How to Make Local Context Matter in National Advice: Towards Adaptive Comanagement in Norwegian Climate Adaptation

HEGE WESTSKOG

Centre for International Climate and Environmental Research Oslo, Oslo, Norway

GRETE K. HOVELSRUD

Centre for International Climate and Environmental Research Oslo, Oslo, and Faculty of Social Sciences, Nord University, Bodø, Norway

GÖRAN SUNDQVIST

TIK Centre for Technology, Innovation and Culture, University of Oslo, Oslo, Norway

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ABSTRACT

Drawing on case studies in 12 Norwegian municipalities, this paper investigates how local context matters for developing national climate adaptation policies that are applicable at the municipal level. Moreover, it explicates which factors constitute this context and how these factors vary across the case municipalities. National climate adaptation policy in Norway can currently be characterized as top down, providing standardized requirements and advice to municipalities. However, Norwegian municipalities vary greatly with respect to physical conditions, organizational resources, and societal needs. They are autonomous to a great extent and are almost solely responsible for developing climate policy and planning within their own territories. Therefore, municipalities adapt national policies to their own context, reflecting local physiographic, organizational, and resource challenges, but these local translations are not fully recognized by national and sectoral actors. This paper underscores that the significant variation in contextual factors between municipalities is not sufficiently addressed and understood by national and sectoral governmental authorities. With the identified variation of the contextual factors across the case municipalities, an adaptive comanagement strategy within a multilevel governance system is suggested as a suitable framework to ensure a proactive approach to local adaptation, that is, mutual understanding and better cooperation between the national and local levels.

1. Introduction

The latest report from the Intergovernmental Panel on Climate Change (IPCC) shows a 95% certainty that climate change is caused by human activities (IPCC 2013). However, climate impacts are complex, dynamic, and nonlinear, and there are uncertainties about future climate and the extent of upcoming impacts. In short, uncertainty is pervasive in climate change research (e.g., Dessai and Hulme 2004). Uncertainty spans the range from climate models to societal vulnerability, adaptation needs, and the effects of mitigative and adaptive measures, often described as cascading uncertainties (Schneider and Kuntz-Duriseti 2002).

The uncertainties about environmental and societal impacts from climate change are even more pronounced at the local level. The impacts vary along physiographic and topographic dimensions. The potential societal impacts also vary depending on a suite of sensitivities, such as available human and financial resources, access to relevant knowledge, and the particular exposure or hazards of a specific location. Added to the uncertainty about impacts are inherent and complex uncertainties in climate projections that increase as the resolution becomes finer. Nevertheless, regional-scale projections show clear trends of increasing temperatures and changing precipitation patterns, which in turn will require adaptation. Climate change is a fuzzy decision-making context with a more pronounced uncertainty than other policy areas as pointed out by Lempert et al. (2004, p. 2): ''Climate change is associated with radically

Corresponding author e-mail: Hege Westskog, hege.westskog@cicero.oslo.no

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diverse decision contexts, geographic scales, and time scales. It comprises many different types of policy problems involving many different types of actors, and thus is not even theoretically optimizable.''

It is clear that climate adaptation is an emerging policy area across societal scales, and findings show that municipalities adapt to climate change even if national guidelines and advice are lacking (Dannevig et al. 2012, 2013). In many European nations, including Norway, municipalities have been assigned the responsibility for local climate adaptation, but the resources and relevant background knowledge (e.g., maps and vulnerability assessments) are not available at the municipal scale. These are only developed for the national and county levels. The authorities expect the knowledge and tools to be highly useful for municipal planning, assuming linearity from national scientific assessments to local implementation. Municipal officials underscore that they are used to planning under uncertainty but that the currently weak national engagement on climate adaptation and lack of roles allocated to the different levels of government limit their ability to adapt proactively to climate change. Therefore, municipalities want their roles to be defined more clearly and ask for better national guidance and support (Amundsen et al. 2010; Dannevig et al. 2012, 2013).

National climate change adaptation has a strong tradition of being science based with a top-down standardized policy approach (e.g., Amundsen et al. 2010), while the nature of the problem, with cascading uncertainties, calls for a flexible management system in which adaptive measures are supported by state-level institutions (Armitage et al. 2007; Olsson et al. 2004).

At a general level and in the short term, climate change impacts are likely to be less severe in Norway compared to elsewhere on the globe and potentially economically positive for some sectors, such as agriculture (Kvalvik et al. 2011; Hovelsrud et al. 2011). On the other hand, the consequences for some municipalities could be significant and substantially affect the inhabitants because of the complex interlinkages between climate change impacts and societal conditions (e.g., West and Hovelsrud 2010; Hovelsrud and Smit 2010). The reasons for the differences are multiple, complex, and closely related to the particular socioeconomic (some have more administrative capacity than others), environmental conditions (some are more exposed to climate impacts than others), and the human and resource capacity (some have more dedicated officials than others) in a given municipality (e.g., Dannevig et al. 2012; Dannevig et al. 2013). This underscores the need to understand the particular local contexts when studying policy development and adaptive responses to climate change. One size does not fit all when it comes to local-level climate adaptation.

Several studies show that the local context matters for effective policy formation and conclude that this topic is largely overlooked both in national policy and in the literature on policy instruments (e.g., Tørnblad et al. 2014). However, a few studies have addressed the need for adjusting national policies to become locally relevant and efficient climate policy strategies (Moser and Ekstrom 2010; Bulkeley and Betsill 2005; Gustavsson et al. 2009). In this paper, we underscore that the significant variation in contextual factors between municipalities is not sufficiently addressed and understood by national and sectoral governmental authorities. The empirical evidence from our case municipalities illustrates a mismatch between the need for a local contextual understanding of climate change adaption and the dominant top-down standardized national policy approach. In this paper, we investigate how the local context matters when developing local adaptation strategies, and we discuss the factors that constitute the local context for adaptation policies. Further, we identify variation in the contextual factors for local adaptation, which calls for an adaptive comanagement strategy across the national, regional, and local government levels. The main geographical focus is Norway, but we zoom in on 12 municipalities in Vestfold County (see Fig. 1).

The next section describes the context of climate change adaptation in Norway and in the case study of the Norwegian County Administration Vestfold and its dozen municipalities. This is followed by a theoretical section developing the adaptive comanagement approach, a methods section, and a presentation of findings from case municipalities based on an analysis of four factors that constitute the local context. Finally, we discuss the need for an adaptive comanagement strategy based on our findings before the results are summarized and concluded.

2. The context

a. Norwegian climate change adaptation policies[1]

Norway has two levels of subnational government, regional or county government and municipalities, respectively, both of which are governed by directly elected councils. A local administration headed by a chief executive officer in each municipality and county

[1] The overview made in this section is based on Heiberg (2012) but includes updated information on the responsibilities from the Norwegian Environment Agency on climate change adaptation.

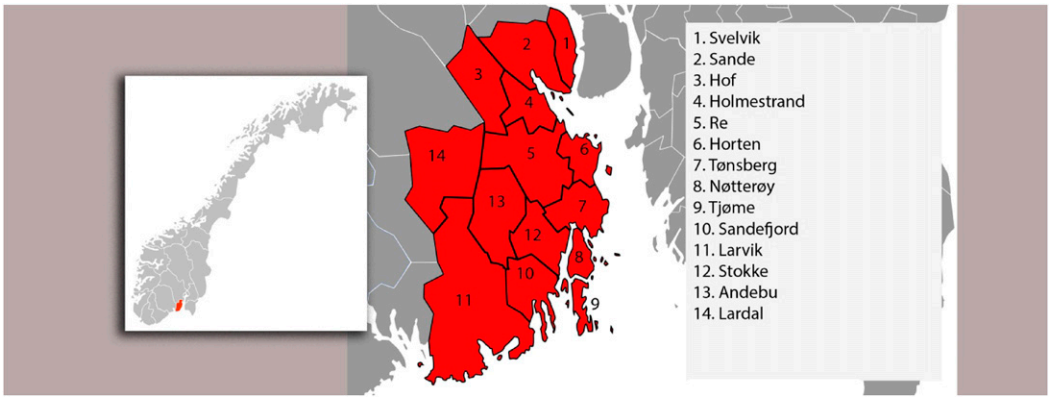

FIG. 1. The county Vestfold (in red) in the southern part of Norway.

provides information for decisions to be taken by the councils and follows up policy decisions. In keeping with practices common to development of the Scandinavian welfare states (cf. Sellers and Lidström 2007), responsibility for implementing national policy decisions has to a large extent been decentralized to local authorities. Thus, municipalities are currently charged with responsibilities for primary and lower secondary education, primary health care, social services, municipal roads, water supply and sewage services, land-use planning, and local environmental issues. In addition to these mandatory responsibilities, municipalities also have residual discretionary authority and are free to engage in other tasks.

Norwegian national authorities have the responsibility to facilitate and oversee that national requirements, guidelines, and intentions are followed by the municipalities (local level), while the municipalities are responsible for planning and implementing measures that safeguard the municipality and the residents, including handling the impacts of climate change. In carrying out this responsibility, the municipalities are to a great extent making their own judgements and design their own policy, within the national requirements and intentions: they decide if there is a need for local measures to mitigate climate change, type of measures to be implemented, and how these instruments will be designed.

When it comes to climate change adaptation and preparedness, the national government develops requirements and provides guidelines for the local level. Through the Civil Protection Act (Lovdata 2016a), Norwegian municipalities are assigned the main responsibility for developing and implementing the necessary measures and to be prepared to secure its citizens against climate-related events. Municipalities are required to map potential hazards and risks to assess the likelihood of occurrences and how they will affect the municipality. Ideally, this is presented in a holistic risk and vulnerability assessment (RVA), which forms the basis for a mandatory preparedness plan for the municipality. Private actors are responsible for planning and implementing necessary measures and for protecting their belongings from exposure to natural hazards, including climate-related events, including assessing risks from flooding and landslides when planning building sites.

In addition, the RVA provides the basis for the municipalities' planning and infrastructure. Spatial planning within the municipal borders is the sole responsibility of the municipality and is strictly regulated by Norwegian national laws on civil and environmental protection against natural and societal hazards (Lovdata 2016b, Act on Natural Damage).

At the national level, several authorities are developing flood plans and maps of landslides relevant for the local level. Specifically, the Norwegian Water Resources and Energy Directorate (NVE) has an important role at the national level. NVE is responsible for preventing damage from flooding and landslides (Heiberg 2012) by mapping, informing, monitoring, and alerting about areas at risk. NVE has regional offices throughout the country, which carry out the sectoral responsibilities of the directorate. Our case municipalities in Vestfold County belong to the ''region south'' of NVE, which is responsible for six counties, including 110 municipalities.

All national authorities are responsible for preventing and handling climate-related hazards such as floods and landslides in their sector, currently with minimal cross-sectoral efforts. However, a cross-sectoral approach to climate adaptation has been called for (NOU 2010), and recently the Norwegian Environment Agency has been given the responsibility for advising other state-level governmental authorities on climate change adaptation.

The county governors compose the national government at the county level and are responsible for ensuring that national requirements and guidelines for climate adaptation are adhered to by the municipalities. The county governors have clear coordinating roles for overseeing that the municipalities are prepared for climate-related events, with their own climate change expertise for guiding the municipalities. The county governor has a legislative right to object to housing and building developments if risks and vulnerability assessments are lacking and if safety requirements have not been addressed.

The interactions between the national level (with its requirements, guidelines, and intentions for climate change adaptation) and the responsibility of the local level to design relevant policy provide an interesting backdrop for studying the importance of the local context in national climate adaptation policies and for considering how local strategies can inform the development of national and sectoral adaptation guidelines. First, given that municipalities are responsible for implementing national climate adaptation policies, it becomes important to understand whether and how municipalities may influence such policy processes and measures. Second, since the national level (including the county governor) is responsible for overseeing municipalities, it is appropriate to study the roles and interactions between these levels. We may expect national actors to be sensitive to variations in local conditions and to be interested in feedback from local actors, but there is lack of knowledge of how such interaction takes place in practice.

In summary, Norwegian municipalities are required by national regulations to develop RVAs that incorporate climate change and to prepare and develop adequate measures for responding to potential climate events (Heiberg 2012). The national level controls and guides the municipalities' work on climate change. The municipalities have a significant degree of freedom when designing their policies, including climate adaptation.

b. The case study area

The 12 case municipalities are located in Vestfold County in southern Norway, which has 14 municipalities in total (see Fig. 1). The study began with contact between the Vestfold County governor and researchers (see methods) and was carried out as an iterative process between the researchers, the governor, and the municipalities. Vestfold County is one of Norway's smallest counties, geographically speaking, in the area, and with 238 748 inhabitants (2013 numbers), it is one of the most densely populated counties. Vestfold has many types of industries including a process industry, an oil refinery, and stone work and is, despite its size, the largest vegetable producer in Norway. Soil, climate, and topography make Vestfold well suited for agriculture and forestry; 20% of the land is farmed, and 56% of the forest is productive (Vestfold Fylkeskommune 2016).

In Vestfold climate- and weather-related risks are directly connected to hazards from quick clay and landslides. In addition, some areas are exposed to flooding and sea level rise combined with storm surge. The challenges associated with key risk factors are not evenly distributed among the case municipalities but vary along a number of dimensions, including the amount of resources allocated to addressing climate adaptation, who is responsible, and in which networks they participate. The three types of intermunicipal networks in Vestfold of relevance to climate adaptation include the countywide Vestfold Preparedness Forum (Vestfold Beredskapsforum), the Vestfold Spatial Planning Network (Vestfold Plannettverk), and a general intermunicipal network called 12K (12 municipalities). The 12K network is a municipal discussion forum for addressing current and often shared challenges related to tasks and regulations; 2 of the 14 municipalities (Svelvik and Sande) chose to participate in the neighboring county's general municipal network (the D5 network) because of the geographic proximity. Table 1 below summarizes the organization of the adaptation efforts and resources allocated in the case municipalities. It also outlines the different networks and efforts for cross-municipal collaboration on climate adaptation.

The resources used in climate adaptation (characterized as few, some, or more) reflect the municipality's allocation of specific human resources to address preparedness/civil protection. If few human and financial resources are earmarked for climate adaptation, it signifies that the responsibility for such tasks is added to a position that is already 100% dedicated. Some resources allocated signify that the responsibility is covered by less than a 50% position. More resources allocated signify that the municipality has a 50%–100% position to cover these issues.

3. Adaptive comanagement

Adaptive comanagement is a useful approach for understanding how the different levels of government interact in our case area. Olsson et al. (2004, p. 75) define adaptive comanagement as "...flexible community based systems of resource management, tailored to specific places and situations, and supported by and working with various organizations at different scales." This approach to adaptive comanagement is mainly

TABLE 1. Central characteristics of the case municipalities' work with climate change adaptation.

Case municipality (inhabitants January 2013)	Organization of climate change adaptation activities	Resources allocated to climate change adaptation activities	Networks that the municipality participates in
Re (8994)	Division for health, social, technical, and business issues	Few resources allocated	12K, Vestfold Preparedness Forum, and Vestfold Spatial Planning Network. Collaborates with Hof and Holmestrand in developing a joint municipal plan.
Hof (3060)	Division for technical, cultural, development, and business issues	Few resources allocated	12K, Vestfold Preparedness Forum, and Vestfold Spatial Planning Network. Collaborates with Re and Holmestrand in developing a joint municipal plan.
Lardal (2435)	Division for environment, technical, and business issues	Few resources allocated	12K, Vestfold Preparedness Forum, and Vestfold Spatial Planning Network.
Tønsberg (41 239)	Division for municipal development	More resources allocated	12K, Vestfold Preparedness Forum, and Vestfold Spatial Planning Network.
Larvik (43 132)	Division for spatial planning and technical issues	More resources allocated	12K, Vestfold Preparedness Forum, and Vestfold Spatial Planning Network.
Andebu (5546)	Division for technical, agricultural, and business issues	Some resources allocated	12K, Vestfold Preparedness Forum, and Vestfold Spatial Planning Network.
Holmestrand (10 350)	Organized in two divisions. Preparedness: Division for technical issues. Adaptation: Division for planning and building issues	Few resources allocated	12K, Vestfold Preparedness Forum, and Vestfold Spatial Planning Network. Collaborates with Re and Hof in developing a joint municipal plan.
Horten (26 595)	A separate section for preparedness. Adaptation in the division for culture, society, environment, and business	More resources allocated	12K, Vestfold Preparedness Forum, and Vestfold Spatial Planning Network.
Svelvik (6570)	Organized in two divisions. Preparedness: Division for technical issues. Adaption: Division for culture and development	Few resources allocated	D5, Vestfold Preparedness Forum, and Vestfold Spatial Planning Network. Coordinates the risk and vulnerability analysis with Sande.
Nøtterøy (21 100)	Division for technical issues	Some resources allocated	12K, Vestfold Preparedness Forum, and Vestfold Spatial Planning Network.
Stokke (11 398)	Division for spatial planning and environment	Few resources allocated	12K, Vestfold Preparedness Forum, and Vestfold Spatial Planning Network.
Sande (8835)	Division for technical issues	Some resources allocated	D5, Vestfold Preparedness Forum, and Vestfold Spatial Planning Network. Coordinates the risk and vulnerability analysis with Svelvik.

applied to local-level studies of natural resource management such as fisheries and wild life.

Inspired by Olsson et al. (2004), we apply the concept of adaptive comanagement to our case study as a flexible system that considers the local context of municipalities in which adaptive measures are supported by different state-level institutions such as the Vestfold County governor and the NVE. Adaptive comanagement is in this case relevant (i) for developing national advice, guidelines, and requirements important to the local level and (ii) for adapting national advice, guidelines, and requirements to the local context in terms of particular challenges and opportunities facing each municipality. The latter is the main focus here. In our elaborations, adaptive comanagement connotes an interdependence between the national and local levels. We are specifically pointing to the need for adaptive comanagement when the relevance of climate change adaptation varies significantly with local contexts and within the same county. This is at the heart of our argument; adaptive comanagement is an approach that captures the particular conditions in a particular place (municipality) but allows for analyzing the interplay with the broader and salient context (the county and state).

An adaptive comanagement approach recognizes that neither the state nor the municipality contains the necessary roles and interests to address the challenges. Moreover, it includes local knowledge and awareness in the decision-making process (Fitchett 2014). This kind of management is based on collaboration between relevant actors in the management of complex and uncertain challenges. Inspired by Armitage et al. (2007) and based on our findings, we argue that management problems associated with climate change impacts cannot be properly addressed through a top-down approach. Climate change and climate adaptation is dynamic, nonlinear, and with a high degree of uncertainty both with respect to projected changes and impacts. It creates new kinds of managerial problems to which a centralized bureaucracy has a limited ability to respond (Gunderson and Holling 2002; Berkes et al. 2003).[2]

Adaptation can be divided into reactive and proactive measures for reducing negative effects or taking advantage of positive consequences. Proactive adaptation refers to anticipated measures needed to deal with future change and reactive as a response to something that has occurred, for example, the aftermath of extreme events (Fankhauser et al. 1999; IPCC 2007). In most cases, adaptation is reactive in terms of being a response to an extreme event that has happened and requires immediate action (Amundsen et al. 2010). Such after the fact responses to extreme events are not sufficient in the long term; they are costly and may not minimize the risks properly unless they are included in proactive adaptation measures. Proactive adaptation is generally more desirable to ensure preparedness and thereby minimize risks but requires in-depth knowledge about potential perturbations (Amundsen et al. 2010). On the other hand, that which may be needed for proactive adaptation (e.g., relevant downscaled scenarios, robust planning tools) may be lacking, which in turn may hinder proper measures to be taken (see also Lempert et al. 2004). We argue that the process of adaptive comanagement in creating space for the local context in national policy development may facilitate proactive adaptation.

Relevant adaptive comanagement factors such as shared decision-making, participatory approaches, and cocreation of knowledge are relevant for climate adaptation (Plummer and Baird 2013). Adaptive comanagement codecision processes between different levels of government might enable cognitive learning (related to the acquisition of new knowledge or to restructuring existing knowledge) and relational learning (referring to improved understanding of other mindsets, enhanced trust, and ability to cooperate) in decision-making for climate change adaptation (Baird et al. 2014). Furthermore, adaptive comanagement processes that involve local knowledge in the decision-making process provide an effective method to deal with change by incorporating local input in management (Fidel et al. 2014).

Some scholars caution that power dynamics might challenge the outcome of adaptive comanagement processes (Watson 2013). The need to simplify and scale up local data to achieve a manageable management regime might leave out certain affected groups or misrepresent them, which can produce conflict. Others suggest that adaptive comanagement processes might be wishful thinking and difficult to achieve in practice (Bown et al. 2013). However, these cautions do not preclude the benefits of adaptive comanagement in finding ways to address climate change risks and challenges. It may also be possible that the potential for conflict and exclusion is greater when adaptive comanagement takes place between interest groups and the government rather than between different levels of government.

A number of scholars point to a need for integration across and between different scales of management,

[2] There are also other managerial problems that share many of the same characteristics as climate change adaptation when it comes to the degree of uncertainty and complexity. Ecosystem management is one such example. See, for instance, Armitage et al. (2009) and Fitchett (2014).

sectors, and among government departments to efficiently respond to climate change (Tompkins and Adger 2005; Bulkeley and Betsill 2005; Bulkeley 2005). Amundsen et al. (2010) further assert that a multilevel governance framework is a way of advancing proactive adaptation and overcoming barriers to adaptation. This literature implies that in order to ensure proactive adaptation strategies locally it is essential for the national government to assign well-defined roles to municipalities by setting goals, creating regulations, and financing adaptation processes for the local governments to implement. Our empirical case study provides useful insights for further developing the notion of a multilevel governance strategy for adapting to climate change. The study shows how the local context matters for the development of local adaptation strategies and that this implies the need for a multilevel governance structure that is both adaptive and comanaging, with room for codecision processes and the option of changing these over time. Below we present two central concepts that are relevant for analyzing climate adaptation at the local level and for further developing the adaptive comanagement approach.

We align ourselves with the language of the IPCC and a framework developed for application to local-level case studies as outlined and discussed in Hovelsrud and Smit (2010), and references therein, and in Ford and Smit (2004). When studying the need for adaptation in conjunction with adaptive comanagement, it is important to distinguish between municipalities that are both exposed and sensitive to hazards or perturbations and those that are only exposed but not sensitive (e.g., Hovelsrud and Smit 2010). This has implications for assessing and designing measures from a national-level perspective: one size does not fit all, even within the same county. Exposure sensitivity refers to the manner and degree to which, in this case, a municipality is exposed and sensitive to particular conditions or natural hazards. ''It reflects the likelihood of climatic conditions or natural hazards occurring in a particular place over time relative to the situational characteristics of places and people which make them sensitive to conditions or hazards'' (Smit et al. 2010, p. 5). These risks could come from extreme weather events or natural hazards such as quick clay slides. Additionally, geographic characteristics, public policy, economic framework conditions, and social parameters determine whether a municipality is sensitive to exposures from risks and hazards. In this way, exposure sensitivity speaks to the susceptibility to particular conditions creating risks or hazards. This is clearly illustrated by the case municipalities in relation to the risks of landslides associated with quick clay. Many municipalities (N10) are exposed to quick clay, but only a few (N3) are both exposed and sensitive to risks of landslides. Our assumption is that the exposure sensitivity to risks and hazards will likely be reduced through deliberate adaptive comanagement because of the potential for addressing the local conditions properly.

The concept of adaptive capacity is receiving increasing attention in the adaptation literature because it problematizes the linear thinking that adaptation will happen if we only have enough knowledge (e.g., Preston et al. 2015; Moser and Ekstrom 2010). It is increasingly recognized that the ability to respond or adapt to perturbations hinges on the degree to which adaptive capacity is activated, utilized, or enabled (e.g., Keskitalo et al. 2011; Hovelsrud et al. 2010). Adaptive capacity reflects an individual's, industry's, or community's ability to cope with, or adjust to, changing conditions. In this case it also reflects the municipality's management of current and past stresses, their ability to anticipate and plan for future change, and resilience to perturbations. In the cases presented here the municipalities' exposure sensitivity and adaptive capacity to climate change is analyzed in conjunction with adaptive comanagement between the local and national levels. Our assumption is that the ability to adapt to risks and hazards will be strengthened through adaptive comanagement because of the inclusion of particular concerns and conditions. While vulnerability is often analyzed as an outcome or a function of exposure sensitivity and adaptive capacity, we do not assess vulnerability per se in this paper [see Adger and Kelly (1999), Smit and Pilifosova (2001), and Turner et al. (2003a,b) for a discussion of vulnerability in relation to exposure sensitivity and adaptive capacity].

4. Methods

The methodological approach is inspired by transdisciplinary thinking on how knowledge can be coproduced by researchers and governmental and municipal officials to solve specific and identified problems (Elzinga 2008; Pohl 2011). Researchers and practitioners have collaborated throughout the study in a three-step approach (planning process, data gathering, and dialogue seminar). In the first step, in 2012, the Vestfold County governor invited researchers from the Centre for International Climate and Environmental Research Oslo and the Center for Technology, Innovation and Culture, University of Oslo, to participate in and observe the process of planning a dialogue seminar on local climate adaptation with participants from the municipalities and the regional and national governments. The aim of the dialogue was to improve climate adaptation in Vestfold County. A reference group

was established by the county governor, involving the researchers, the county governor, and the Vestfold County Council, Vestfold Energy and Environmental Forum, the Norwegian Directorate for Civil Protection (DSB), and selected municipalities. The selection of municipalities was based on previous involvement in work on climate adaptation, including municipalities with a relatively heavy engagement in the issue. The reference group held regular meetings throughout the process and met with the municipalities to discuss both the outcome of the dialogue seminar and new and improved measures for climate adaptation. The researchers contributed with knowledge about local adaptation strategies and with competence on how to produce, summarize, and transfer such knowledge between researchers, managers, and decision-makers.

In the second step, the researchers conducted 26 interviews with representatives from 12 of the 14 municipalities. (Recruitment from two municipalities was unsuccessful.) The recruitment was conducted by the county governor, and the target group was municipal personnel central to climate adaptation efforts, in particular the chief municipal executive (Rådmann) and officials responsible for emergency planning and preparedness and spatial planning. Not all municipalities were able to participate with representatives from the three areas of responsibility either because of time constraints or that the positions were vacant. In some municipalities, the person responsible for spatial planning was also responsible for emergency planning and preparedness. In addition, interviews were conducted with the county governor (2) and DSB representatives (1; see Table 2 below). A guide for semistructured interviews was developed in collaboration with the reference group. The researchers developed a set of questions to be included in this guide, which was discussed by the reference group. Questions were adjusted according to these discussions and a final interview guide was developed to be used in the interviews. The interviews were recorded (except for the DSB), and minutes were taken.

Questions to municipal officials included status of climate adaptation work; how it was organized; how they perceived their own knowledge about the issue; what competence, knowledge, and network they were involved in; and the possibilities to feed this to the national and regional authorities that provide climate adaptation advice to municipalities. We asked how they collaborated with other municipalities and actors and their views on the regional and national governmental actors involved in adaptation. We asked specifically about what they perceived as requirements from regional and governmental actors and what kind of support they needed. In addition, the interviewees were queried about potential barriers they were confronted with when addressing climate adaptation. The interviews with the county governor and DSB covered topics such as how the guiding and overseeing of the municipal efforts on climate adaptation were conducted and what it included (e.g., municipal experiences), their assessment of the resource needs and barriers in today's climate adaptation policies, and possible future improvements in municipal climate change adaptation.

TABLE 2. Number of persons interviewed in the case municipalities.

Municipality	Number of persons interviewed
Larvik	3
Stokke	2
Nøtterøy	1
Tønsberg	3
Andebu	2
Lardal	3
Re	2
Hof	3
Holmestrand	4
Horten	1
Sande	1
Svelvik	1
County governor in Vestfold	2
The Norwegian Directorate for Civil Protection	1
Total persons interviewed	29

The third step of the study was a follow-up dialogue seminar on climate adaptation with all 14 municipalities (including Tjøme and Sandefjord, which did not partake in the interviews). The municipalities were invited to the seminar by the county governor. Prior to the seminar the participants received a copy of the final report containing results from the interviews and feedback from the reference group. The researchers participated in the 1-day seminar and recorded the discussions and dialogues on adaptation challenges and possible solutions pertaining to Vestfold. The findings below are based on data collected from the three-step process.

The process ended with a reference group meeting summing up the results and discussing the coproduction process. We shared our experiences and specifically discussed how the research aims had been changed during the process. The researchers had initially planned to carry out a qualitative field experiment by interviewing the dialogue seminar participants before and after the seminar to assess changes in their perspectives on municipal adaptation policies as a result of the seminar participation. However, through the seminar planning process, it became clear that the country governor

considered it more fruitful to get a thorough understanding of the adaptation work in the municipalities and use this information as a background for designing the dialogue seminar. This illustrates the need for a flexible attitude toward what needs to be done, how it will be done, and the outcome of a coproduction process. We further discuss the experiences gained in the coproduction process in section 6, where we address the need for having an adaptive comanagement strategy in climate adaptation.

5. Findings

In this section, we present the empirical findings of how the local context matters for adaptation to climate change and analyze the limits to adaptation created by broad and generic national guidelines that lack contextual management strategies. Our study shows that local context matters with respect to (i) hazards and exposure sensitivities, (ii) adaptive capacity in terms of human and economic resources, (iii) adaptive capacity in terms of network and knowledge access and transfer, and (iv) adaptive capacity in terms of cobenefits, focus, and linkages to other municipal tasks. Table 3 summarizes the findings along these four dimensions.

a. Hazards and exposure sensitivities

The case municipalities can be roughly divided into inland and coastal with respect to physiographic characteristics and location. The physical location affects the nature of the natural hazards and the risks to which the municipalities may or may not be exposed. Along the coast, storm surge is an obvious hazard when combined with sea level rise and increased extreme weather events, while inland, flood risks are related to rivers and waterways. Quick clay is an overall physiographic characteristic both inland and at the coast. However, some of the municipalities such as Re and Hof are exposed but not sensitive to hazards from quick clay because houses, buildings, and infrastructure are not located in areas with such risks, and they are neither exposed nor sensitive to flood risks. In response to our questions about challenges related to weather and climate change, the municipal officials in Re asked us to look out the window and see for ourselves: the main part of the built area is on small hills situated above an agriculture landscape. A small stream runs through the municipality, and in the event of extreme precipitation there is a small chance that there will be ''some extra water on the agricultural land.'' The case of Re municipality also provides a good illustration of how current management practices unfold. Re municipality does not prioritize climate adaptation and vulnerability assessments likely because of the perception of low exposure sensitivity. However, they call for more dialogue with the county governor in order to better define their priorities given few available resources. But when the county governor representatives are visiting to control and guide the municipal activities they cannot answer questions about how to prioritize between tasks that are mandatory (e.g., care for elderly and schooling) and climate change adaptation needs and vulnerability assessments. The county governor's office is not yet ready to take the responsibility for prioritizing municipal goals and indicate that they are not prepared to give specific advice on how Re should handle climate change issues. This is because the country governor is afraid, in retrospect, of being accused of giving wrong advice to the municipalities. They also argue that they would not like to interfere with the municipalities' decisions and judgements, which they after all are entitled to make (see section 2).

Similarly, Hof municipality has experienced few worrying climate-related incidents: ''We have many small creeks and many dirt roads, but this does not cause any problems for us.'' The two municipalities do not perceive themselves as vulnerable to climate change.

Another exposure sensitivity shared among most of the municipalities is underdimensioned pipes for draining surface water. While some municipalities, such as Nøtterøy, have adapted by finding technical solutions to get rid of the surface water, others are still in need of upgrading the system. A particular sensitivity in Lardal is the large number of outdated private water works and wells, which under extreme precipitation are exposed to drainage of surface water with the risk of contamination.

Hazards associated with quick clay are currently related to existing housing and buildings constructed on land that may be threatened by landslides. Risk of landslides will be exacerbated with the projected increased precipitation. Some of the municipalities (Sande and Lardal) lack maps outlining the subsurface soil and geological conditions prone to landslides, which implies lack of relevant information to assess such conditions and an uncertain exposure and sensitivity. Larvik and Tønsberg are exposed and sensitive to flooding because major industry and housing are constructed along main waterways that flood during periods of heavy snow melt and extreme precipitation. With the projected precipitation increase, the exposure sensitivities will highly likely require adaptive measures. Other smaller municipalities, such as Andebu, have constructed buffer zones and protection of river banks against slipping to protect against current levels of flooding in smaller waterways. It is uncertain whether these measures will be sufficient to meet projected increased water levels.

TABLE 3. Municipalities: The four dimensions. (Low: low risk to humans, infrastructure and buildings. Moderate: possible risk to humans and possible damage to infrastructure and buildings. High: Life threatening and high health risk—severe risk of damage to infrastructure and buildings.)

Municipality, population	Hazards and exposure sensitivities	Adaptive capacity: human and economic resources	Adaptive capacity: networks, knowledge, and transfer (networks, see Table 1)	Adaptive capacity: cobenefits and linkages to other municipal tasks
Re	Low risk. No significant water ways/rivers and no significant threats of flooding. No housing constructed in quick clay areas. Pipes and drainage not sufficient to meet the occasional extreme precipitation.	Currently not a priority due to perceptions and experiences of low risk. Not enough human resources to work with adaptation and preparedness for future risks.	Few contacts at the state level. Express that they have a sufficient overview of the challenges.	None made.
Hof	Low risk. Some risks of drainage from agricultural fields into drinking water under extreme precipitation events.	Currently not a priority due to perceptions and experiences of low risk. Not enough human resources to work with adaptation and preparedness for future risks.	Few contacts at the state level. Express that they have a sufficient overview of the challenges.	None made.
Lardal	Moderate/low risk. Quick clay areas that are susceptible to extreme precipitation. A proportionally large number of private waterworks, which are not secured against extreme precipitation events—health concerns. Significant river, but no significant threats of flooding.	The existing human resources are not coordinated. Economic resources lacking to produce proper maps of quick clay areas. Not enough human resources to work with adaptation and preparedness for future risks.	Aware of own knowledge gaps but not successful in acquiring such knowledge. Miss more knowledge/information from state-level actors and coordination of databases. Few contacts at the state level.	None made.
Tønsberg	Moderate risk—quick clay in existing housing areas and flood risks.	Sufficient resources to handle civil protection and municipal planning. Good communication and coordination between different sectors, optimizing human and economic resources.	Good access to knowledge from state-level actors. Miss more detailed and relevant flood maps from NVE.	None made.
Larvik	Moderate risk—quick clay in built areas. Risks of flooding and landslides along significant water way.	Dedicated human resources in civil protection, and two involved in climate and energy planning. Have sufficient human resources but express that they do not have sufficient time to cover all needs.	Notes the challenges of large intermunicipal networks. The municipalities have different needs and better coordination could be made. Have good access to knowledge from state-level actors.	Adaptation part of climate and energy plan.
Andebu	Moderate/low risk. Several smaller water ways and areas are secured by construction of buffer zones and protection of river banks against flooding. Possibly problems with quick clay in established residential areas (a couple of houses) but aware of risks when planning of residential areas.	Not enough human resources to handle all the tasks. Too many objectives in the existing plans and lack of coordination among them. The plans are not always congruent. Proactive thinking in how to solve some adaptation problems.	Are active in developing formal networks (e.g., with Stokke) and see the value in sharing resources with other small municipalities. Few relevant contacts at the state level.	Adaptation is seen in relation to human health.
Holmestrand	Low risk. Occasional storm surge cause flooding in basements, which may increase with sea level rise. Quick clay present but not in built areas.	Lack resources to prioritize the area. The person responsible for civil protection has this task in addition to already existing tasks that occupies 100% of the position.	Few relevant contacts at the state level.	None made.

TABLE 3. (*Continued*)

Municipality, population	Hazards and exposure sensitivities	Adaptive capacity: human and economic resources	Adaptive capacity: networks, knowledge, and transfer (networks, see Table 1)	Adaptive capacity: cobenefits and linkages to other municipal tasks
Horten	Low/moderate risk. Presence of quick clay. Express a concern for risks in connection with increased precipitation and storm surge.	Engaged official as chief municipal executive. Have prioritized economic resources to reducing risk and vulnerability.	Have relevant contacts at the state level. Express that the state level has not provided a sufficient overview of risks of quick clay.	Adaptation closely linked with civil protection.
Sande	Moderate risk. Quick clay in the center of the municipality and under existing houses, which are under risk of slide.	Human resources available to address the risks from quick clay. A civil protection coordinator. Express that their cross-sectoral coordination is good.	Cooperates with neighboring municipalities. Have relevant contacts at the county and state level.	None made.
Svelvik	Low risk. Quick clay in relation to existing houses, and small water ways that may swell with increased precipitation. Storm surge in combination with increased precipitation and underdimensioned pipes.	Economic challenges that limit the possibilities for working with adaptation. Room for improvement of cross-sectoral communication.	Lack of coordination of databases from the state level a problem—reduce access to knowledge. Cooperates with neighboring municipalities. Have few contacts at the state level.	None made.
Nøtterøy	Low risk. Presence of quick clay. A long coastline and storm surge will have consequences for spatial planning.	Express that they have sufficient and competent human resources. Have their own climate advisory board that includes the mayor.	Overarching knowledge and advice needed that can be adapted to the local context. Have relevant contacts at the state level.	None made.
Stokke	Low risk. Storm surge in combination with increased precipitation and underdimensioned pipes. This might also have consequences for drinking water quality.	Not a prioritized area of policy and also lack resources to prioritize the area.	Few relevant contacts at the state level. Collaborates with Andebu.	None made.

Coastal municipalities (Nøtterøy, Svelvik, Horten, and Holmestrand) have identified storm surge as a current hazard to which they are exposed and sensitive. Increased storm surge and extreme weather events combined with the effects of projected sea level rise (approximately 40 cm by 2100; data from Norsk Klimasenter) will increase these challenges significantly. Hence, physiographic challenges as identified across the municipalities range from none to high exposure sensitivity to weather and climate change.

b. Adaptive capacity: Human and economic resources

A general feature of our case studies is that the smaller municipalities (population size) of our sample (Re, Hof, Lardal, Andebu, and Svelvik) have dedicated few human and economic resources to deal with climate adaptation and civil protection (see Table 1 above). As stated by the interviewee from Svelvik: ''It is a challenge to have sufficient human resources and expertise in all areas. We are few and we don't always have enough time to evaluate and consider everything. We don't have enough money and resources are limited.'' Interestingly, the tasks associated with climate adaptation are assigned to people who are fully occupied with other tasks that are more pressing or mandatory (education, care for elderly, and health; see also Dannevig et al. 2013). Tasks associated with adaptation and civil protection against weather-related events and hazards are closely linked to spatial planning but are not necessarily subsumed under such activities in the smaller municipalities. The larger municipalities (Larvik, Tønsberg, Horten, and Nøtterøy) have earmarked economic resources for dedicated positions to work with climate adaptation and civil protection. The medium-size municipalities (Holmestrand and Sande) vary in the way they dedicate resources. In Holmestrand, the work on civil protection is allocated to a person who is already responsible for a number of other tasks, while Sande has allocated some human resources to specifically deal with climate adaptation.

The findings show variation in the degree of coordination between sectors, independent of municipal size. Two types of coordination of climate adaptation emerge between civil protection and spatial planning and between the different sectors and spatial planning. Tønsberg coordinates well by including climate change when coordinating across the different municipal sectors with civil protection and planning. While Horten coordinates the work on adaptation and civil protection across sectors such as health and crisis administration, climate change is included neither in spatial planning nor between spatial planning and other sectors. Hence, these municipalities vary in the degree to which they dedicate resources to climate change adaptation and in whether and how they coordinate with other sectors.

c. Adaptive capacity: Networks, knowledge, and transfer

As shown in Table 1, the municipalities vary in network participation and in how much they coordinate their planning efforts. All the case municipalities are involved in the countywide Preparedness Forum and the Spatial Planning Network for Vestfold. Most of the municipalities are involved in 12K (see section 4). Three of the municipalities (Re, Hof, and Holmestrand) have a common municipal plan, which includes the spatial plan, but have to date not included climate adaptation in their work. Sande and Svelvik collaborate on developing their RVA. The remaining municipalities (Tønsberg, Larvik, Lardal, Andebu, Stokke, Horten, and Nøtterøy) have done little to coordinate their efforts.

The municipalities also vary with respect to knowledge access. In our study two aspects warrant attention: (i) the municipalities do not have access to relevant knowledge due to a limited network and a lack of expertise on how to locate the knowledge, and (ii) locally relevant knowledge about quick clay slides and flooding has not yet been developed by state-level agencies (NVE) because such events are not life threatening in these municipalities. The authorities prioritize the development of quick clay and flood maps where health and lives are threatened. For NVE to develop such maps, major mapping exercises are needed.

Lardal is a good example of both aspects; they lack the network needed for gathering information, and they lack the necessary maps on quick clay and flooding needed in their planning activities. Tønsberg has a sufficient network and know where information can be found, but the maps they need for planning purposes are not available. Some of the municipalities have clear ideas on the kind of knowledge that is needed to support local climate adaptation. Some also have the capacity to articulate how this knowledge should be tailored to the local context, but this input is not taken into account by national authorities. Nonetheless, most of the municipalities in Vestfold do not have sufficient expertise to know what kind of information is needed to further develop adaptation strategies.

d. Adaptive capacity: Cobenefits and linkages to other municipal tasks

Andebu is one municipality that explicitly makes the link between public health and climate change, partially because of one engaged municipal planner. This planner

has expertise in public health and is also responsible for planning in the municipality. She has been heavily involved in the development of the climate and energy plan in which adaptation is included. Her engagement in both issues has influenced her linking climate change adaptation in Andebu to public health. In Larvik, engaged officials integrate both climate mitigation and adaptation in one and the same climate and energy plan. Such plans usually focus solely on climate mitigation. Horten is highly engaged in civil protection and acknowledges that climate adaptation has become an important aspect of such protection. Horten expressed a need for including climate adaptation in their plans because of the cobenefits in linking civil protection and climate adaptation. The officials argue that this will strengthen their image as a municipality well prepared for disaster.

Table 3 summarizes the results.

6. The call for adaptive comanagement

Climate change impacts unfold locally, and how it is dealt with in municipalities depend on the local municipal context. Below we discuss the implications of our findings for the governance of climate change adaptation at the local level and if and how adaptive comanagement may improve climate change adaptation in the municipalities.

Table 3 shows that there is great variation between the 12 case municipalities with respect to physiographic challenges, available resources, networks, needs, knowledge, and focus areas, illustrating that they experience different exposure sensitivities, which in turn result in different adaptation needs. A comparison shows that the municipalities differ in the extent to which they have resources to mobilize for adaptation to climate change. They also differ in expertise and capacity to both utilize and meet national guidelines and requirements. The national adaptation guidelines and requirements are general and overarching, and local concerns and needs are not the main target. The guidelines and requirements are in turn interpreted in each municipal context, which may lead to differing ways of operationalization. The outcome may be either too little or too much adaptation. With too little adaptation, municipalities may respond or adjust to national guidelines inadequately because of a lack of resources and relevant knowledge. They may not prepare for future climate adaptation in a proactive manner but instead adapt reactively, which is likely to leave them more vulnerable (this may be the case for Holmestrand and Svelvik in the future). Too much adaptation pertains to national adaptation guidelines and requirements demanding engagement in adaptation issues even when few exposure sensitivities are identified in the municipality (to be expected for Re and Hof). Therefore, general national guidelines lacking contextual management strategies may result in either too much or too little engagement in adaptation. A changing climate will create new challenges for local communities and local governments. Climate change uncertainties and reactive adaptation practices together make a strong motivation for an alternative approach to governance that is flexible and adequate to address future climate risks and hazards.

The variation across local contexts demands an adaptation policy that addresses the particular needs of a municipality and provide locally relevant advice. This approach may even out the high variability between the municipalities along the four local context dimensions mentioned above (physiographic/physical challenges; human and economic resources; networks, knowledge, transfer, cobenefits, focus, and linkages; see Table 3). Adjusting adaption policies to the local contexts is beneficial in a broader national or regional context in that it ensures a better fit across the municipal borders, independent of size and resources. A governance practice that is based on dialogue between the levels of government where the different characteristics of the municipalities and the local knowledge base is taken into account provides opportunity to adjust adaptation policies to the local context rather than assuming that every municipality should be treated equally.

In Norway the multilevel governance structure gives clear responsibilities to the different levels of governments (see section 2) and is akin to a top-down approach. The county governor is a centralized bureaucracy (Gunderson and Holling 2002; Berkes et al. 2003) that oversees and provides general guidelines not specifically addressing the local context. This is illustrated with the case of Re referred to in section 5 in which the county governor avoids giving locally relevant.

An adaptive comanagement process, including different levels of government, increases the likelihood of better coordination of local, regional, and national resources allocated to adaptation efforts. Many case municipalities (Svelvik, Tønsberg, Larvik, Re, and Sande) ask for better coordination across municipalities facing similar adaptation challenges and/or municipal structures. They note that this would increase cross-municipal learning experiences, expand adaptation networks, and possibly coordinate cross-border resources. These coordination initiatives, they suggest, could be facilitated through national and regional governments (county governor). Our case study shows that the county governor is interested in assuming such a role

and wishes to be more engaged as a facilitator. This is illustrated by the active role of the governor in the dialogue seminar. Coordination across municipalities offers a way to even out the municipal differences resulting from size and resources and to address common adaptation challenges.

An adaptive comanagement process entails a greater facilitation of cross-sectoral and cross-institutional linkages, which ensures better use and release of more resources. Through such processes, more relevant and accurate assessments of local risks and impacts, both current and future, will likely be developed. Through adaptive comanagement processes different types of knowledge are brought together to make strategies and plans for climate change adaptation. In this study, the transdisciplinary process brought together different types of knowledge (researchers and practitioners) with the purpose of planning the dialogue seminar on adaptation (see section 4). The planning brought together multiple sources of expertise, which resulted in new knowledge and an increased understanding of the different perspectives. Through the interviews with the municipalities (with questions developed in collaboration between researchers and practitioners), the importance of allowing for variations in climate adaptation work at the municipal level became clear. Conversely, it became evident that including the local context in multilevel government practices comes with its own challenges both through the assigned role of the county governor and through the independence of municipalities to design their own policies. The process allowed for learning, both cognitive and relational, through the results from the interviews and from different perspectives (see also Baird et al. 2014). Finally, the transdisciplinary approach of this paper also illustrates another key point for adaptive comanagement processes: the design of the dialogue seminar facilitated the emergence of new knowledge needs. The county governor first pictured this seminar to entail standard presentations of adaptation issues with time for questions from the participants. Through the transdisciplinary process it became clear that it would be much more beneficial to design the dialogue seminar with the municipalities as a process with group work and presentations. This revealed a need for more local-level expertise on climate risks in order for the municipalities to ask informed questions and demand more clearly what was needed to improve work on climate adaptation. Hence, an adaptive comanagement process might also entail a greater possibility of identifying knowledge needs that are not covered in the current database and an opportunity of addressing those needs in further developments.

Nearly all (9) of our interviewees (Holmestrand, Re, Tønsberg, Lardal, Horten, Nøtterøy, Larvik, Andebu, and Sande) note that the resources allocated by the state for advice and provided necessary assessments of risks are too scarce to cover local knowledge needs. Detailed mapping of risk areas in a municipality is only required when there is a risk of loss of lives and health. However, several of the municipalities ask for a more detailed mapping of risk areas for quick clay and flooding to increase their knowledge about the hazards when planning new housing, infrastructure, or business, even if these areas are not categorized as at risk for loss of lives and health (see Kirchhoff and Dilling 2016). This is exemplified in the following quote: ''It was said that the NVE would provide more knowledge about the danger from quick clay, but that has not been done. We miss more and specific knowledge from national actors'' (Lardal municipality).

As discussed earlier, adaptive comanagement processes can be organized in different ways (Armitage et al. 2011), but they all include systematic use of networks, working groups, and other arenas for regular dialogues, discussions, and knowledge exchange between different levels of government. They also include clear targets for these processes and an understanding of the long-term horizon needed to build the necessary institutional arrangements that support knowledge exchange and decision-making processes for prioritizing measures at the local level. This clearly requires financial and human resources allocated from both the state and municipal levels in our case study. For some municipalities, resources and funding are important but equally so is advice on how to make the right priorities. Some municipalities are economically constrained and must prioritize tasks required by law and do not necessarily have the resources to prioritize climate adaptation. Furthermore, some municipalities note that climate adaptation is too serious to be handled solely by them. These are interrelated and not mutually exclusive perspectives, which call for better prioritization and involvement by the national level and dedicated economic resources. With respect to adaptive comanagement processes, this calls for the national government to open up a more dialogue-oriented governance practice across national, regional, and local levels. Existing collaborative networks among the municipalities could be expanded and could also include the county governor and relevant directorates, as exemplified by the dialogue seminar.

Research points to the need for a multilevel governance practice to cope with climate change adaptation (e.g., Tompkins and Adger 2005; Amundsen et al. 2010) and that there is a need to move toward a framework of

multilevel governance and new network spheres for addressing environmental issues like climate change. We expand on this notion by arguing that the multilevel governance framework for adaptation policies needs to be adaptive and based on comanagement. An adaptive practice asserts that policies can be changed according to the challenges faced by climate change, and a comanagement practice allows for knowledge, resources, and networks to be better adapted to the particular localized exposure sensitivities and risks. This is highly likely to result in more efficient and proactive adaptation processes and practices at the local level.

7. Summary of findings and conclusions

This paper addresses how the local context matters for developing climate adaptation policies relevant and applicable to future challenges. Municipalities vary with respect to physiography, human and economic resources, networks that they participate in, knowledge they possess, how this knowledge is transferred between different government levels and sectors, how and if they link climate adaptation to other municipal tasks, and, finally, with respect to the barriers to adaptation. Climate change requires a proactive adaptation policy that is capable of adjusting to changes in multiple conditions. Currently, the Norwegian state-level governance structure and practice is organized to provide general requirements and guidance on climate adaptation, leaving the decision on which measures to choose and how to implement them to the municipalities. The main task for the state is to oversee and supervise municipalities to ensure that the general national requirements are fulfilled. This effectively reduces the potentials for contextualized advice and a dialogue-oriented approach that in turn create necessary flexibility both in scope and time. Our results show that current national policy is too general to be applicable for municipalities and to address risks resulting from future climate change. This study shows that the case municipalities require locally adapted information and knowledge and tailored advice from the national authorities in order to adapt. Experiences from other policy areas provide relevant guidance for how this can be done. Adaptive comanagement processes need time to develop and find its right format (cf. Armitage et al. 2011), and the process can be facilitated through diverse modes of communication, deliberation, and social interactions (e.g., meeting, workshops, study tours, and visits). Further, a key feature of adaptive comanagement is the testing of policies in practice. The aim is to continuously learn from the experiences and adapt policies accordingly (Lynch and Brunner 2010). These experiences can also be used to inform other communities about the results. As Lynch and Brunner (2010) point out, the collection of different contexts and experiences might create creative policy alternatives that are significant clues for adapting to a changing climate.

We argue that adaptive comanagement between national, regional, and local levels represent a useful way to address many of the limitations and challenges concerning climate change adaptation at the municipal level. Adaptive comanagement allows for flexible responses to diversified local contexts and with respect to changing future conditions. A dialogue-oriented process between different levels of government is needed to ensure this flexibility (e.g., Berkes and Armitage 2010). This may also entail a greater utilization of different types of knowledge, including local and scientific knowledge that may contribute their knowledge to develop a proactive and locally adjusted climate adaptation. Furthermore, the knowledge held by municipal officials must be recognized and acknowledged as a resource for enriching national advice given to municipalities or even to become coproduced advice. Our results show that this may require a change in how the tasks of the different government levels are perceived, expressed, and handled. Adaptive comanagement requires a flexible and contextualized governance practice in which municipal officials take an active role as partners, which is in contrast to today's more top-down-oriented management practices. This shows that the multilevel governance called for to address climate change adaptation at the local level (Amundsen et al. 2010) needs to be expanded to allow for adaptability and comanagement. It furthermore requires that the role of the Norwegian County governors is discussed and revised to include contextualized advice and coproduction of adaptation policies. The way this role is interpreted and practiced today suggests that the county governors are not prepared to take on this responsibility.

Conversely, there are limits to adaptive comanagement processes that should be acknowledged. First, a higher degree of contextualized policy practice would likely require more resources for addressing current and future climate change adaptation, which demands an increased focus and willingness from both state and municipal levels for long-term allocation of such resources. Second, an awareness of the risks of unequal power relations between different actors in an adaptive comanagement process is needed (Watson 2013). In our case, the county governor oversees and controls that the municipalities comply with national requirements, indicating that there will be unequal power in an adaptive comanagement process. However, Norwegian municipalities are entitled to make autonomous decisions and

expect their voices to be heard. This might reduce the risks of uneven power relations.

Last, from a fuzzy decision-making context, which includes the pronounced uncertainty level in climate change, flexible policies are both required and preferred. Adaptive comanagement is a possible way to achieve such flexibility in both policy and practice, with multilevel governance and different forms of knowledge.

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