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# Silos as barriers to public sector climate adaptation and preparedness: insights from road closures in Norway

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## ABSTRACT

Organisational perspectives propose that structural arrangements affect policy outcomes. Drawing on these perspectives, it is worthwhile to find out whether and how disagreements among public authorities create barriers to public sector adaptation and preparedness. As the literature on weather vulnerabilities and climate adaptation recommends increased public sector coordination, exploring the possibilities of governance can contribute to the improvement of lifeline conditions. Insights from a Norwegian case study suggest that the different mandates of responsible public authorities sometimes clash. Such clashes limit the abilities to sustain welfare and business conditions when avalanches and blizzards cause highway outages. The findings also show that governance might only partly improve public sector peril response measures, as there is rarely sufficient flexibility to consider specific interests or preferences, for example, to keep a highway open until a school bus or a freight delivery has passed.

**KEYWORDS** Adaptation; governance; multi-level system; preparedness; public administration; natural hazard

## Introduction

Communities around the world are vulnerable to sudden lifeline cut-offs caused by natural hazards. Such problems are becoming increasingly serious, given climate change and the advance of the 24/7 society that expects and requires unrestricted road access. Public authorities grapple with how to sustain or improve the quality of life, health, welfare and livelihoods following these cut-offs.

In this complex world, authorities disagree on how best to delineate multifaceted climate-induced dilemmas that threaten people's welfare and business conditions. Yet in public administration, coordination across policy sectors and levels of governments has gained increased importance (Peters

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2015a). Although departments tend to operate in silos (i.e., they do not share information or work together), policy problems such as climate change and weather-induced challenges transcend organisational boundaries, administrative levels and sectors (Lægreid and Rykkja 2014).

Against this background, we ask whether organisational silos create obstacles for public authorities when trying to solve preparedness and adaptation problems related to natural hazards. Do differences among these authorities create barriers to public sector adaptation and preparedness? If so, could the public authorities contribute to improving welfare and business conditions, if they increased their coordination (i.e., changed their governance structures) when responding to disruptions caused by natural hazards?

Drawing on organisational and governance approaches, we explore the relationships between public authorities with responsibilities for winter climate-induced highway closures in Troms County in northern Norway. This region is interesting, since several of its communities are prone to being disconnected from the outside world through road closures, electricity outages and telecommunication outages.

We describe the responsibilities of authorities and elucidate upon the difficulties of resolving problems with local preparedness and adaptation caused by winter climate-induced highway closures. We also investigate whether modified governance structures may contribute to mitigating the drawbacks of cut-offs of lifelines: physical networks that are vital to the health, safety, comfort, and livelihoods of a community (Platt 1991).

This investigation is relevant for several reasons. Empirically, it is timely for decision-makers to pay more attention to winter climate-induced perils and related uncertainty problems (Lawrence 2015), particularly in multi-layered institutional contexts with significant decentralisation like Norway's (Hollis and Ekengren 2013). Several preparedness studies indicate deficient policy guidance and limited coordination among levels of public administration (Fimreite, Lægreid, and Rykkja 2014; Høydal 2007); there is also a lack of in-depth understanding of sub-national policy-making, or of the ways in which institutional procedures work when nature's forces strike. There is also a lack of studies of the problems bedevilling public authorities at various levels and sectors in affluent societies, specifically the perils of sudden winter climate-induced highway closures. These issues are not only interesting in their own right, they are also vital to people's lives since local preparedness and adaptation contribute to the security of a society (Baker et al. 2012; Wilson 2006) and the upkeep of business conditions.

A vast body of literature has proposed government reform and 'good governance' as solutions to societal issues (Leftwich 1993). Brooks, Adger, and Kelly (2005) maintain that adaptive capacity to natural disaster events

and climate-induced calamities is largely associated with governance. Adaptation encompasses various actions to protect people, conducted by individuals, groups, governments and public bodies – mostly within hierarchical structures and the constraints of institutional processes (Adger, Arnell, and Tompkins 2005). Among the barriers to adaptation are failure in collective decision-making and ambiguity over who is responsible for action (Tompkins and Adger 2005). Adger, O'Brien, and Lorenzoni (2009) underline that climate-related adaptation is a multi-scalar process of multi-level governance from the bottom up and from the top down. Thus, increased coordination across public sector agencies and levels may help to solve severe multi-faceted problems triggered by nature's forces. Such assumptions have guided extensive research on the adaptation and preparedness related to natural hazard events and climate issues (Biesbroek et al. 2013, 2014). Implicit is often an optimistic comprehension that if governance issues are resolved, then natural disaster preparedness and adaptation capacity will improve. However, the unpredictability of natural hazard incidents indicates that this may be a disputed field of governance (Zurita et al. 2015).

While the selected case does not represent a change in the governance structure, investigating perceptions and current barriers do provide insight into whether improved governance may contribute to solve these problems. It should be added that while multi-level and other types of governance research often include civil society, the present study concentrates on public authorities, agencies and their contractors, as civil society in the study areas has extensive experience in the short-term adaptation to road closures (Jacobsen, Leiren, and Saarinen 2016).

In the following, we present the organisational and governance perspectives and delineate our expectations before presenting the methods. In the empirical section, we describe the formal responsibilities, perceptions and mandates of public authorities, as well as their work related to local security, natural disaster preparedness and protection against avalanches and blizzards. Finally, we discuss the evidence in light of the organisational perspectives and governance theory, explaining how different roles and responsibilities result in disagreement among public authorities in terms of how to sustain welfare and business conditions during adverse natural events. The article concludes with some general thoughts about natural hazards as public authority challenges.

## **Organisational and governance perspectives**

Climate adaptation researchers call for increased coordination across actors and levels, arguing that neither local nor upper management works well by themselves (Berkes 2009). Biesbroek et al. (2013) claim that practitioners tend to believe in abilities to solve problems. As a result, there is a lack of

analytical frameworks that guide the realist and pessimist types of barrier examination to climate-related adaptation. A realist perspective sees many societal challenges as wicked, a pessimist perspective assumes that government contributions to solving climate-induced problems are only minor (Biesbroek et al. 2014). By focusing on the ability of public authorities to restore lifelines to the outside world or problems that are related to cut-offs from the outside world, we draw on organisational and governance perspectives.

### **Organisational perspectives**

The organisational perspective in institutional theory is useful for understanding how administrations handle natural hazards. As known from classics in the literature on public administration (March and Olsen 1989), structural arrangements at various administrative levels and how they relate to each other affect policy outcomes. The delegation of responsibilities determines the topics that reach the agenda, the topics that are seen in juxtaposition, and that topics that are ignored (Cohen, March, and Olsen 1972). Moreover, organisational settings may shape public decisions, as organisational affiliations typically inform policy content and affect staff thinking and behaviour (Egeberg 2003).

Organisational arrangements create borders that focus decision makers' attention and help them to comprehend a complex reality (Egeberg 2003). Hence, the locations of responsibilities for various policy areas are important (i.e., portfolios in different sectors or political and administrative levels). Departments tend to operate in silos. They can be ambitious about joint policy development and horizontal coordination, both of which often face a range of barriers in practice. This is known in general (Peters 2015a), and in relation to preparedness and climate adaptation (Forino et al. 2017). For example, local planners who have key preparedness and planning responsibilities, may only have a 'superficial understanding' of how to implement sustainability objectives (Berke and Conroy 2000); and local authorities tend to lack the competence and plans to resolve climate-induced hazards (Amundsen, Berglund, and Westskog 2010). Lower administrative levels are inclined to wait for instructions, information and measures from above (Rygshaug and Solli 2012) while national and sectoral authorities do not sufficiently take into account the different local contexts (Westskog, Hovelsrud, and Sundqvist 2017). In many cases, adaptation planning does not sufficiently contribute to local societal security (Baker et al. 2012; Wilson 2006). Based on such insights, our *first expectation* is that organisational silos or disparities among the responsible public authorities create barriers to problem solving.

### ***Governance approaches***

In most European societies, public administration has traditionally solved social problems in a sectoral and hierarchical manner (Kettl 2015): authority emanates from the top and orders are passed down the line (Pollitt and Bouckaert 2004). However, in the twenty-first century the state alone cannot solve many complex societal problems (Meuleman 2008), by its orders or by 'rule of law' (Benson 2009). To understand natural hazards and other environmental problems, researchers have proposed a variety of governance modes (e.g., markets, networks, top-down approaches).

'Governance' refers to new governing processes (Rhodes 1996, 1997) and how governments act (Kettl 2015). Network governance has become most commonly associated with the idea of governance; for example inter-organisational networks that bring together governing bodies and cooperating organisations to solve public problems (Sørensen and Torfing 2005, 2009). As such, policy networks reflect stable social relationships among interdependent actors, coalescing around policy problems and/or programmes (Kickert, Klijn, and Koppenjan 1997).

'Multi-level governance' has insights that are beneficial for political systems with several tiers of authority (Marks 1992). As a framework, it provides an understanding of policies at a higher political level, as a result of the continual international, national, regional and local coordination. Overlap and interdependence characterise the relationships between these levels (Hooghe and Marks 2001). Multi-level governance has a horizontal dimension, when actors at different political levels meet to agree on policies (Hooghe and Marks 2001). It also has a hierarchical dimension, where constant top-down coordination results in interventions at lower levels from a higher-level authority (Egeberg 2006). Examples include situations when a higher authority organises courses for civil servants, imposing rules on how lower-level tasks should be performed. The hierarchical approach challenges self-control at the lower levels.

While the hierarchical multi-level approach may contribute to understanding decisions at the sub-national level, the key intention of multi-level governance is to bring sub-national actors into the understanding of policy development at higher political levels (Piattoni 2009). For local responsibility studies (i.e., social adaptation and preparedness to natural hazard events), meta-governance is more widespread than multi-level governance. This is because meta-governance is concerned with the influence of higher political levels on policy processes that have been delegated to lower political levels. 'Meta-governance' means 'coordinating different forms of governance and ensuring a minimal coherence among them' (Jessop 1997, 7). It depicts formal public organisations' need to retain some control over decentralised decision-making organisations (Meuleman 2011).

Recognising that there are limits to the vertical hierarchical power as well as to horizontal regimes of self-coordination (Whitehead 2003), meta-governance highlights practices and procedures that contribute to secure governmental influence (i.e., command and control) in matters that lower political levels are responsible for (Amore and Hall 2016). It also encompasses the state's attempts to steer actors in particular directions (Sørensen 2006), for example when higher-level management supervises local authorities, where the latter has the key responsibility in climate adaptation.

While our first expectation proposes that the typical portfolio approach creates barriers to problem solving, adaptation researchers see governance as a way to resolve such issues. In the transport sector, where responsibilities are fragmented, strengthened coordination across levels and between departments and agencies seems to be rational and helps to steer through chaotic situations (Moser and Ekstrom 2010; Peters 2015b).

It could also be expected that the involvement of higher levels via meta-governance improves preparedness and adaptation, as the key level responsible for adaptation policy, the local level, is often criticised for having weak adaptation competence (Amundsen, Berglund, and Westskog 2010). Our *second expectation* is therefore that increased coordination via meta-governance will make public authorities better at handling conditions caused by natural hazards. As our case does not represent altered meta-governance structures, we respond to this second expectation based on the investigations of informants' perceptions.

## Methods

To understand public sector multi-level meta-governance related to winter climate-induced road perils, a study of a region is relevant, as it involves a range of public authorities and agencies at different levels with a variety of responsibilities. We focus on Troms County (Norway), which encompasses several communities that are prone to sudden highway closures caused by avalanches, heavy snowfalls and strong winds.

The data are primarily qualitative and include written documentation about formal responsibilities and oral data from nine interviews and two workshops. Informants were chosen for the purpose of integrating perspectives from a range of administrative levels and from relevant actors who are not part of government administrations. We selected informants from two municipalities to incorporate viewpoints from two local administrations: Tromsø, including the biggest city in Troms in terms of population, and Berg, a small municipality. Both areas are exposed to winter climate-induced highway closures. All informants remain anonymous.

The first four interviews were carried out on 4–5 February 2015 in the small community of Senjahopen, which experiences highway closures nearly

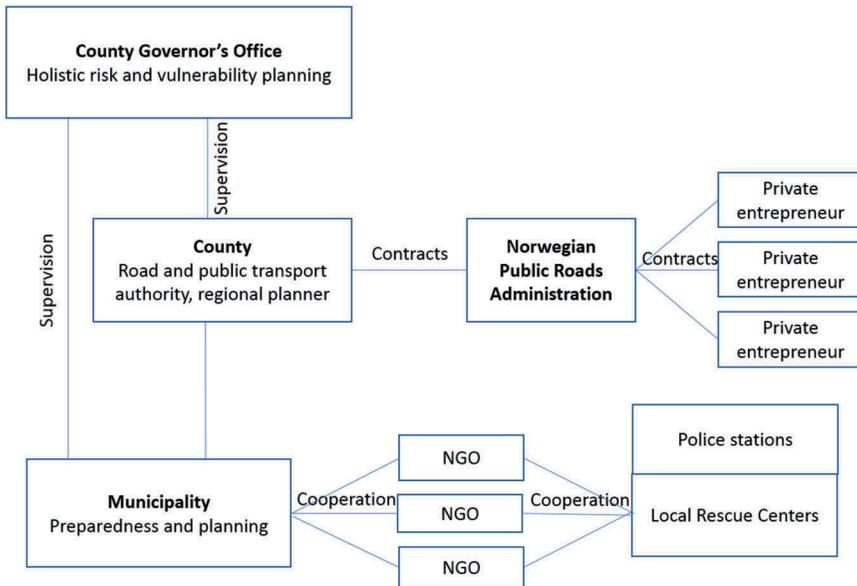
every winter. The informants were three members of the ambulance service (Interview 5), two employees of a freight company (Interview 6), one politician (Interview 7) and one snow truck driver (Interview 8). Four telephone interviews were completed in April 2015 with civil servants from Tromsø (Interview 1), the Norwegian Public Roads Administration, Region North (Interview 2), the County Governor's Office in Troms (Interview 3) and the Berg municipality (Interview 4). One additional interview with a business manager in Senjahopen was conducted on 7 August 2017 (Interview 9). Informants in Interviews 1–4, including three representatives from the regional administration, the county of Troms, participated in two workshops in Tromsø. Workshop 1 met on 2 February 2015 and Workshop 2 on 30 March 2017. The workshops were semi-structured, like the interviews, but open for group discussions. The sample size is a consequence of the number of authorities and agencies involved. These are small organisations. Hence, the study was limited to the most important staff. The sample is large enough to answer the research questions (Marshall 1996).

## **Resolving local preparedness and adaptation problems in Troms**

In Norway, public authorities' responsibilities are organised in accordance with the sector principle, with municipalities and counties being independent. Despite the delegation of responsibilities, the state often wants to influence decisions (Sørensen 2006). This also happens in Norway's road sector (Leiren, Krogstad, and Longva 2015). Moreover, cooperation is deficient within the transport sector (Tennøy 2012). Even at the same administrative level, portfolios related to the transport sector are typically located in different departments (Leiren, Krogstad, and Longva 2015). In this section, we summarise the key responsibilities of the most important local, regional and national actors. We also describe their experiences, perceptions, challenges and mandates.

### **Formal responsibilities**

The road sector involves cooperation among national, regional and local actors (Figure 1). Actors at the *national* level supervise, coordinate and monitor local preparedness and security responsibilities. The County Governor's Office, the regional representative of the national state, supervises local tasks. It trains municipality staff (the Instructions of the County Governor's Office from 2008). In major emergencies, the County Governor's Office may be tasked with crisis coordination, to ensure that the situation is effectively handled with a clear division of responsibilities and sufficient competence at all administrative levels. The County Governor's Office focuses on preparedness, holistic risk and vulnerability analyses. The County Governor's Office may object to local



**Figure 1.** Overview of relations between key public authorities and their roles in cases of Norwegian regional highway closures (NGO: non-governmental organization).

or county plans to ensure that civil protection is properly considered. This is sometimes controversial, as the Plan and Building Act is unclear, as it includes both ‘can’ and ‘should’ formulations.

At the *regional* level, the County is important, because of its role as a road owner, public transport authority and regional risk planner. Its competences are in the hands of two departments: the planning department, which revises the regional risk and vulnerability plans, and the transport department, which provides public transport services and road services and investments. As the largest road owners in Norway, the counties rely on the expertise of the Norwegian Public Roads Administration (hereafter: Roads Administration) to plan, estimate road projects, and procure maintenance and investment contracts. On behalf of the County, the Roads Administration decides whether a highway should be closed at times of heightened avalanche risks or (impending) extreme weather (e.g., blizzards, heavy snowfall). The Roads Administration also carries out public procurements for the County, granting the rights for entrepreneurs to compete for road maintenance and investment contracts. The Roads Administration monitors entrepreneurial performance to ensure compliance with the contracts. It delegates entrepreneurs to assess avalanche and blizzard risks but makes the final decisions on highway closures and openings. This sectoral authority has, like the police, the authority to close a road and direct traffic (Road Traffic Act § 7). The Roads Administration has a responsibility to know

the road and roadwork risks, threats and vulnerabilities and is obliged to work cross-sectorally with emergency planning (Directorate of Public Roads 2015). It is also responsible for ensuring preparedness to safeguard the best possible accessibility on the main road networks under various strains. The Roads Administration includes six regional authorities; the Northern Region is the relevant subdivision for this investigation.

The primary responsibility for work related to preparedness and adaptation lies at the *local level*. This is in line with the Norwegian proximity principle, according to which crises should be handled at the lowest possible organisational level. The Civil Protection Act confers upon the municipality the primary responsibility to respond to any peacetime emergency. The Act requires the municipality to undertake civil emergency preparations to safeguard the continuation of key social services, including local infrastructure, health services, elderly care and public information. The municipalities are obliged to root societal security in all planning and budget processes. Important tools include local planning (under the Plan and Building Act), risk and vulnerability analysis and local crisis management plans. Every municipality is legally required to have a local preparedness plan, which is its operative plan for crisis and catastrophe management. It should be revised annually. Training, in line with the preparedness plan, should be carried out every second year.

### ***Various perceptions of road closures***

Closing a highway causes numerous problems. Residents of areas with frequent and sudden road closures express worries about their life and well-being (e.g., fatal road accidents; not being able to get to and from appointments with health services and medical practitioners), livelihood (e.g., income losses for businesses as goods cannot be transported; employees hindered from getting to and from work) and welfare (e.g., running errands, transporting children to or from school, receiving visits from relatives and friends). These are also concerns of municipalities. Moreover, there are concerns that municipalities will not appeal to prospective residents or businesses (Interview 1; 4).

When a highway is closed, the foremost concern of the municipality is the protection of public services (e.g., education, health, and technical services) in the best possible way (Interview 1, 4). Kindergartens and schools have their own procedures for pupils and parents when, for example, an access road is (or likely to be) closed. The municipality ensures the necessary help and medical care at both sides of a road closing. When the weather forecast and snow observations indicate likely highway closures, the municipality must ensure alternatives to critical services (Interview 1).

Citizen and business transportation needs require the municipalities to request improved information and more flexibility related to highway closures, pertaining to common disputes about when and how often highways should

be closed, closure durations and the dissemination of information. The municipalities wish to be able to provide citizens and enterprises with advance information about a road closure. In that way, people might be able to enter or leave an area while the road is still open (Workshop 1). Along the same lines, industrial interests highlight the need for early information about closure: 'When a company is not able to deliver its goods, the buyer looks for another supplier and the contract may be lost forever' (Interview 5). A highway closure may have huge ripple effects for industries. For instance, fish processing plants and transport companies may lose contracts when a highway is closed, because they are not able to make a delivery on time (Interview 9).

The informant from the Roads Administration confirms that there is pressure not to close highways that are vulnerable to avalanches. This person disagrees with the demand that the Roads Administration should provide advanced information about when it will close highways.

There is no way that we will close [the road] in one hour, just to let the school bus through. No, we can't wait to close the road and [because of the risk] there is no way that we would let a school bus drive through. We don't allow ourselves to be pushed [to do that]. (Interview 2)

On the one hand, there is a perception that it is possible to offer sufficient warning about avalanches. On the other hand, sudden risks may occur. The role of the Roads Administration is to close the highway at times of heightened avalanche or blizzard risk. This is a question of probability: 'The problem is to know how certain you should be that an avalanche might be triggered before you close [the road]. Often, avalanches strike without the road barrier being closed' (Interview 2). Weather changes quickly. A road may seem safe but suddenly the wind turns. The Roads Administration argues that they would often be crying wolf if they were to provide information about imminent road closures before they close. The Roads Administration does not see how it could make such warnings safe (Interview 2).

While the Roads Administration does not release information about when it will close a road, a former subcontractor (i.e., the snow plough company that also provided risk assessment data to the Roads Administration) used to inform businesses, the school and the commuters when a road was likely to be closed (Interview 5). A new subcontractor did not (Interview 8). On certain stretches of road, snow trucks would clear most of the road, even when it had been closed for general passage (Interview 4). In this way, the road was ready for traffic as soon as the barrier was lifted, reducing the amount of time that the road was closed.

When roads are not cleared frequently, there might be too much snow for a plough to get through. Therefore, the use of heavier equipment may be necessary (Interview 5; 8). The new subcontractor had less road maintenance and risk assessment experience than the previous subcontractor

(Interview 8). In addition, the staff had issues with the fleet (Interview 7; 8). A consequence was that the highway remained blocked for a longer time than residents considered acceptable (Interview 7).

This has sometimes resulted in intimidation of plough drivers, by residents demanding where the snow truck was (Interview 8). The Roads Administration contends, 'We have lost people with local knowledge because the community has bothered them so much' (Interview 2). This is related to the competitive tendering processes, as there has been local dissatisfaction over changes in road maintenance companies, due to uncertainty about their expertise and equipment.

### ***Different mandates***

The authorities and agencies have different mandates that are important for the understanding of highway closures. The municipalities have several social and economic responsibilities. In contrast, the Roads Administration is solely responsible for highway safety and accident prevention. The informant from the Roads Administration states that it is good that their organisation does not have any additional responsibilities: 'We cannot consider heart attacks or whether someone is about to give birth. If we should consider that there must be transport, then it would be [an] impossible [task]. We do not have that social responsibility. (Interview 2)'

Similarly, an ambulance driver opined that, 'It's good someone else has the responsibility to close the road. I would have driven, no matter what the weather was like' (Interview 5). Hence, the driver suggests that fatal road accidents could have happened if the ambulance service had decided to brave a dangerous road.

Informants also propose that the different perspectives are partly related to costs: 'The municipalities' economy is poor. It's not easy to provide alternative transport [when the roads are closed]' (Interview 2). Along these lines, a representative of one of the municipalities argues, 'The police make decisions about evacuations. [...] It is very good that this does not end up being an issue for municipal assessments, based on the economy' (Interview 1). If it was, it may have been much harder to make evacuation decisions. These opinions suggest that given the limited resources, decisions to close a highway or to evacuate might have been different if the public authorities responsible for covering the costs were also the ones that made the decisions, as evacuation and alternative transport are expensive.

The municipality may order alternative transport from the public transport authority, which is part of the county. The county may, for example, make a passenger vessel available when a road is closed. Small municipalities can rarely afford to arrange for extraordinary services (Interview 4); however, the County Governor's Office has discretionary funds to which municipalities may apply to cover their costs.

### ***Local security and preparedness planning and competence***

While municipalities experience that authorities at higher levels do not consider societal needs when closing a highway, those authorities point out difficulties with local preparedness planning and competence. In many municipalities, preparedness depends on a few key staff (e.g., in the administration), and their possible experience with serious weather events (Interview 3). Several municipalities do not document their work but they may still be good at sharing experiences and norms within their organisation. However, the law requires documentation, as this is supposed to protect the municipality. The municipalities are obliged to write reports and define their needs in planning and preparedness systems.

Informants at the regional level opine that some municipalities do not fully understand their preparedness responsibilities. It seems that many municipalities have not realised how serious the weather hazards might be and therefore have not integrated the need for preparedness planning and crisis management (Workshop 2). However, municipalities that have a comprehensive Risk and Vulnerability Analysis may still struggle to implement their plan, directing their expectations towards other service providers (e.g., the Roads Authorities) that are expected to 'tidy up' (Workshop 2).

The system does not work as well as it could, due to the different roles of the public authorities (informant in Workshop 2). One example is the county's regional Risk and Vulnerability Analysis, which explains what needs to be done during major hazards. Major hazards are different from small hazards in terms of how long a road remains closed. When the hazards are minor, the responsibility for responding is assigned on a case-by-case basis. The municipalities are responsible for analysing the situation and inviting the county to participate. The county does not react until it has been contacted by the municipalities, for example, to provide a passenger vessel when an access highway is closed.

Moreover, the county has extensive planning responsibilities but it can be reluctant to exert those responsibilities in order to avoid being perceived as superior to the municipality. Informants argue that if the County shows reluctance to be a supervisor, it does not deserve its planning responsibility.

In interviews, the representative of the County Governor's Office observed that a good plan involves politicians and is cross-sectoral (Interview 3). However, in some municipalities the responsibility for preparedness is in the hands of the chief fire officer. This officer may not have the cross-sectoral overview that a planner is expected to have (Interview 3). Furthermore, 'politicians are uncertain as to whether [statements in plans] decrease their ability to act as it gives stronger municipal plans which may restrict other ideas' (Interview 3). This means that politicians might find

plans limiting rather than enabling, as plans tend to draw attention to what is in the plan, while limiting the possibility to benefit from other ideas.

According to the County Governor's Office, local security and preparedness planning problems are usually more serious in small municipalities than in larger ones. One problem is a lack of capacity: 'Small municipalities have poor plans, bad and weak holistic risk and vulnerability analyses. It's a problem to get them implemented. We believe it is about resources and competence' (Interview 3). One informant in the small municipality of Berg confirms that a lack of resources is a problem: 'We do not have anyone with professional expertise in this field' (Interview 4). As a result, the County Governor's Office is more frequently in contact with the smaller municipalities than with the larger ones. While the smaller municipalities lean on the County Governor's Office for counselling, the larger ones do not need that kind of support (Interview 1; 3). Resource constraints increase the importance of volunteer work by non-governmental organisations (NGOs), such as the Red Cross, which have their own preparedness plans (Interview 5).

### ***Avalanche safeguarding and surveillance***

While different authorities are doing their best to meet local needs, what residents really want is open and safer roads. However, informants at different levels insist that building snow sheds, avalanche galleries and tunnels is expensive. They ask the political question of how good preparedness should be in Norway and whether it is realistic to resolve natural hazards with infrastructure measures (Workshop 2). More specifically, should public authorities spend millions on road improvements and safeguarding in districts characterised by depopulation even when there are many thriving businesses in those areas? Moreover, even with avalanche safeguarding, the roads are not fully safe. A tunnel does not guarantee road safety, as climate change may cause avalanches elsewhere.

Some informants suggest that technology may be a preferable solution to road infrastructure (Workshop 2). New monitoring and prevention technologies (e.g., snow radars, drones, shooting out snow) may make the situations more predictable and reduce the risk. Such technology improvements may help to resolve one persistent issue pertaining to whether and when an avalanche may occur: information. 'That's what the population wants the most; they want information' (Interview 4).

### **Discussion**

Turning to the expectations mentioned in the theoretical section, the *first one* proposes that the typical portfolio approach creates barriers to problem solving. On the one hand, the data do indeed show how different roles and

responsibilities cause disagreements among public authorities about how to sustain or enhance welfare and business conditions. The municipalities are responsible for citizen and industry needs. In contrast, the Roads Administration is responsible for keeping the roads safe. This manifests in different perceptions of solutions. For example, the municipalities claim that announcing imminent road closures will be useful for citizens and enterprises. In contrast, the Roads Administration argues that this is not an operational option, as the weather often changes quickly, and therefore they would often be crying wolf if they tried to issue warnings. One weakness of the silo system is that knowledge may be lost (or gained) when tendering processes lead to changes of snow-clearing actors. The difference of opinion demonstrates that organisational theory is important for understanding why the winter road closures present several dilemmas – in line with Fimreite, Læg Reid, and Rykkja (2014), who attribute deficiencies in crisis management to organisational processes.

On the other hand, the evidence suggests that there are advantages to working in silos. In some instances, the public authorities and emergency services are content with silos (i.e., that another authority takes the decision to close roads, so that evacuations are not hindered by tight budgets or fatal road incidents): if it was up to the ambulance staff, the driver would have driven no matter what the road conditions were. The public departments and services comply with ‘standard’ operating procedures (March and Olsen 1989) and – to some extent – they are content to do so.

The *second expectation* is about the improvements of public authority preparedness and the adaptation via meta-governance. While meta-governance measures exist, such governance is to some extent lacking, due to lack of requests from below and fear of unwanted interference from above. The informants agree that better coordination across public sector actors and levels may help to solve problems related to highway closures. They suggest that this could be done by increasing county involvement. The county has important regional planning, risk and vulnerability responsibilities as well as being a public transport authority, but does not usually get involved in road closure problems, unless they are contacted by the municipalities.

Referring to the involvement of higher levels via meta-governance, there is already considerable policy guidance from the state to the municipal level in Norway. The County Governor’s Office supervises and monitors municipal plans and their implementation. However, the evidence suggests that there is a lack of capacity at the municipal level. This result is in line with Rykkja (2014, p. 136), who finds that most County Governor staff believe that the Norwegian proximity principle rarely functions in practice. In the present context, in particular small municipalities lack key competence and staff capacity. The general impression is that the integration of preparedness

planning and crisis management in the municipalities and the implementation thereof is deficient, although improving.

Municipalities in Troms County have low scores in terms of fulfilling the requirements for municipal contingency (Directorate of Civil Protection 2016). However, as mentioned under the first expectation, the informants themselves suggest that a higher administrative level – not the County Governor's Office (i.e., national) but the county (i.e., regional) – should have more and clearer responsibilities. This could improve preparedness and increase adaptation capacity, but only if the county assumes this responsibility. This finding offers some support to the optimistic perspective in the natural hazards and climate adaptation literature that sees governance as helpful (Biesbroek et al. 2014).

The data support the proposition that improved governance contributes to advanced preparedness and adaptation to winter climate-induced highway problems. However, governance is only a partial solution. Even with improved governance, the evidence indicates that winter highway closure challenges in northern Norway remain a problem that is so multifaceted that there is no agreement about how to define and solve it (Rittel and Webber 1973). The findings also endorse a realist perspective that many societal challenges are indeed 'wicked'. Moreover, results partially confirm a pessimist perspective, that government contributions to solving such climate-induced problems are minor or limited (Biesbroek et al. 2014).

This brings us back to the first expectation. The evidence shows that the organisational aspect is important for understanding why governance can only partially resolve the winter climate-induced highway closure problems in Troms. While an increased understanding for each other's roles, for example through improved communication, may settle disputes about how best to improve societal welfare and business conditions, disagreements will persist because of the different fields of responsibility.

Other reasons for the limits of governance include the elemental forces. In Troms, it is impossible to solve the problem of climate-induced highway outages because there are no optimal solutions for such uncertainties caused by natural forces (see Chapin et al. 2008). This confirms the erratic natural hazards as a challenged governance domain (Zurita et al. 2015). Avalanche safeguarding is expensive and public resources for improvements will always be limited, especially in sparsely populated regions.

The findings suggest that road improvement resources are limited, despite sizeable livelihood interests in one of the study areas (e.g., large fish processing plants, service providers for the fishing fleet) that depend on unrestricted access to roads. Even if several stretches of highway near the study areas are protected by avalanche galleries, snow sheds and tunnels, it seems unlikely that all winter highway closures can be prevented on such roads that run alongside steep

mountains exposed to blizzards and heavy snowfalls. Most avalanches cannot be predicted. As such, exposed highways are usually closed without any warning. In addition, polar low pressures that are difficult to forecast can bring sudden heavy snowfalls, underlining the impossibility of advance hazard warnings.

In several mountainous vicinities, uncertainty may increase with climate change. Even with improved avalanche safeguarding, avalanches can still bury highway stretches in vulnerable locales. However, novel radar tracking of avalanches combined with traffic lights and better distribution of updated road information will make it easier to live with such natural hazards and (possible) road closures. Even so, inhabitants and businesses may not always welcome these warning systems, as they may prefer safer and open roads by the construction of avalanche galleries, snow sheds and (improved) tunnels.

There is a tension between public demand for accessible roads and the evaluations of risk of using those roads during difficult winter conditions. The lack of notification of when road closure will happen creates frustration. As mentioned, it is impossible to provide such information every time. What we can learn from this case study is that clarification of the impossibility to give advance notice could make the public more sympathetic to the authorities.

## Conclusions

Public sector adaptation and preparedness to winter climate-induced road closures generally function well, given the present road and winter maintenance standards. However, in asking whether and how discrepancies between public authorities create barriers to public sector adaptation and preparedness, we find that working in silos affects public authorities' ability to sustain welfare and business conditions when winter weather forces road closures. Because public authorities, agencies and emergency services have different civil protection and emergency roles, their responsibilities sometimes clash. In most emergencies, there is little or no flexibility to consider particular interests or preferences (e.g., keeping a highway open until a school bus or a freight delivery has passed), given the imminent avalanche or blizzard risks. Additionally, diverse economic and social interests among residents and businesses complicate the possibilities for resolving the issue of winter road closures.

Under such circumstances, it is interesting to understand whether and how governance may contribute to improve lifeline conditions. In studies of climate adaptation and natural hazard preparedness, governance is commonly seen as a solution to climate-related perils and associated problems. Our study provides only partial support to such an optimistic governance perspective; the findings reveal limited coordination among the responsible actors, confirming natural hazards as a contested field of governance. Yet

the different public departments and emergency services are also content to have certain decisions made by other departments without their input, arguing that not having to consider all kinds of considerations (e.g., economy and health) may help to prevent fatalities on the roads.

While improved governance may somewhat improve the welfare and business conditions, unpredictable natural forces make sudden winter climate-induced highway closures in northern Norway a dilemma that cannot be definitively resolved. Use of new or improved technology may only partially mitigate the effects of unpredictable natural forces, even in potential situations with considerable road investments, and increased coordination will not resolve all public sector issues related to winter climate-induced highway closures in similar areas. In organisational terms, while improved communication among public authorities may settle certain differences and improve preparedness, some discrepancies will remain because of different areas of responsibilities.

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