewhat centralized Norwegian governance system, the regional actors can pursue slightly different approaches in their means of coordination of adaptation planning.

That fact the county governors, except for the case of Sogn og Fjordane, rarely use objections to municipal plans on the grounds of inadequate consideration of adaptation, the limited appearance of adaptation in the mandatory "Planforum" meetings and the low awareness among municipal users of the regional planning and RVA reports, indicates that the adaptation issue is not high on the agenda at either the local level or the regional level. The two only designated boundary organizations in this context, NVE and the GAS, seek to legitimize knowledge for adaptation through creating boundary objects such as online map tools for avalanche risk mapping and a guide for sea level rise mapping. But the users involved in these boundary organizations are at the national level, not the local or regional. The lack of boundary arrangements involving the municipal actors and these organizations could be one explanation for the lack of salience. The regional users act as inter-mediators between

scientific knowledge as well as co-produced knowledge from the national level boundary organization and the municipal users, firstly through the dialogue that results as a consequence of the county governors power to place objection on a plan, and secondly through meetings and events. Together, these means of coordination constitutes a *hybrid management space* between the regional level and local level where translation, communication and mediation, to a varying degree, takes place and at least some legitimate and salient knowledge for adaptation emerges. This hybrid management space resembles the concept of "boundary spaces" that " (…) permits us to consider the interpenetration of different organizational spaces in particular space–time configurations" (Mahony, 2013, p. 21), and thus captures the contingent and temporal nature of the type of boundary arrangements that we typically find in the area of adaptation planning, which are not captured by the traditional definition of boundary organization (Mahony, 2013).

The regional plans and RVAs hold potential as boundary objects, but currently they are rarely applied in the production of municipal spatial plans. That would probably warrant a stronger involvement of local users in the production of these documents, in order to create salience and accountability (Cash et al., 2003). Currently, local users are only able to have a say in the production of these documents through public hearings. Additional opportunities to increase boundary work lie with the coordination ofy meetings, seminars and conference,in particular the sub-regional planning networks and the frequent "Planforum" meetings. These share similarities with "shadow spaces for social learning" in that they create informal meeting places between experts and knowledge users at various governance levels (Pelling et al., 2008).

6. Conclusion

The role of regional planning in multi level adaptation governance has been under diagnosed in the research literature. Given that a well functioning science-policy interface is paramount for adaptation (Corfee-Morlot et al. 2011), theories of boundary work can help explain how this can be achieved (e. g. Hoppe & Wesselink 2014). The aim of this paper has been to investigate the extent of boundary work in the coordination of adaptation planning by regional governance actors. Our finding show that despite a centralized system, with presumably little room for regional policy formation on spatial planning and adaptation planning, the way adaptation planning is coordinated and carried out results in differences between the counties. We also find that the means of coordination employed by the regional governance actors involves boundary work, but the results indicate that this is currently not sufficient for making adaptation a salient issue at the local level. Also, our findings indicate that the hybrid management space created by the regional governance actors holds significant potential for increasing this salience if local users and their knowledge, get more strongly involved in co-producing knowledge for adaptation planning (Cash et al., 2003).

The research findings show how boundary work theory can inform governance research: it has illustrated how concepts related to boundary work can contribute to understanding patterns of adaptation governance. It can provide a lens through which to analyze institutional arrangements and strategies concerning the use of knowledge in policy making, and for choices about the deployment of policy coordination instruments. It could also potentially provide an explanatory framework for policy implementation and policy effectiveness if one accepts that policy knowledge must be co-produced in order for it to be credible, legitimate and salient. It is a question for further research to design frameworks and methods that can measure the impact and effects of boundary arrangements for regional and local level governance with greater accuracy. Boundary work theory is also a necessary and important component in analyzing adaptation planning and governance, as this policy area is, to a very great extent, dependent on bridging science and policy.

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APPENDIX

Interview guides and list of interviews

INTERVIEW GUIDES USED IN LOFOTEN, ARTICLE ONE

FISHERMEN (2008-2010)

Introduction

Anonymity clause

Tell about yourself

Part 1: Current

1. Are you experiencing changes in national fishery policy, regulations and market conditions?
2. Which consequences do these change have?
3. What consequences does it have that the cod is shifting northwards?
4. Which consequences does bad weather have?
5. How can you adapt to these changes?
    a. What – why
6. Which conditions (prices, regulations, other actors) affect how you can adapt?
    a. Technical conditions
    b. Regulations, laws
    c. Accept from colleagues
7. What resources are needed to adapt?
    a. Support from national agencies, ministries, municipalities or research institutions
    b. How does this work?
8. How are you relating to scientific knowledge, from marine research or climate research?

Part 2 Past

9. What did the fishermen do during the periods with no cod in the 1980ies?
10. Do you have any idea about what the causes of the absence of cod could have been?
11. What were the consequences? How did you adapt?

12. What types of adaptive measures?
13. Why did you choose these measures?
14. How does the situation today differ from that of previous episodes without cod?
15. What happened with the fish buyers here last time the cod was absent?

Part 3: Future

16. Which changes will the industry see in the future? And the local communities?
17. Which consequences do the changes bring?
    a. Opportunities
    b. Challenges
18. How is your ability to adapt to these changes?
19. If the cod will move northward in the future, which consequences will it have for you?
20. What conditions affects future adaptation options?
21. Which resources affect your ability to adapt?
22. Comment on down scaled climate change scenarios.

Part 4 (added in second field trip)

23. Do you pay attention to the climate change debate?
24. Do you believe in what the researchers says?
25. How do you relate to knowledge from the marine scientists, does it affect the way you operate? Or are you likely to trust your own and your colleague's experience more?

FISH BUYERS/STOCKFISH PRODUCERS (2008-2010)

Part 1: Current

1. What issues is most pressing for the moment?
2. How exposed is the company for fluctuations in delivery of cod?
3. How exposed is the company for fluctuations in drying conditions for stockfish?
4. What is your strategy to secure sufficien landings of fish?
5. How do you cope with the uncertainty in landings, market conditions and drying conditions?
6. What do you do if there is no cod?
7. How do you cope with poor drying conditions?

8. How can you adapt to changing conditions?
9. Which conditions (prices, regulations, other actors) affect how you can adapt?
    a. Technical conditions
    b. Regulations, laws
    c. Accept from colleagues
10. What resources are needed to adapt?
    a. Support from national agencies, ministries, municipalities or research institutions
    b. How does this work?

Part 2 Past

11. What did you do to secure landings of fish during the periods with no cod in the 1980ies?
12. How did you cope with the year with poor drying conditions in 2001-2007?
13. What were the consequences? How did you adapt?
14. What types of adaptive measures?
15. Why did you choose these measures?

Part 3: Future

16. Which changes will the industry see in the future? And the local communities?
17. Which consequences do the changes bring?
    a. Opportunities
    b. Challenges
18. How is your ability to adapt to these changes?
19. If the cod will move northward in the future, which consequences will it have for you?
20. What conditions affects future adaptation options?
21. Which resources affect your ability to adapt?
22. Comment on down scaled climate change scenarios.

INTERVIEW GUIDE FARMERS (2009-2012)

Part 1: Current

1. How do you adapt farming to the extent of fluctuations in weather and growing conditions that you have here in Lofoten?

2. Are you experiencing changes in national agricultural policy, regulations and market conditions?
3. Which consequences do these change have?
4. How can you adapt to these changes?
    a. What – why
5. Which conditions (prices, regulations, other actors) affect how you can adapt?
    a. Technical conditions
    b. Regulations, laws
    c. Accept from colleagues
6. What resources are needed to adapt?
    a. Support from national agencies, ministries, municipalities or research institutions
    b. How does this work?

Part 2 Past

7. Have you experienced years with exceptional challenging weather and growing conditions?
8. What were the consequences? How did you adapt?
9. What types of adaptive measures?
10. Why did you choose these measures?

Part 3: Future

11. Which changes will the industry see in the future? And the local communities?
12. Which consequences do the changes bring?
    a. Opportunities
    b. Challenges
13. How is your ability to adapt to these changes?
14. What conditions affects future adaptation options?
15. Which resources affect your ability to adapt?
    a. Support from national agencies, ministries, municipalities or research institutions
    b. How does this work?
16. Comment on down scaled climate change scenarios.

LIST OF INTERVIEWS REPORTED IN ARTICLE ONE (IN PERSON)

#	Interviewee	Date
1	1. environmental officer	4.09.08
2	2. head of planning and developement	4.09.08
3	3. Fisher (old)	4.09.08
4	4. Fishbuyer/stockfish	5.09.08
5	5. NGO	5.09.08
6	6. NGO Coastal fisheries	5.09.08
7	7. Local historician	5.09.08
8	8. Fisher, NGO fisheries,	6.09.08
9	9. Agricultural extension service officer	6.09.08
10	10. Fishery directorate officer	6.09.08
11	11. Farmer (dairy)	16.02.09
12	12-14 Fishers and Fishbuyers (tree interviewed together)	17.02.09
13	15. Municipal officer (harbour)	17.02.09
14	16. Municipal officer (agriculture)	17.02.09
15	17. Fishbuyer –stockfish producer	18.02.09
16	18.-20 Fishers (intervierviewed together)	18.02.09
17	21.-22 Farmers (husband and wife, organic)	19.02.09

18	23. Municipal officer (industry)	19.02.09
19	24. Fishbuyer (stockfsih	20.02.09
20.	25. Author (key informant)	20.02.09
21.	26. Fisher (also local politician)	21.02.09
22.	27. Farmer (dairy, female)	21.02.09
23	28. Fisher	13.10.09
24	29. Farmer (sheep)	13.10.09
25	30. Farmer (sheep and dairy)	13.10.09
	Town hall meeting	12.10.09
26.	31. Fisher (also politician)	14.10-09
27.	32. Fishbuyer- stockfish producer	14.10.09
28.	33. Fishbuyer (also fish farmer, female)	15.10.09
29.	34. Fisher (older)	22.07.10
30.	35. Fisher (younger)	22.07.10
30.	36. Municipal officer (environmental, new)	09.11.12
31.	37. Farmer (goat)	10.11.12
32.	38. Farmer (sheep)	10.11. 12

INTERVIEW GUIDE EIGHT MUNICIPALITIES, ARTICLE TWO AND TREE.

Introduction

Anonymity clause

Tell about yourself

Part 1: Agenda-setting

1. is adaptation to climate change on the municipal agenda?
    a. How and when did that happend?
    b. How important was the participation in the NORADAPT-project? Would adaptation be on the agenda irrespective of participation in the project?
    c. Why is adaptation on the agenda?
    d. Who was active in setting adaptation on the agenda?
        i. Was it the politicians or the administration?
        ii. Was other local actors involved
2. Where is adaptation on the agenda?
    a. Has adaptation been in the local media?
3. To what extent is adaptation on the agenda?
    a. Compared to other policy issues such as:
        i. Mitigation of green house gas emissions
        ii. other environmental protection measures
        iii. developement
    b. Has the extent of being on the agenda changed recently? Why?

Part 2: Conditions for adaptation work

4. Do the municipality has the relevant competence for working with adaptation?
    a. On which areas is it lacking?
5. Do the municipality has sufficient administrative capacity for working with adaptation?
    a. Departments or areas that are standing out?
6. Does your department have the opportunity to commission external expertise if needed?
    a. Do you know were to find external expertise?
    b. Do you have sufficient competence to commission the relevant expertise?

Part 3: Experiences with adaptation

7. Have you experienced climate related natural hazards that have required action from the municipality?
8. How has the municipality experienced the knowledge that the NORADAPT-project has delivered, such as downscaled projections for climate change?
    a. Relevant?
    b. Comprehendible?
    c. Was it new and surprising, or well known?
    d. Other?
9. How do you use the scenarios?

Part 4: Questions relating to use of societal scenarios

10. How do you experienced the knowledge about future vulnerability to climate change after reviewing the scenarios for future societal development in the municipality?
    a. Relevant?
    b. Comprehendible?
    c. Was it new and surprising, or well known?
    d. Other?
11. Is local knowledge included in the assesments, in addition to the knowledge of the involved officers?
12. Is uncertainty a barrier when it comes to:
    a. Whether climate change is caused by humans
    b. The climate models
    c. The downscaling of climate models
    d. In the local effects of climate change
    e. How societal change affect vulnerability?
    f. Other issues regarding uncertainty?
13. Suggestion for other questions?

ANNUAL QUESTIONNAIRE SUBMITTED TO PROJECT MUNICIPALITIES

1. Are thre changes in the organisation of the project work?
2. What kind of process is the adaptation work tied to? (municipal plan, Risk and Vulnerability assesment etc)
    a. Are there changes in the topics the adaptation work is focusing on?
    b. How far has the municipality gotten in assess climate change risks?
3. Has the municipality received downscaled climate scenarios?
    a. Are these assesed?
4. Has the municipality received societal scenarios?
5. Has the municipality treated the climate change vulnerability assesment (politically or administratively?
6. Has the municipality started to develope adaptation strategies?
7. Will the municipality have a documented vulnerability assesment and/or adaptation strategy by the end of 2010?
8. Is there need of additional support from the research partners?
    a. Other need of support?

LIST OF INTERVIEWS REPORTED IN ARTICLE TWO AND TREE (BY PHONE)

#	**Municipality**	**Interviewee**	**Date**
1	1.	1. Human security officer	07.10.09
2	1.	2. Planner	13.08.09
3	2.	3. Environmental officer	28.10.09
4	2.	4. Water officer	28.10.09
5	2.	5. GIS officer	28.10.09
6	3.	6. Water officer	13.10.09
7	4.	7. Environmental officer	

8	5.	8. Head of planning and developement	05.08.09
9	5.	9. Agricultural officer	17.09.09
10	6.	10. Environemtal officer	07.10.09
11	6.	11. Planner	07.10.09
12	7.	12. Agricultural officer	23.09.09
13	7	13. Planner	23.09.09
14	8.	14. Planner	25.09.09
15	8	15. GIS officer	25.09.09
16	8	16. Head of administration	25.09.09

FOLLOW UP INTERVIEWS

#	**Municipality**	**Interviewee**	**Date**
17	6	10. Environmental officer	17.03.11
18	6.	11. Planner	17.03.11
19	4	8. Head of planning and developement	14.04.1
20	1	1. Human security officer	23.03.11
21	1	17. Human security officer	23.03.11
22	7.	13. Planner	06.04.11
23	7.	12. Agricultural officer	06.04.11
24	2	3. Environmental officer	09.03.11

25	2	4. Water officer	09.03.11
26	3	7. Environemtal officer	19.04.11
27	5	8. Head of planning and developement	19.04.11
28	8	15. GIS officer	19.04.11

INTERVIEW GUIDE REGIONAL LEVEL, ARTICLE FOUR

Anonymity clause

Tell about yourself

OFFICIALS AT REGIONAL GOVERNANCE ORGANIZATIONS

1. Have natural hazards and adaptation to climate change been higher on the agenda after the implementation of a new planning and building act in the municipal spatial plans?
2. Are the approved plans adhere better to regulations now than before?
3. Do municipal planners contact you when initiating a new spatial planning process
4. Do municipalities requests knowledge of climate change and climate change impacts?
    a. What is your answer?
5. Where do you find relevant knowledge about climate change impacts and natural hazards?
6. Which regional plans are having adaptation as a topic?
7. Which arenas and processes are resulting in dialogue and knowledge dissemination to/with municipal planners?
8. Do you see it as an important part of your duty to disseminate knowledge about climate change adaptation and natural hazards?
9. How are your division of labour with other regional governance actors?

MUNICIPAL OFFICIALS

1. How has natural hazards and climate change adaptaiton been threated in the current spatial plan or RVA?

2. Will you do more detaild risk assesment base don input from the project or from regional level?
3. Are input from regional level implemented in plan?
4. Which role did the officials at the county governor or the county council have in the way natural hazards and adaptation to climate change was treated in the plan?
5. Which arenas and processes have you participated in that have increased your knowledge of adaptation to climate change?
6. Could the municipality have reached the same conclusion on the topic of natural hazards and adaptation without:
    a. Participation in the project
    b. Guidance from regional level actors?
7. In the future, do the municipality have the competence to carry out these kinds of assesment without external support?
    a. Would i be a goal to do it without support?
    b. What is the necesarry conditions and requirements to do this withouth external support?

LIST OF INTERVIEWS REPORTED IN ARTICLE FOUR (PHONE)

#	County or municipality	Interviewee	Date
1	County 1	County governor official	07.10.14
2	County 1	County council official	17.09.14
3	County 2	County governor official	16.09.14
4	County 2	County council official	09.10.14
5	County 3	County governor official	07.10.14
6	County 3	County council official	17.09.14
7	County 4	County governor official	19.09.14
8	Municipality 1	Municipal planner	14.08.14

1	Municipality 2	Municipal planner	15.08.14
10	Municipality 2	Municipal planner/engineer	15.08.14
11	Municipality 3	Municipal planner	Sept., 2014
12	Municipality 4	Municipal planner	15.09.14
13	Municipality 5	Safety official	27.09.14

SUMMARY

As it is becoming increasingly apparent that climate change is inevitable, society will need to adapt to the impacts. The concept of climate change, and therefore also adaptation, relies on abstract climate science. This poses challenges for agenda-setting adaptation as a policy issue, when it has to compete with more immediate and familiar concerns. This thesis seeks to explain the emergence of adaptation to climate change governance at the local and regional levels in Norway. It builds on research conducted through several case studies carried out in nine municipalities and four counties in Norway between 2008 and 2014. The results are presented in four articles. The results show that adaptation to climate change is not readily seen as a salient issue in climate change sensitive sectors or in municipalities. By integrating insights from cultural theory, science and technology studies and agenda-setting theory, it is concluded that agenda-setting of climate change adaptation requires human agency in providing local legitimacy and salience for the issue. The thesis also finds that boundary arrangements are needed to bridge the gap between local knowledge and scientific knowledge for adaptation governance. Attempts at such boundary arrangements are already in place at the regional governance levels, but they must be strengthened if municipalities are to take further steps in implementing adaptation measures.

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