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The influence of governance structure on local resilience: Enabling and constraining factors for climate change adaptation in practice

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Across the globe, the need to adapt is urgent. Coastal communities are particularly vulnerable to climate stressors such as rising sea levels and erosion, while more extreme and variable weather events interact to accentuate risk. While local governments are increasingly recognized as a central local actor in climate adaptation, research continues to focus on resilience at municipal or national levels of government, limiting circumstances for analysis of differing governance structure. Regional government structure can vary drastically, offering a novel opportunity to explore the effects of governance structure on local capacity for resilience. Framed through a resilience lens, this comparative qualitative study analyzes adaptation within two distinct regional governments, finding that unique structural attributes of regional governments can enable or constrain climate adaptation planning. For instance, increased adaptive capacity, through greater access to critical resources, can facilitate action. In contrast, implementation can be constrained by regional agent priorities and a lack of adaptation consideration in granular planning tools. This study sheds light on how to better utilize strengths of regional governments, and how to integrate interventions within broader policy frameworks to overcome common adaptation barriers.

Keywords: Regional governance; Local-level adaptation; Climate change impacts; Strategic policy; Climate resilience; Canadian local government; Planning

Highlights:

- Governance structure can both benefit and challenge climate adaptation planning
- Local-scale governments require multi-level government support to leverage adaptation
- Internal adaptive capacity is not necessarily sufficient for effective adaptation in practice
- Responsibility for overwhelming maintenance restricts capacity for proactive action
- Adaptation implementation requires substantial jurisdiction and authoritative power

1. Introduction

Climate change is arguably humanity's most pressing challenge. Even with ambitious mitigation efforts, climate stressors will continue to unfold due to lags in the climate system (IPCC 2018). Adaptation planning strives for the development and implementation of policies and strategies that aim to moderate or reduce harm associated with observed and projected climate hazards (IPCC 2018). Recent studies have shown that investment in adaptation strategies can help communities improve their resilience to contemporary and emerging climate stressors (Bush & Lemmen 2019; IBC 2020). Resilience, in many communities replacing sustainability as a planning priority, refers to the capacity of social, economic, and environmental systems to cope with climate stressors (IPCC 2018; Kythreotis, Jonas, Mercer & Marsden 2020; Smith, Martin & Wenger 2018). In research, adaptation goals are often expressed through a framework of increasing resilience, which broadly encompasses the ability of socio-ecological systems to adapt and transform in response to external disturbances and stressors (Davoudi et al. 2012; Meerow & Newell 206; Tyler & Moench 2012). However, resilience has been described as ambiguous or 'fuzzy' in concept, with application in policy and planning statements characterised as high-level, rather than meaningful (Smith et al. 2018). Consequently, in practice, adaptation measures are seldom implemented and often ineffective, leading to unintended consequences that decrease resilience (Kehler & Birchall 2021). Ineffective adaptation measures are frequently the result of a narrow understanding of adaptive capacity – the conditions that enable people to anticipate and respond to change – that focuses solely on access to resources, such as adequate finances and expertise to implement adaptation (Cinner et al. 2018). However, in a broader sense, adaptive capacity runs parallel to resilience, encompassing access to resources, flexibility to change strategies, ability to act collectively, respond to change, and agency to change (Cinner et al. 2018).

Frameworks that incorporate theory and practice can help to bridge this divide, with resilience theory, in particular, gaining traction in this space. Resilience theory highlights the need to, rather than focusing on future risk projections, address vulnerability in urban systems by leveraging agents and institutions to successfully implement adaptation planning initiatives that support systems (Tyler & Moench 2012). In this context, systems are the essential services and include natural ecosystems (e.g., wetlands and urban forests) and physical infrastructure (e.g., major road and railways) (Birchall, MacDonald & Baran 2022). Agents are individuals such as planners, elected officials, and other decision-makers, who are critical in the conceptualization and implementation of an adaptation agenda (Ekstrom & Moser 2014). Agents can aid resilience building by aligning their priorities with adaptation goals, and by championing the incorporation of adaptation into strategic planning tools (Birchall & Bonnett 2021). Institutions are the informal or formal rules that govern society and can include policy, planning documents, regulations, and support tools (Tyler & Moench 2012). These are important for translating adaptation goals into practice, and can help to increase community resilience by restricting development in vulnerable locations, for instance.

Increasingly, research shows that local-level governments, such as regional governments, can be central actors in fostering resilience through effective climate change adaptation (Bonnett & Birchall 2022; Galarraga et al. 2011; Shi 2019). In recognition of the advantages offered by a regional approach to addressing spatially broad and complex issues such as environmental change, there has been significant local government reform towards increased regionalism (Miljan & Spicer 2015; Purkarthofer 2021). The formation of regional governments is intended

to allow for greater political jurisdiction and authority, as well as enhanced service delivery, system management, and resource capacity. Regional governments are also expected to promote more coordinated planning, institutions, and political priorities, in comparison to municipalities (Miljan & Spicer 2015). As a result, these advantages may enable regional governments to overcome the persistent challenges municipalities face in strategic planning for local-scale resilience and adaptation.

Despite widespread recognition that successful adaptation requires cooperation across multiple levels of government, research on adaptation governance continues to focus either on the municipal or national level of governance (Dannevig & Aall 2015). Indeed, adaptation planning opportunities and constraints are largely explored through municipal case studies, with a focus on large cities (Butler et al. 2021; Kythreotis et al. 2020). In Canada, regional governments can vary substantially in structure, offering an opportunity to contrast how governance structure influences resilience and adaptation at a regional level. Like many parts of the globe, the need to foster resilience is critical for Canadian coastal regional governments: climate vulnerability is distinctly heightened where sea level rise, coastal erosion, and more extreme weather events interact to accentuate climate-related risk (IBC 2020).

In an effort to bridge gaps in literature and contribute a Canadian context to global discourse, this study uses a comparative approach to explore the role of regional governments in climate adaptation planning. Resilience theory is used as a lens (Tyler & Moench, 2012; Birchall & Bonnett 2021) to critically examine the systems in place (infrastructure, ecosystems), and what factors enable or constrain adaptation through the decision-making processes of agents (individuals responsible for decision-making) and institutions (planning and policy), in two regional case studies: the Regional District of Nanaimo (RDN), British Columbia, and Cape Breton Regional Municipality (CBRM), Nova Scotia. The intent of this article is to leverage the comparative aspects of these case studies to examine how regional governance structure influences local-scale resilience. Utilizing resilience theory, the factors which constrain or enable local governments to meaningfully build local capacity for resilience through adaptation planning are identified and explored. Overall, this exploration seeks to contribute to academic discourse by further unearthing the gap between scholarship and practice in adaptation planning. From a practical standpoint, the intention is to provide decision-makers with insight on how to better utilize the existing strengths of regional governments, and how to overcome regional adaptation barriers by integrating targeted interventions within broader policy frameworks.

This article is organized as follows: Firstly, Section 2 provides a brief overview of the case study sites and relevant regional governance structures, with the aim of facilitating an understanding of local context and how the existing policy environment influences local-scale resilience. This is followed by a short description of the research approach in Section 3. Section 4 utilizes a combined and comparative approach to examine reoccurring themes identified during the analysis. Lastly, Section 5 explores key findings through literature and the three elements of resilience theory (systems, agents, and institutions).

2. Context: Policy environment and governance structure

Local governance retains significant potential to bolster resilience; however, the ability to do so in practice remains hindered (Bonnett & Birchall, 2022; Kehler & Birchall, 2021). To grasp what factors constrain adaptation implementation globally, the following section explores the policy environment and governance structure impacting adaptation in both Canadian case study communities. To this end, the following section lays the groundwork necessary to make effective use of resilience theory in the analysis and comparison of the two coastal regional governments.

2.1 Local-level adaptation

Despite the global nature of climate change, the impacts of climate stressors manifest at local scales, creating distinct challenges for local governments responsible for public infrastructure and assets, ecosystems, and resident health and safety (Bush & Lemmen 2019; IPCC 2018). Consequently, effective adaptation hinges on planning with the local context in mind (IPCC 2018; Kythreotis & Bristow 2017). Nationally, the Canadian Government has taken action to develop a range of climate policy initiatives, including the Pan-Canadian Framework on Clean Growth and Climate Change, Greening Government Strategy, and Federal Adaptation Policy Framework (Government of Canada 2021). Following the lead of the federal government, many provincial governments have also developed their own climate action plans; yet, despite the critical need for local-level adaptation, only three provinces – Nova Scotia, Ontario, and British Columbia – have mandated that local governments act on climate change (Guyadeen et al. 2019).

Despite the provincial call for action on climate change, at a regional level the capacity to do so remains hindered by two critical factors. Firstly, provincial and federal policy guidance on climate action continues to focus on mitigation, with less direction for adaptation planning. For instance, while British Columbia has mandated that local governments incorporate emissions reduction targets in strategic planning, no similar mandate exists for adaptation (Baynham & Stevens 2014; Bonnett & Birchall 2022). Secondly, policy direction from higher levels of government seldom distinguishes between the role of municipalities (i.e., cities) and regional governments (a type of local or sub-national government that operates just above municipalities) in climate action. In reality, these local-level governments differ in crucial ways: municipalities and regional governments often have drastically different jurisdictions and authoritative powers, and regional governments are often responsible for infrastructure and populations across vast, often vulnerable geographic areas. Without context-specific adaptation policy that deliberately considers unique regional challenges and clarifies the role of regional governments in climate action, such policy runs the risk of hindering local capacity for resilience (Horney et al. 2017).

2.2 Case study comparison – differences in regional governance structure

The RDN and CBRM (see Supplemental Data, Figure 1 and Table 1) were selected for this research in consideration of their regional jurisdiction, coastal location, and vulnerability to similar climate related impacts (e.g., sea level rise, coastal erosion and intense weather events). These locations differ, however, in their governance structure, institutional makeup, geographic area and population size. The two case studies were deliberately selected in light of these distinctions, presenting a unique opportunity to explore how differing regional governance

structures and planning attributes can either constrain or facilitate adaptation conception and implementation.

Regional governments and bodies were first established in the 1950's and early 1960's in response to complex issues spanning multiple political boundaries that could not be resolved at the municipal level (Robinson & Webster, 1985). Across Canada, local governments are primarily responsible for the provision of a range of services within a city or region (CLGF, 2019). Most importantly, both municipalities and regional governments are responsible for the provision of critical services which the public requires to meet basic necessities (e.g., fire and police, the provision of utilities, and transportation). While almost every Canadian province and territory engages in regional planning, not all provinces have a federally recognized multi-tiered local government system, and, therefore, the structure of regional governance can vary considerably (CLGF 2019). As a result, differences in jurisdiction, authoritative power and responsibility can all impact a regional government's ability to promote effective adaptation planning and bolster resilience of critical infrastructure systems (Purkarthofer 2021; Shi 2019).

Regional Districts (RD) in British Columbia are structured differently than other regional governmental entities in Canada. Rather than the municipalities operating under the authority of RDs, the authoritative power of RDs is extended upward from incorporated municipalities (Government of BC 2008). RD jurisdiction for essential services exists only outside municipal jurisdiction and decisions must be made by regional boards, supported by residents, and adopted by bylaw (Government of BC 2008). As a result, an RD's jurisdiction is constrained to specific service areas that can vary drastically according to local contextual factors and resident preferences. For instance, if a regional board and electors do not prioritize climate action within their service area, they may remain increasingly vulnerable to climate stressors.

Regional Municipalities (RM) in Nova Scotia, on the other hand, are an amalgamation of previously existing municipalities, and thus function as municipal entities (Government of Nova Scotia 1998). This means that while RMs have the jurisdiction and authoritative power of the municipalities, they are also taking on the combined responsibility for the region and therefore have more diverse servicing responsibilities than RDs (Government of Nova Scotia 1998). The process of forming regional governments through municipal amalgamation stems from an effort to reduce costs by increasing the efficiency of service delivery and infrastructure maintenance over a region (Wallace et al. 2019). However, for better or worse, the differences in governance structure resulting from amalgamation are hypothesized to influence the capacity of regional governments to promote adaptation planning.

While a RD functions as an intermediate, additional level of governance between municipal and provincial, a RM is simply an amalgamation of municipalities and functions as the lowest level of government. In this study, this critical difference, when analyzed through resilience theory, offers potential insights into what structural factors constrain or facilitate strategic planning for climate change. How regional governments use their jurisdictional and authoritative powers to build adaptive capacity through adequate service delivery and system management impacts local-scale resilience. Both the RDN and CBRM are responsible for critical service areas where adaptation initiatives can be embedded to reduce climate vulnerabilities. However, while the RDN is responsible for providing services to rural/electoral areas alone, service provision is required for both urban and rural areas within the CBRM political boundary. The CBRM thus

has additional responsibilities and expectations regarding service provision and governance functions.

3. Approach

Grounded in urban planning, this qualitative research employs an instrumental and comparative case study methodology. Comparative case studies are gaining traction within climate and policy research in recognition that this type of in-depth investigation can yield generalizable knowledge with far-reaching, practical implications (Mees 2016). With resilience theory as a lens and through the cases of the RDN and CBRM, this research explores how regional governance structure impacts adaptation planning and resilience building.

The study included an on-site (first-hand) observational component, which took place in 2017. This facilitated an appreciation of the physical setting of the community, and the interactions that take place in this space (Birchall, MacDonald & Slater 2021). Method and data rigor was bolstered by incorporating a review of regional strategic planning documents (e.g., Regional Growth Strategy, Municipal Planning Strategy, and Climate Change Action Plan). The review of these tools was critical for determining how climate adaptation is integrated within regional planning and policies guiding long-term growth and development.

This study included interviews (60-90 minutes in length) with key actors (senior level local government decision-makers) from the RDN and CBRM (n=8) (Table 1). These took place in 2017. Participants were selected using a criterion and snowball sampling approach to determine what key actors were in the best position to shed light on regional adaptation initiatives. This ensured that interviewees could provide expert/context-specific information regarding the respective regional government's approach to strategic planning and climate adaptation. Key actors involved in this study included planners, engineers, sustainability officers, and personnel from emergency management.

To encourage rich, dynamic discussions, the interviews were semi-structured in format. The dialogue was guided by a protocol that followed a hierarchy of questions, ranging from broad introductory questions to follow-ups, probes and targeted questions. The protocol was flexible by design, with section content influenced by the observational component, review of relevant strategic policies, as well as the study's theoretical lens. The interviews were digitally recorded and professionally transcribed verbatim. Transcripts were examined using a constant comparative and thematic analysis. Themes were identified through a multi-step coding process, then organized into a hierarchy portraying participant meanings, experiences, and expertise in the context of climate adaptation planning.

Department/ unit	Code	Formal interview (minutes)
Regional District of Nanaimo, BC		
Water Services and Asset Management	RDN1	52
Long-range Planning, Energy and Sustainability	RDN2	45
Long-range Planning, Energy and Sustainability	RDN3	51
Sustainability	RDN4	62
Cape Breton Regional Municipality, NS		
Planning and Development/Planner	CBRM1	104
Engineering and Public Works, Department	CBRM2	63
Emergency Measures	CBRM3	60
Recreation, Parks, Grounds and Buildings and Facilities Department	CBRM4	53

Table 1. Key actors.

This table lists the key actors that were interviewed as part of this study.

4. Findings

Findings are presented using a combined and comparative approach and are organized into two broad themes: 1) key climate stressors; and, 2) regional government policy and planning response. Within these two sections, several subthemes are identified. These findings enable our comparative approach and facilitate the effective use of resilience theory, allowing for a meaningful discussion of the urban resilience elements highlighted by Tyler and Moench (2012) and the significance of governance structure for adaptation planning. Firstly, exposure to key climate stressors gives context to the effects of climate change on local systems, highlighting factors which increase exposure and decrease resilience. Secondly, regional government policy and planning response lends insight into how regional governance structure influences the ability of agents and institutions to respond to increasing system vulnerability.

4.1 Key climate stressors – infrastructure exposure to flooding and coastal erosion

Geography and coastal proximity subject both the RDN and CBRM to increasingly volatile weather, putting critical infrastructure systems at significant risk and reducing the communities'

propensity for resilience. As climate change worsens, stressors are becoming more frequent and intense, presenting challenges for decision-makers in these communities (IBC 2020; Lemmen et al. 2016). Interviewees reported the RDN and CBRM as having both similar and distinct climate stressors. These findings were further verified through the strategic document review. While the RDN experiences severe drought, due to differing coastal geography, the CBRM is exposed to harsh coastal storms. However, for the purpose of comparison, the following section will focus on only those stressors shared between case studies: Both the RDN and CBRM both experience severe flooding and coastal erosion. In both cases, several external factors come together to accentuate the exposure to these climate stressors, highlighting the critical need for increased resilience.

The RDN and CBRM are both characterised by extensive coastlines composed of erodible materials and face significant risks from flooding (CBRM 2014; RDN 2011). As expected, climate change is worsening the severity of flooding and coastal erosion (Bush & Lemmen 2019). More frequent extreme weather events, storm surges, and rising sea levels combine to heighten the risk of coastal flooding and erosion, while overland flooding risk is increased by changing topography, dynamic river systems, and intense precipitation (Bush & Lemmen 2019; Warren & Lulham 2021). However, while such severe climate stressors can be adapted to incrementally, current development patterns continue to increase exposure for both the CBRM and RDN. In both case studies, resilience is restricted by the challenges facing existing infrastructure and continued development in hazard-prone, erodible low-lying areas – demonstrating a lack of long-term strategic planning for expected climate effects.

Limited adaptation planning for increasing flood risk has had significant impacts on system resilience in both the RDN and CBRM. Critical infrastructure, including roads, bridges, culverts, and other assets have been wiped out by intense flooding events, requiring costly upgrades, maintenance, and structure rehabilitation. In the CBRM, for instance, a major fire station, a sewage treatment plant, a boardwalk and the CBRM municipal offices are all located at low elevations and highly vulnerable to coastal flooding (CBRM 2014). Indeed, as a result of more frequent overland flooding alone, fifteen separate instances of severe infrastructure damage have been recorded in the CBRM over the past 30 years (CBRM 2014; CBRM2). This number increases significantly when coastal flooding is taken into account. Similarly, the RDN has experienced over 10 major river flood instances since 1997, with more than half resulting in property damage and resident evacuation (RDN 2019). This comes as no surprise as the RDN is home to three major floodplains: Nanaimo River floodplain, Little Qualicum River floodplain, and Englishman River floodplain (RDN 2011).

As climate stressors worsen and population growth motivates new development in hazardous locations, coastal erosion is expected to continue increasing (Bush & Lemmen 2019). Erosion of the shoreline poses a significant threat to coastal utilities, infrastructure, and residential development in both communities (RDN 2011; CBRM 2014). While both case study communities are seeing increasingly severe effects, the culpable climate stressor and average rates of coastal erosion vary. While the CBRM has seen an average retreat rate of 1.38 m/year between 2000 and 2007, the RDN has seen an average retreat rate of 0.09 m/year between 1996 and 2016 (City of Nanaimo 2019; Lemmen et al. 2016). Rates of coastal erosion in the CBRM are pronounced because of storm surges, extreme weather events, and wave action (CBRM1; CBRM2; CBRM4). Here, persistent coastal erosion has led to several instances of roads, bridges, and trails being eroded or washed out (CBRM 2014). However, despite the severe impacts coastal erosion has had on existing infrastructure, the CBRM lacks adequate regulations and

bylaws to limit new development in these areas (CBRM 2004; Cape Breton Spectator 2019). In the RDN, shoreline erosion is largely triggered by river dynamics and intense precipitation, rather than severe coastal storms and storm surges. Still, due to a prominence of steep slope zones, there are "issues with sloughing hillsides, particularly on the coastal areas" (RDN1). In this case, intense precipitation and tidal/sea level changes interact to undermine cliffs, resulting in erosion events that can threaten the development above. Despite the high-risk nature of coastal development, in the RDN there exist no strict zoning or setback requirements limiting development in hazardous areas. Rather, the most hazardous locations are deemed "development permit areas" and allow development once an engineering assessment is carried out and a permit has been issued (RDN 2022).

Despite the severity of these impacts, both communities have been unable to effectively adapt to increased flooding risk and erosion. According to the interviewees, decision-makers are already overwhelmed by the severity and frequency of events, citing that limited resources and vast regional jurisdictions have hindered the capacity to maintain impacted infrastructure and plan strategically for future risks.

4.2 Regional government policy and planning response

Despite the regional status of both case study governments, as highlighted previously, the governance structure varies significantly; while the RDN is an additional level of government, the CBRM is an amalgamation of several municipalities. Through key actor interviews and a review of strategic planning documents, two subthemes emerged that strongly correlated structure to resilience theory: strategic planning and policy, and adaptive capacity.

4.2.1 Strategic planning and policy

Both regional governments demonstrate the need for adaptation measures to reduce vulnerability to flooding, erosion, and other pressing climate stressors. While some results suggest high-level adaptation policy response to growing vulnerabilities, others indicate that implementation of adaptation continues to falter. The RDN and CBRM have undertaken efforts to integrate climate change adaptation within strategic policy and planning frameworks (see Supplemental Data, Table 2).

While language around climate change is becoming commonplace within strategic planning documents in both regional governments, decisive action has yet to be undertaken. Our findings offer a simple explanation: despite intentions to act on climate change, adaptation is still in conflict with other regional political priorities and/or falling low on the list of strategic priorities. For instance, in the RDN, momentum and interest in working towards a regional adaptation agenda has slowed over time; according to RDN1 "there is less interest politically at present on dealing with climate change." Similarly, in the CBRM, political interest in leading anticipatory adaptation efforts is lagging. While not an unexpected finding, consistent prioritization of reactionary measures to perceived immediate threats, such as economic stagnation, constrains local governments capacity for anticipatory adaptation and decreases local resilience to climate change (Birchall et al. 2021; Ford & King 2015). Indeed, the data suggests that decision-makers' commitment to bolstering regional economic and development goals takes precedence over climate change action, hindering implementation:

> "So we have a… municipal climate change action plan, that's adopted by council [and] it's got some fairly comprehensive policies but it's difficult to implement them… that's when it gets difficult politically especially in an area where we're saying well we need to stimulate development" (CBRM1).

The lagging implementation experienced in both the RDN and CRBM results from insufficient high-level direction regarding adaptation goals. Although many strategic planning frameworks include climate considerations, mitigation action remains dominant, and where adaptation is present, wording is often non-committal and high level. For example, many strategic documents in the CBRM merely reference adaptation indirectly, and in the RDN, language around adaptation goals includes frequent use of ambiguous terms such as "support" and "encourage" (Table 3). As a result, the translation of adaptation goals and policies into practical applications requiring action, such as granular bylaws and regulations, varies significantly between case studies, reflecting the vastly different structural factors between both regional governments.

In the RDN, despite ambiguous language regarding adaptation, implementation has been successful to some extent. Decision-makers have taken initiative to ensure that the broad adaptation goals within strategic and guiding documents have filtered down into zoning and development within their jurisdiction. This is evident in the RD's use of development permit areas, floodplain bylaws and regulations, water restrictions, and flood construction levels that aim to address climate vulnerabilities by discouraging development in hazard-prone areas (RDN2). While this granular policy has provided some reduction of vulnerability, large-scale anticipatory action, such as addressing high-risk areas through firm restrictions on new development and requirements to update or relocate existing infrastructure, continues to fall behind.

In the CBRM, however, findings reveal that adaptation is not formally integrated within regulations and bylaws, stifling implementation. Importantly, an interviewee pointed to a complete absence of climate considerations within development setbacks (CBRM4). This is echoed by the strategic planning documents, which suggest that no coastal setbacks have been implemented by the regional government (CBRM 2004). A senior planner from CBRM recently commented on the lack of climate adaptation in regulations and bylaws, in an interview with a local news outlet:

> "We do not have a standardized setback from water bodies or a minimum elevation above sea level in the CBRM Land Use Bylaw. This issue was discussed several years ago when a report on development standards for the Bras d'Or watershed was prepared which was presented to the Councils of all four municipalities abutting the lake. That report recommended both minimum setbacks and minimum elevations for new waterfront development. However, those recommendations were never incorporated into our bylaws" (Cape Breton Spectator, 2019).

In practice, this means that development goals take precedence, at the cost of limiting local resilience. Without any formally integrated adaptation considerations in the CBRM, despite the substantial risks of flooding and coastal erosion, new development in high-risk areas can continue.

4.2.2 Adaptive Capacity

Adaptive capacity remains a critical component of resilience. Implementing adaptation measures requires willingness to utilize available resources, such as finances, information and skills, to take meaningful action (Fitton et al. 2021; Cinner et al. 2018; Ford & King 2015). Regional adaptive capacity varies substantially between the two case study communities. Our findings indicate that the RDN has the necessary internal resources to undertake climate change adaptation planning, while CBRM is challenged by a lack of finances, climate change informed personnel, and climate data.

Adaptation successes in the RDN, while limited, can be attributed to several factors that bolster its capacity, namely reliable economic resources and substantial leadership from regional personnel. According to interviewees, the RDN benefits from a stable tax base and other sources of incoming revenue (e.g., provincial grants and development fees). With leadership from regional government personnel, these financial resources have been used to undertake regional risk assessments/vulnerability analysis, and collection of climate data (RDN4; RDN3). These personnel then further serve as adaptation champions by raising climate awareness throughout regional departments, and by promoting the development of climate adaptation policies and programs (RDN4). However, despite significant resource capacity for adaptation, anticipatory action continues to lag in the RDN. Findings from the interviews indicated that the primary obstacles are "not so much financial as political," suggesting that a lack of political will, rather than resource capacity has challenged the RD in moving forward on adaptation planning (RDN3).

Conversely, limited financial capacity is a key factor constraining the process of climate adaptation planning in CBRM. The RM has faced stagnant economic growth and a low rate of population growth, resulting in a limited tax base (CBRM 2004). The interviewees emphasized that regional decision-makers are, at present, immersed in planning for economic recovery and frequently prioritize strengthening regional development opportunities, typically at the expense of resilience building. According to an interviewee, decision-makers are hesitant to dedicate limited resources to climate data collection and to the implementation of adaptation policies that may hinder development, even if development is proposed in a hazardous area (CBRM1).

5. Discussion

Climate change is a growing concern in both the RDN and CBRM. While decision-makers in both regions have begun to integrate adaptation goals and policies within strategic planning, such initiatives continue to fall short due to a variety of factors. Both regional governments suffer from a lack of transparent and granular policies that foster accountability. However, circumstances differ between communities: on one hand, the RDN possesses the resources to bolster resilience yet lacks the authoritative powers and political will to enact adaptation measures, while on the other hand, despite possessing adequate authoritative powers, the CBRM lacks both resource capacity and political will. These findings further expose structural challenges resulting from the drastically different forms of regional government.

The following section utilizes the three key elements of resilience theory (Tyler & Moench 2012) and provides a discussion on the distinct structural factors that facilitate or constrain regional adaptation planning. Interventions to enhance regional resilience are also identified.

5.1 Systems

Enhancing system resilience is a vital component of effective adaptation to climate change. However, this is also a complex task, involving efforts that aim to enhance the flexibility, diversity, safe location, and connectivity of physical infrastructure and ecosystems (Tyler & Moench 2012). Our findings demonstrate that structural challenges prevent regional governments from enhancing system resilience: Jurisdictional constraints limit authoritative power necessary to take effective action, while responsibility for varied system development and maintenance over vast geographic areas complicate action and consume resources.

Critically, findings demonstrate an alarming lack of system readiness for climate impacts. For both case study communities, large amounts of regional infrastructure tend to be concentrated in locations that are susceptible to climate stressors, without adequate adaptations to cope with the anticipated impacts. Continued development in these areas perpetuates risk to increasingly frequent and severe events, while prominence of aging infrastructure throughout the region further increases system vulnerability (Torabi et al. 2018). For many regional governments, existing infrastructure and utilities lack the capability to endure climate impacts as they were developed to serve smaller populations or built to standards informed by outdated climate data (Torabi et al. 2018). For example, in the CBRM, critical infrastructure, including a major fire station and sewage treatment plant, is located at very low elevations and thus highly vulnerable to accelerating coastal flooding and erosion. With population growth, more frequent and severe climate stressors, and continued development in vulnerable locations, adaptation of regional infrastructure is becoming increasingly urgent (Torabi et al. 2018).

Regional governments can implement adaptation efforts to increase the resilience of infrastructure and ecosystems located within their political boundary. For example, vulnerability can be reduced through more robust management policies and regulations (Miller 2020; Tyler & Moench 2012). However, in addition to being hindered by agents and institutions, adaptation efforts are also constrained by practical factors such as overwhelming responsibility and limited jurisdiction to act. As seen with the RDN, jurisdictional constraints result as municipal jurisdiction competes for authoritative power and limits what measures the regional level can implement. On the other hand, despite authoritative power and jurisdiction to act, amalgamation seen in the CBRM has complicated enhancing system resilience. Because regional governments tend to have larger geographic areas than municipalities, they are often responsible for managing multiple infrastructure systems with varying usage depending on population concentration. This variation further limits the ability of regional agents to develop and implement a comprehensive strategy for increasing system resilience.

5.2 Agents

Government structure influences momentum on adaptation policy and, as a result, vulnerability. As our findings demonstrate, dedicating sufficient resources to initiate adaptation planning does not guarantee adaptive capacity or willingness to implement adaptation in practice. While decision-makers in both case study communities were able to access enough critical resources to initiate the adaptation planning process and incorporate climate action into

strategic planning tools, momentum waned here. Conflicting agent priorities limit vital cooperation necessary to implement adaptation. Our findings indicate that while some agents in both regional case studies have spearheaded the integration of adaptation goals into strategic planning documents, other agent priorities conflict. In both case study communities, immediate economic or political concerns tend to take precedence, consequently delaying and constraining the implementation of strategic adaptation goals in practice.

In the case of the RDN, decision-makers have access to sufficient internal finances, climate data, and personnel. However, several factors such as regional agent perceptions and priorities (i.e., waning political interest) contribute to a lag in adaptation implementation and hinder momentum on building climate resilience (Liao et al. 2019). Lack of political willingness to implement adaptation poses significant challenges to strategically bolstering resilience (e.g. Birchall et al. 2022; Ford & King 2015). Scholars stress the importance of political leadership and championing in order to prioritize adaptation as a strategic initiative, for spurring the process of adaptation planning, and for sustaining momentum over time (Birchall & Bonnett 2019; Liao et al. 2020; Torabi et al. 2018).

While agents in the CBRM were able to access personnel and data to facilitate the integration of adaptation into strategic planning tools, their capacity to implement adaptation policies has been significantly impacted by financial challenges. Amalgamation of numerous municipalities into a single regional government, as in the CBRM, offers the authoritative powers necessary to practically implement adaptation policy, provided there are motivated agents in positions of power. However, amalgamation can also magnify pre-existing financial constraints due to added jurisdictional and servicing responsibilities (Wallace et al. 2019). Substantial financial impediments can diminish agent motivation regarding climate adaptation: political concerns that revolve around bolstering regional economies take priority, and often conflict with and constrain action on climate change (Torabi et al. 2018). For instance, in the CBRM, agents such as elected officials and other senior officials are reluctant to implement adaptive policies that restrict new development in hazardous areas in fear of discouraging economic growth and business opportunities.

5.3 Institutions

Our findings show that institutions, both informal and formal, inform the structural challenges constraining the ability of regional governments to meaningfully act and reduce the vulnerability to climate change impacts within their service area. While regional institutions can promote resilience building, others, such as informal institutions around the perceived political nature of adaptation, hinder accountability for increased vulnerability. Consequently, in practice, adaptation policies lack the detail and granularity necessary to compel implementation and therefore perpetuate inaction.

Scholars highlight that development of strategic adaptation policy is a key step to help align planning and development decisions in practice with an adaptation agenda (Birchall & Bonnett 2021; Stults & Woodruff 2017; Wheeler 2008). However, in order to achieve reduction in vulnerability, these adaptation goals and policies must be translated into fine-grained planning tools and regulations that promote action and accountability (Birchall & Bonnett 2021). This development of fine-grained formal institutions can compel adaptation by effectively steering development out of hazardous locations (Birchall et al. 2022; Meerow & Woodruff 2019). Furthermore, fine-grained planning tools can also help neutralize conflicting agent priorities

through a legislative framework which justifies prioritising adaptation strategies and dedicating resources to actions in practice (Birchall & Bonnett 2021). Despite this need for granularity, results demonstrate that for both case studies, many adaptation goals and policies are indirect and stand as high-level aspirations. While both the RDN and CBRM have moved to integrate climate adaptation goals and policies into strategic planning documents, practical, fine-grained institutions – such as bylaws, set-backs or development restrictions – remain limited, in particular for the CBRM.

In general, our findings demonstrate that institutional barriers may be more pronounced in amalgamated regional governments such as the CBRM. These planning challenges stem directly from the amalgamation process where, following their formation, amalgamated regional governments are required to harmonize several previously existing local planning frameworks in a timely and comprehensive manner (Miljan & Spicer 2015; Wallace et al. 2019). The added complexity and pressure to align often disparate planning documents quickly, combined with political institutions and vague, non-committal language about adaptation, results in adaptation falling low on the list of planning priorities. Indeed, scholars note that other planning priorities, such as transportation and/or economic development, are likely to be prioritised in the harmonization process over the complex process of regional adaptation planning (Wallace et al. 2019).

One explanation for the difficulties both regional governments face in implementing adaptation goes beyond regional structure and institutions alone. The existence of provincial institutions guiding higher levels of government can greatly hinder the ability for local governments, amalgamated or not, to take accountability for adaptation implementation. As explored in Section 2.1, institutions delegating power to lower levels of government – such as provincial legislation prescribing the powers, function, and jurisdiction of regional governments – retain significant influence on regional resilience building (Butler et al. 2021; Lorenz et al. 2016). Despite many local institutional challenges faced by regional governments, provincial institutions continue to perpetuate these challenges and hinder resilience. While both the provinces of BC and NS mandate that local governments act on climate change, these mandates largely focus on mitigation (Guyadeen 2019). The lack of an adaptation mandate can explain the imbalance between mitigation and adaptation priorities within regional strategic planning documents (Baynham & Stevens 2014). Simultaneously, provincial institutions specifying the distinct functional abilities and authoritative powers of regional governments can further constrain adaptation planning. For example, regional governments may only operate within established service areas that must be voted on by residents and adopted by bylaw. Thus, without a climate change adaptation service, regional governments are limited in their ability to translate adaptive goals and policies in practice (Bonnett & Birchall 2022).

5.4 Interventions to enhance regional resilience

Through application of a resilience lens, several adaptation barriers at the regional scale were identified, which are particularly pronounced for amalgamated governments. Resource constraints, such as limited finances due to increased servicing and planning responsibilities, hinder the ability of regional governments to undertake adaptation planning. Adaptation implementation is further impeded by the political willingness and priorities of regional agents, which often conflict with adaptation goals, particularly where adaptive capacity constraints are intense and political priorities focus on short-term strengthening of regional economies. This

process unearthed key opportunities for intervention at the regional scale. Although this research has identified barriers that are often common to both municipal and regional governments (e.g., political will, conflicting priorities, and resource constraints), the following recommendations focus on distinct barriers experienced by regional governments (Table 2). Further, the following interventions are targeted at the provincial level of government given that institutional reform at this scale will have direct and binding influence on regional governance.

Constraints	Interventions	Benefits to resilience
Adaptation policies in regional planning and development tools lack specificity and granularity necessary to foster resilience.	Development of a provincial adaptation mandate with adequate financial support.	• Strengthening regional interest in adaptation • Integration of adaptation in local planning documents/regulations • Increased local capacity to implement adaptation
Authoritative and jurisdictional challenges impede the ability of regional governments to implement adaptation.	Prescribe greater authoritative power to local governments through provincial legislation.	• Enabling local governments to take decisive adaptation action where appropriate
The amalgamation process results in institutional constraints that complicate regional adaptation planning.	Provincial guidelines on best practices for harmonizing strategic planning documents during amalgamation.	• Overcoming unintended negative consequences during harmonization • Incorporation of adaptation goals into strategic policy

Table 2. Interventions for regional resilience.

This table lists several constraints found in this study, their recommended interventions and the general benefit to resilience.

6. Conclusion

Continued climate change is locked in, regardless of the level of future mitigation. Climate stressors such as flooding, coastal erosion, and drought are increasing in frequency and severity, leading to critical challenges for local governments in Canada. Vast amounts of infrastructure have been damaged and wiped out, maintenance costs have skyrocketed for local governments, and the safety and wellbeing of populations are increasingly threatened. Climate adaptation is thus urgent. It is widely accepted that local governments (i.e., municipal and regional governments) are responsible for taking the lead on implementing adaptation initiatives. Yet, the role of regional governments is less understood and studied.

What is the role of regional governments in climate adaptation planning? Drawing on the experiences of the RDN and CBRM, and through a resilience lens, this research demonstrates how structural attributes of regional governance can both benefit and challenge climate adaptation planning. In particular, and as seen with the RDN, regional scale governments offer a unique opportunity to leverage cooperation: By pooling resources and fostering coordinated planning efforts, it is possible to increase local capacity for climate adaptation. Regional governments can thus provide a critical platform for enhancing adaptive capacity. However, our research emphasizes that sufficient resources do not guarantee effective adaptation planning in

practice. Like municipalities, regional governments are subject to conflicting priorities, which can have a significant influence on whether adaptation goals are implemented in practice and momentum on an adaptation agenda is sustained. Regional governments also face distinct adaptation barriers resulting from governance structure. RDs, such as the RDN, benefit from less servicing responsibility and increased resource capacity, but are constrained by limited jurisdiction and authoritative power. For the CBRM, the amalgamation of several municipalities results in a more complex strategic planning process and decreased resource capacity due to pronounced financial burdens stemming from extensive responsibilities.

While limited to a Canadian context, this comparative case study, by analyzing how regional governance structure impacts resilience, lends widely applicable insight into why adaptation implementation often fails. For local governments, regardless of structure, maximizing their ability to take meaningful action on adaptation requires the following circumstances: firstly, the internal ability to incorporate adaptation policies into strategic planning documents; and secondly, the jurisdiction and authoritative power to practically implement adaptation policies into fine-grained planning tools. However, without dedicated support from higher levels of governance, such circumstances remain unlikely – demonstrating the need for greater provincial initiative to support local governments in adaptation. This would be most readily achieved through a provincial adaptation mandate, targeted adaptation interventions within overarching provincial policy frameworks, and dedicated funds and support for local implementation. These insights can have policy implications for decision-makers in Canada, and elsewhere, and are intended to prompt further research on the dynamic role of regional governments in adaptation planning.

Conflicts of interest/Competing interests

There are no conflicts of competing interests associated with this submission.

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Ethical approval

All procedures performed in studies involving human participants were in accordance with the ethical standards of the University of Alberta's Human Ethics Committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

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