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Unpacking intermunicipal climate adaptation networks in Arctic Norway

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Abstract

Purpose – This study aims to examine how intermunicipal networks support climate change adaptation (CCA) in Arctic Norway, where municipalities face limited capacity alongside accelerating climate change. It explores how network activities contribute to adaptation efforts and identifies structural barriers that constrain their effectiveness.

Design/methodology/approach – Drawing on survey data and a boundary-spanning framework, this study thematically categorizes network activities across four dimensions: organizational form, adaptation focus, risk type and priority level. Geographic mapping of the networks is used to identify regional patterns of collaboration.

Findings – Eighteen intermunicipal networks are identified, operating among 33 of the 39 municipalities. Network density analysis indicates low overall connectivity, suggesting that such collaborative arrangements remain relatively uncommon. The networks exhibit strong regional clustering, with CCA often serving as a secondary objective within networks primarily focused on spatial planning and risk management. Participation is largely homogeneous, which limits boundary spanning. The findings further suggest that national legislation reinforces path dependencies, steering municipal collaboration towards compliance-oriented and siloed approaches.

Practical implications – The findings underscore the need for diverse and inclusive forms of intermunicipal cooperation that enable experimentation, cross-sector dialogue and long-term strategic planning. Such approaches can help municipalities move beyond the narrow regulatory agenda and strengthen collective adaptive capacity.

Originality/value – This study provides new insights into how intermunicipal networks shape CCA in Arctic Norway. By applying a boundary-spanning lens, it highlights both the adaptive focus and the limitations

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of existing arrangements, emphasizing the need to reconsider collaborative approaches that can support more transformative climate adaptive responses.

Keywords Networks, Adaptation, Arctic, Climate change, Municipalities

Paper type Research paper

1. Introduction

The impacts of climate change are becoming increasingly visible worldwide (Pörtner *et al.*, 2022). Although this is a global phenomenon, significant regional variations exist (AMAP, 2021). The Arctic, for instance, is warming at a disproportionately faster rate than other regions (Rantanen *et al.*, 2022). This rapid warming is already affecting ecosystems, infrastructure and communities, leading to significant changes across these systems (AMAP, 2021; Hanssen-Bauer *et al.*, 2017). As a result, climate change adaptation (CCA) is widely recognized as a critical strategy to mitigate the consequences of climate change (Lee *et al.*, 2023). Yet, CCA poses complex governance challenges, particularly for small and rural regions with limited administrative and financial capacity (Vindegg *et al.*, 2022). In the Arctic, where warming is accelerating and institutional capacity is unevenly distributed (Aall *et al.*, 2023), the need for anticipatory and collaborative governance is urgent. Despite this, little is known about how such collaborative governance arrangements operate in Norwegian Arctic contexts (Bulkeley *et al.*, 2003).

Municipalities play a significant role in designing and implementing CCA strategies (Fila *et al.*, 2024; Fünfgeld, 2015; Haupt and Coppola, 2019; Noble *et al.*, 2015). Municipalities are often tasked with addressing local climate risks, ensuring public safety and integrating climate adaptation into planning and decision-making processes (Dannevig *et al.*, 2013; European Commission, 2021; Meld. St. 26, 2022–2023). Despite this formally recognized role, small municipalities often struggle to navigate both the institutional complexities and the long-term uncertainties that climate adaptation entails (Fila *et al.*, 2024). Research on municipal climate adaptation has largely focused on large urban centres or transnational municipal climate networks (TMCN), leaving small and under-resourced municipalities and their peer-to-peer collaborations relatively overlooked (Bulkeley *et al.*, 2003; Fila *et al.*, 2024; Fünfgeld *et al.*, 2023; Teles and Swianiewicz, 2018). As a result, the contributions of small-medium sized municipalities to CCA, particularly through cooperative networks, remain insufficiently studied.

Norway exhibits a clear north–south divide in CCA efforts. Northern municipalities, which tend to be more sparsely populated, face higher exposure to climate risks but show lower levels of adaptive responses (Aall *et al.*, 2023; Aall *et al.*, 2024; Norsk Senter for Berekraftig Klimatilpassing, 2025; Scherzer *et al.*, 2019). This paper examines intermunicipal networks in Norway's two northernmost Arctic counties, focusing on how these collaborations shape climate adaptation in the region. Our analysis is guided by two widely acknowledged assumptions found in both scholarly literature and policy discourse. The first assumption is that municipalities are considered key actors in climate adaptation. They are widely regarded as custodians of local adaptation efforts and are responsible for adapting to climate change impacts within their borders (Meld. St. 29, 2011–2012; Vindegg *et al.*, 2022). This assumption is grounded in both international adaptation frameworks and Norwegian legislation, which emphasize the principle of responsibility (European Commission, 2021; Meld. St. 26, 2022–2023). The second assumption is that networks provide benefits for participants and can support CCA efforts. This assumption is corroborated by the literature, which suggests that networks can facilitate learning, coordination and resource sharing (Bausch and Koziol, 2020; Berkes, 2009; Blåka *et al.*, 2025; Dąbrowski, 2018; Dapilah *et al.*, 2020; Fila *et al.*, 2024; Frantzeskaki *et al.*, 2012; Hanssen *et al.*, 2015; Hauge *et al.*, 2019; Hebinck and Loorbach, 2024; Muraoka and Avellaneda, 2021).

This study explores the convergence of these two assumptions by analysing a set of intermunicipal networks through a theoretical framework grounded in boundary-spanning theory (Tang *et al.*, 2018). It assesses the organizational design of the networks, the types of adaptation activities they support, the climate risks addressed and the degree to which adaptation is a central versus secondary focus. Rather than merely describing the collaboration, the aim is to evaluate how, and to what extent, these networks enable municipalities to develop more integrated, anticipatory and sustained approaches to CCA, as stipulated in national legislation (Meld. St. 26, 2022–2023).

2. Background – Norwegian climate adaptation governance and networks

The European Union emphasizes the critical role of local governments in implementing climate adaptation, recognizing their unique ability to tailor measures to local contexts (European Commission, 2021). Norwegian legislation (Meld. St. 26, 2022–2023; Meld. St. 29, 2011–2012; Meld. St. 33, 2012–2013) reflects this perspective. Acknowledging the broad range of sectors impacted by climate change, including spatial planning, public health and nature management. The national government also highlights the importance of diverse actors' responsibilities and cross-sectoral collaboration in CCA efforts. However, national legislation primarily provides municipalities with two key frameworks for addressing CCA: the risk and vulnerability analysis (RVA) and the Planning and Building Act (Kommunal- og distriktsdepartementet, 2024; Plan - og bygningsloven, 2008; Sivilbeskyttelsesloven, 2010). These frameworks emphasize a long-term perspective and the anticipation of future climate impacts to ensure resilience and sustainability over time. This decentralized allocation of adaptation responsibilities aligns with Norway's broader policy of promoting local government autonomy (Meld. St. 5, 2019–2020). It places substantial responsibility on municipalities, requiring them to manage climate risks both within and beyond the scope of these legal mandates. Limited financial resources and institutional capacity have led to uneven implementation of CCA measures across the country (Norsk Senter for Berekraftig Klimatilpassing, 2025). While mechanisms such as the Norwegian Environment Agency's (NEA) climate adaptation grant have sought to support cooperative efforts, available funding remains insufficient relative to demand (Miljødirektoratet, 2026b; Vindegg *et al.*, 2022). In 2022, only 19 out of 46 applications were approved, and the grants awarded were far below the requested amount (Merkesdal, 2022). This creates regional disparities, with smaller northern municipalities often falling behind in adaptation initiatives (Norsk Senter for Berekraftig Klimatilpassing, 2025).

Networks play an important part of Norway's CCA strategy (Meld. St. 26, 2022–2023). Known networks in Norway include "Cities for the Future" and "Climate Project Troms," which connect municipalities with national actors (Hauge *et al.*, 2019). Previous network studies show that regional proximity is a common driver for cooperation, such as Trøndelag's climate adaptation network (Dixon and Elston, 2020; Miljødirektoratet, 2026a; Næss and Solli, 2013). Evaluation of these networks have shown significant participation benefits and enhanced efforts in implementing adaptation in the participating municipalities (Handberg *et al.*, 2019). Yet, participation is uneven, with smaller municipalities exiting due to capacity constraints (Blåka *et al.*, 2025; Hanssen *et al.*, 2015). Single-level networks (between municipalities) could therefore be more attractive to these smaller municipalities. Such collaboration can occur informally or formally: informal networks formed through personal connections or *ad hoc* collaborations can be equally vital for participants, while formal networks are considered better positioned to secure funding and policy influence due to their structure and stability (Hauge *et al.*, 2019; Thomas, 2002). Meanwhile, and as noted above, the assumption of network benefits to small and medium sized municipalities to realize their adaptation responsibilities, remains largely unexplored by current research.

3. Theoretical framework – analysing boundary-spanning networks

Networks are here understood as social collaborative structures composed of nodes (actors) and links (connections) between them (Bergenholtz and Waldstrøm, 2011; Waldstrøm, 2001). Compared to multi-level networks, which connect actors across institutional levels, single-level networks facilitate peer-to-peer (e.g. municipality-to-municipality) cooperations. These single-level networks often involve actors with similar norms and shared language, which can support mutual learning, trust building and the pooling of resources to address common challenges (Bergenholtz and Waldstrøm, 2011; Dąbrowski, 2018; Vindegg *et al.*, 2022). To understand how intermunicipal networks support or hinder effective CCA, the concept of boundary spanning is used. Boundary spanning, as defined in organizational theory, refers to practices that enable actors to work across organizational, sectoral or temporal boundaries (Aldrich and Herker, 1977; Tang *et al.*, 2018). This concept highlights how collaboration across institutional borders facilitates knowledge exchange, coordination and innovation – key elements of climate adaptation governance (Tang *et al.*, 2018). The study focuses on two dimensions: horizontal and temporal boundary spanning (Stjerne *et al.*, 2019; Thomas, 2002). Horizontal boundary spanning refers to collaboration across different organizations or sectors at the same governance level. This is critical for addressing complex interdisciplinary issues such as climate change (Meadows, 2008; O'Brien, 2009). By linking actors from spatial planning, public health and environmental management, networks can promote integrated solutions, such as green infrastructure (Noble *et al.*, 2015). Temporal boundary spanning involves aligning temporal frames and priorities among actors with different time horizons. For instance, an ecologist may focus on long-term ecosystem changes unfolding over decades, while politicians often operate within the short-term constraints of election cycles, prioritizing immediate benefits to secure public support (Bausch and Koziol, 2020). Effective CCA requires reconciling these timelines to develop durable, forward-looking strategies (Bressers and Lulofs, 2010; Dąbrowski, 2018; Hebinck and Loorbach, 2024; Noble *et al.*, 2015). A central challenge in this process is temporal discounting, whereby actors assign varying levels of importance to future outcomes based on their discount rates (Bressers and Lulofs, 2010; Noble *et al.*, 2015; Stjerne *et al.*, 2019). Discount rates reflect the reduced value actors assign to future benefits or costs compared to short-term ones.

Both forms of boundary spanning are particularly important in network operations, as they facilitate cross-organizational cooperation, which can foster more holistic and transformative adaptation approaches. This perspective provides the theoretical foundation for examining how intermunicipal networks in the Arctic support municipalities in their efforts to achieve effective climate adaptation. Building on these established boundary-spanning concepts (Bressers and Lulofs, 2010) this study operationalizes the theoretical lens through four thematic categories (Table 1). Together, they provide a structured approach to assessing the extent and character of boundary-spanning activities within networks.

The first thematic category assesses the organizational structure of networks. These structures can vary and influence a network's effectiveness and inclusivity (Fünfgeld, 2015; Hanssen *et al.*, 2015; Shyrokykh, 2022). Networks are broadly defined to capture a diverse range of single-level collaborations, distinguishing between formal and informal arrangements. Informal networks, although less structured, can still offer significant benefits, such as flexible and rapid communication (Baez-Camargo *et al.*, 2023; Bressers and Lulofs, 2010). Formal networks, conversely, are often better equipped to secure funding and political recognition (Fünfgeld *et al.*, 2023; Hanssen *et al.*, 2013; Hauge *et al.*, 2019). Following Thomas (2002), network effectiveness can be evaluated through strength, scope and duration. Formal networks typically exhibit greater strength through clearly defined roles

Table 1. The four main thematic categories, with descriptions and examples, used as a guiding framework for categorizing survey responses

Category	Description	Example	References
Network organization	Formal or informal structure, degree of commitment and funding	Informal cooperation vs. formally funded projects such as *I front-nettverket*	(Bressers and Lulofs, 2010; Fünfgeld, 2015; Shyrokykh, 2022; Thomas, 2002)
Adaptation types	Type of adaptation activity: institutional, physical/structural or social	Zoning plans (institutional), sea walls (physical), awareness campaigns (social)	(Berrang-Ford *et al.*, 2021; Noble *et al.*, 2015; O'Brien, 2009; Tompkins *et al.*, 2018)
Risk focus	Whether the network addresses direct or transboundary climate risks	Local flooding vs regional food supply impacts	(Berninger *et al.*, 2022; Noble *et al.*, 2015; O'Neill *et al.*, 2022)
Level of focus	Whether CCA is the network's primary or secondary focus	Dedicated CCA planning vs integration within spatial planning	(Beitnes *et al.*, 2025; Dąbrowski, 2018; Hauge *et al.*, 2019; Leiren and Jacobsen, 2018; Selseng *et al.*, 2021)

and commitments, broader scope through shared goals and mandates and longer duration through resources and support. These factors make formal networks particularly robust in supporting and sustaining CCA efforts (Jacobsen and Kiland, 2017).

The second thematic category concerns types of adaptation. Adaptation can span a wide range of sectors, making it inherently fluid (Tompkins *et al.*, 2018). Norwegian municipalities must address climate impacts across domains such as health, infrastructure, land use and education (Meld. St. 26, 2022–2023). Due to the multifaceted nature of adaptation, no standard method exists to evaluate its success. Therefore, a stocktaking approach is adopted based on the IPCC typology: institutional, physical/structural and social adaptation (Berrang-Ford *et al.*, 2021; Noble *et al.*, 2015; O'Brien, 2009). In Europe, physical/structural adaptation measures dominate, followed by institutional adaptation (Berrang-Ford *et al.*, 2021). However, there is growing recognition of the need to diversify adaptive strategies, including social dimensions (Bendell, 2018; Noble *et al.*, 2015). A broad adaptation spectrum within networks indicates attention to multiple risks and promotes holistic resilience, signalling more extensive boundary spanning.

The third thematic category examines risk focus as CCA often targets risks intensified by climate change, e.g., localized hazards such as flooding (Noble *et al.*, 2015; O'Neill *et al.*, 2022). However, transboundary climate risks, where one region's exposure affects others, are becoming increasingly relevant, particularly in interconnected systems (Petit *et al.*, 2015). Such risks are more complex and are often overlooked by municipalities due to their abstract nature and indirect effects (Selseng *et al.*, 2021). Addressing transboundary risks demands higher levels of both horizontal and temporal boundary spanning (Berninger *et al.*, 2022).

The fourth thematic category distinguishes between the levels of focus that networks have in relation to CCA. CCA efforts are often shaped by sectoral norms and mandates (Barquet *et al.*, 2024; Berrang-Ford *et al.*, 2021; Dąbrowski, 2018; O'Brien, 2009). In Norway, adaptation is frequently embedded within the emergency management or infrastructure planning sectors and guided by legislative frameworks (Beitnes *et al.*, 2025; Leiren and Jacobsen, 2018; Meld. St. 26, 2022–2023; Meld. St. 29, 2011–2012; Selseng *et al.*, 2021). This often results in adaptation being framed as an extension of risk management, focusing on immediate threats rather than long-term strategies and lacking temporal considerations

(Lie *et al.*, 2024; Selseng, 2023). When adaptation is a secondary concern, it is often added to existing agendas without cross-sectoral integration. By contrast, networks that prioritize adaptation are more likely to promote comprehensive planning (Hauge *et al.*, 2019; Hoppe *et al.*, 2014). These networks are better suited to supporting both horizontal and temporal boundary spanning and to fostering more transformative climate responses.

4. Methods

A mixed-methods approach was used to capture single-level CCA networks in northern Norway (Cheek, 2023; Creswell and Creswell, 2017). The primary method was qualitative, involving the use of a survey to collect network data (Blaikie and Priest, 2019; Holtom *et al.*, 2022), followed by thematic analysis (Clarke and Braun, 2017; Fereday and Muir-Cochrane, 2006) to examine the structure, focus and content of the identified networks. To complement the qualitative findings, a quantitative component was incorporated to delineate the networks geographically. This spatial analysis helped to identify isolated municipalities and cooperation hotspots. Overall, this mixed-methods design enabled both the identification of existing networks and an understanding of how they contributed to adaptation responses in the case area. The following sections elaborate on the case area, study design, data collection and data analysis.

4.1 Case area

Two Norwegian Arctic counties, Troms and Finnmark, were selected as the case area (Simeonova and Fitzgerald, 2023) for three main reasons. First, their location in the Arctic means they are situated in a rapidly warming environment (AMAP, 2021), making CCA particularly urgent. Second, despite this vulnerability, a comprehensive overview of collaborative CCA efforts in northern Norway is lacking, especially in Finnmark (Norsk Senter for Berekraftig Klimatilpassing, 2025). Third, given the documented north–south divide in CCA implementation, focusing on the northern regions is essential for understanding existing collaborative efforts and their potential contribution to CCA implementation. The two counties comprise 39 municipalities, with population density varying significantly across the region. The urban centre of Tromsø has the highest population density, with 79,204 inhabitants. By contrast, more peripheral municipalities such as Berlevåg and Kautokeino have much smaller populations, with 885 and 2,858 residents, respectively (Statistisk sentralbyrå, 2024). This categorizes the majority of municipalities as small, following the definition used by Fila *et al.* (2024), which identifies small municipalities as those with fewer than 20,000 inhabitants.

4.2 Study design and data collection

Data were collected between September 2024 and February 2025, using an online survey distributed via the Nettskjema platform. Prior to distribution, a comprehensive mailing list was compiled to identify municipal employees engaged in work related to climate change impacts and adaptation. Few municipalities have dedicated personnel for CCA; such responsibilities are often assigned to roles such as spatial planner or preparedness coordinator. Accordingly, the target group included staff working in preparedness, spatial planning and nature protection, as well as municipal directors, who often have a broader overview of municipal activities. This approach follows Dannevig *et al.* (2013). The number of relevant employees per municipality ranged from 3 to 17, depending on available personnel and publicly accessible contact information. In total, 228 individuals received the survey. To ensure comprehensive outreach, recipients were encouraged to share contact details of potential additional participants within their municipality, using a snowball sampling technique (Parker *et al.*, 2019). Two reminder emails and follow-up phone calls were used to increase the participation rate. The survey gathered information on the respondent's municipality, the CCA-related networks in which their municipality participates, how these networks operate and which topics and themes are addressed within them. As the analysis takes place at the network and municipal level, individual responses from the same municipality were aggregated. While recognizing that individuals often drive the establishment of networks (Fila *et al.*, 2024; Hauge *et al.*, 2019), nodes are classified as municipalities rather than as individual municipal representatives, since individuals operate within the constraints of their local government structure (Morgan *et al.*, 2024). For visualization purposes, the results distinguish between inferred and recorded network links. Only recorded links are presented visually, but links are inferred between municipalities that were reported by survey respondents as collaborating under the same set of thematic categories. This means that if Municipality A reports collaboration with Municipalities B, C and D under the same set of thematic categories, it is inferred that Municipality B also collaborates with C and D, and vice versa.

This survey-based approach was chosen to provide a broad, systematic overview of intermunicipal cooperation across two Arctic counties. Some limitations remain. As CCA is a broad and cross-sectoral field, relevant activities may occur across multiple departments. In many cases, only one respondent per municipality completed the survey, which may skew the results towards that individual's knowledge. To ensure validity, responses were cross-checked, and any uncertainties were discussed among the authors.

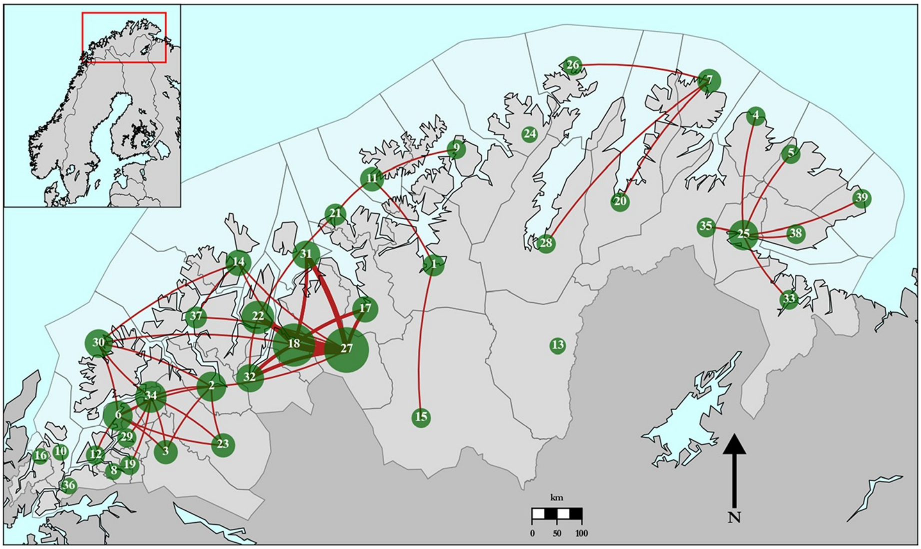
4.3 Data analysis

The collected survey data were cleaned to exclude networks that did not focus on CCA as either a primary or secondary topic. Many of the excluded networks dealt with pollution clean-up and/or mutual support agreements in the event of a disaster. Several multi-level networks were documented but excluded from the general data analysis and geographical delineation, as they fell outside the scope of the study. Nevertheless, the total number of multi-level networks identified is reported to provide additional context (see Appendix 1). Survey responses falling within the scope of the study were assigned to their respective municipalities and thematically coded according to the four categories described in the previous section (see Table 1). This analysis followed an abductive approach, enabling an interplay between theory and collected data (Reichertz, 2007). The literature and theoretical concepts outlined previously informed the development of three of the four thematic categories. The fourth category, distinguishing between primary and secondary focus, was developed inductively, as many of the networks referred to adaptation as an "add-on" rather than as the central topic of their work or establishment. Following the thematic categorization, the identified network categories were analysed for interrelations.

To ensure rigour, exclusions and questionable categorizations of networks were resolved through discussion among the authors. Once categorized, the results were geographically delineated using a network theory method (West, 2001). In the visualization, administrative boundaries and municipalities in Troms and Finnmark were mapped and overlaid with multi-layered network connections. Each node represents a municipality, with node size scaled by aggregated degree (i.e. the sum of connections). Connections are visualized with varying thicknesses to reflect the intensity of collaboration. The administrative boundaries of the map were sourced from Kartkatalog (Kartverket, 2025), and Python 3.10 was used for scripting. Network density was calculated using methods similar to those described by De Laat *et al.* (2007), Martinez *et al.* (2003) and McCulloh *et al.* (2013). This quantitative component complements the qualitative findings, providing a richer understanding of collaborative patterns. The categorization of the thematic categories is illustrated using a stacked bar chart developed in Microsoft Excel.

5. Results and discussion

This study examined the role of single-level networks in fostering CCA across northern Norway. A total of 27 individuals responded to the survey, representing 24 out of 39 municipalities, corresponding to a municipal-level response rate of 61.5%. This high response rate for an online survey suggests a reasonable degree of reliability and validity (Holtom *et al.*, 2022). The response rates were relatively similar between Troms (58.3%) and Finnmark (41.7%), with 14 and 10 municipalities responding, respectively. The survey identified 32 networks, of which 14 were multi-level and therefore excluded from the geographical delineation (see Appendix 1). The remaining 18 geographically delineated networks are shown in Figure 1, with thematic categorization presented in Figure 2. Although only 24 municipalities responded directly, the results cover 33 municipalities due to collaborative links reported by respondents. This inclusion helps balance the effect of non-response by incorporating municipalities that, although not responding directly, are recognized as active participants in the



Nr	Name	Nr	Name	Nr	Name	Nr	Name	Nr	Name	Nr	Name	Nr	Name	Nr	Name
1	Alta	6	Dyrøy	11	Hasvik	16	Kvæfjord	21	Loppa	26	Nordkapp	31	Skjervøy	36	Tjeldsund
2	Balsfjord	7	Gamvik	12	Ibestad	17	Kvænangen	22	Lyngen	27	Nordreisa	32	Storfjord	37	Tromsø
3	Bardu	8	Gratangen	13	Karasjok	18	Kåfjord	23	Målselv	28	Porsanger	33	Sør-Varanger	38	Vadsø
4	Berlevåg	9	Hammerfest	14	Karlsøy	19	Lavangen	24	Måsøy	29	Salangen	34	Sørreisa	39	Vardø
5	Båtsfjord	10	Harstad	15	Kautokeino	20	Lebesby	25	Nesseby	30	Senja	35	Tana		

Figure 1. Geographical distribution of identified single-level networks in Troms and Finnmark counties. Lines are aggregated and appear thicker when multiple links exist, indicating higher levels of collaboration. Municipalities are listed alphabetically and numbered consecutively

Source: Authors' own work

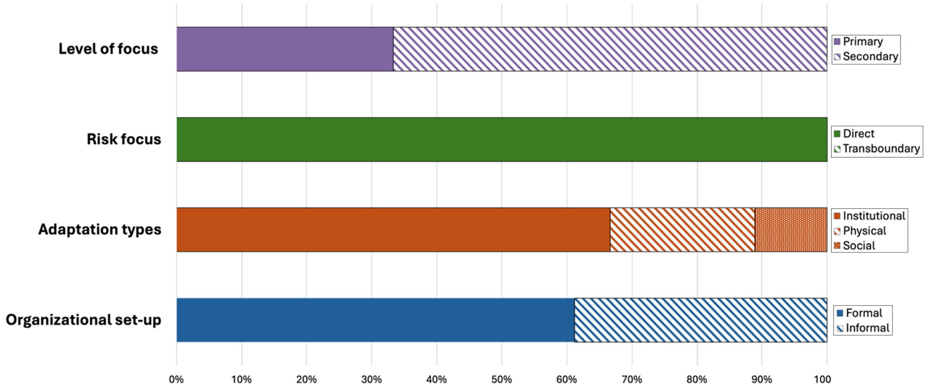


Figure 2. Distribution of subcategories of the four main thematic categories – organizational setup, adaptation types, risk focus and level of focus – expressed as percentages

Source: Authors' own work

case area by their peers. This approach enhances the comprehensiveness and representativeness of the case area (Morgan *et al.*, 2024). Six municipalities remain unrepresented (id. 16, 10, 26, 8, 24, 13), four of which were identified as participants in multi-level networks. The geographical disparity in identified single-level networks, 72% in Troms versus 28% in Finnmark, highlights regional differences in prioritizing CCA collaborations. This imbalance may be explained by limited adaptive capacity, including challenges in organizing, managing and allocating personnel or time for such collaborations (Miljødirektoratet, 2026b; Norsk Senter for Berekraftig Klimatilpassing, 2025). Another contributing factor may be that CCA is simply not perceived as a critical issue; some respondents noted that climate adaptation is often perceived as a secondary concern relative to other municipal tasks.

The network map (Figure 1) reveals several regional clusters, with collaboration largely driven by geographical proximity – a pattern consistent with previous studies (Dixon and Elston, 2020; Morgan *et al.*, 2024; Næss and Solli, 2013; Shyrokykh, 2022). For instance, clusters in the northeast and north-central regions demonstrate strong regional ties. Meanwhile isolated nodes in the south primarily participate in multi-level networks. The Lyngenfjord region stands out as the most collaborative area, with municipalities such as Nordreisa (id. 27), Kåfjord (id. 18) and Lyngen (id. 22) acting as star nodes due to their high levels of cooperation. This aligns with previous studies identifying Lyngenfjord as a particularly active region for CCA (Aall *et al.*, 2024). The high level of cooperation is attributed to a long history of collaborative in disaster risk management, driven by geohazards linked to the area's unstable mountainous terrain, which has fostered significant expertise in evaluating and mitigating associated risks. Collaboration in the area is further facilitated by the presents of a dedicated preparedness coordinator in Kåfjord municipality, who provides human resources to the networks. Accumulated knowledge and specialized personnel are important factors in sustaining network operations. This also better positions the municipality to take a leading or coordinating role in network operations (Norges vassdrags- og energidirektorat, 2015; Thomas, 2002), illustrating the importance of capacity (Vindegg *et al.*, 2022). Despite these regional successes, the overall network density was calculated at 22.8%, indicating loose connectivity across the case area (De Laat *et al.*, 2007; Martinez *et al.*, 2003; McCulloh *et al.*, 2013). This relatively low density suggests that single-level intermunicipal networks are not widely utilized for discussing CCA topics. On the other hand, municipalities in Troms and Finnmark actively participate in emergency preparedness and spatial planning networks (Miljødirektoratet, 2026b; Skjelmo, 2019). Emergency preparedness networks, often multi-level in nature, benefit from the county governor's financial and organizational support, as well as thematic expertise. Meanwhile, spatial planning networks are commonly organized through intermunicipal planning offices, enabling municipalities to cooperate on spatial and societal plans. Both types of networks, while valuable for ensuring compliance with legislative requirements such as the Planning and Building Act and the Civil Protection Act, tend to focus solely on institutional or physical adaptation if they have a CCA component (Beitnes *et al.*, 2025; Meld. St. 26, 2022–2023; Vindegg *et al.*, 2022). This strong emphasis on preparedness and spatial planning often results in adaptation being treated as an add-on, where climate work is approached primarily as an administrative obligation rather than an opportunity for proactive, systemic change. This tendency is evident not only in network operations but also in how most municipalities approach adaptation efforts in general (Beitnes *et al.*, 2025; Lie *et al.*, 2024; Selseng *et al.*, 2021).

5.1 Thematic categorization and network challenges

The thematic categorization of networks (Figure 2) reveals that formal structures dominate organizational setups (61%), with institutional adaptation being the most prevalent focus (66.7%). Physical adaptation accounts for 22%, while social adaptation is the least common (11%). Notably, none of the networks addresses transboundary risks, indicating a significant gap in addressing broader, systemic climate change challenges. Additionally, most networks consider CCA a secondary concern (66.7%), with only a small proportion prioritizing it as their primary focus (33%). Analysis across the categories shows that networks with a primary focus on CCA tend to be formally organized and prioritize institutional adaptation. Notably, only two networks address social adaptation, both of which are informally organized and have a secondary focus on CCA. Interestingly, these informal networks emerged from relationships built within multi-level, formally organized networks, demonstrating the potential for multi-level networks to catalyse new collaborations.

While networks have the potential to span boundaries and integrate diverse perspectives, our findings suggest that the networks in this study remain highly homogeneous. They primarily involve preparedness coordinators from neighbouring municipalities, with limited participation from other professionals such as spatial planners, environmental managers or health officials. Although the networks cross organizational boundaries, they fail to bridge internal departmental divides within the individual participating municipalities. This lack of diversity hampers the networks' ability to align differing timelines, perspectives and strategies, which are essential for effective boundary spanning (Hebinck and Loorbach, 2024; Stjerne *et al.*, 2019). Consequently, the networks tend to focus narrowly on institutional adaptation, risking a "planning without action" dynamic (Beitnes *et al.*, 2025; Selseng *et al.*, 2021). This limited focus is partly attributable to the national legislative framework, most notably the Planning and Building Act and the Civil Protection Act. While these laws are crucial for ensuring public safety, they also create path dependencies that reinforce siloed approaches and discourage cross-sectoral collaboration in climate adaptation (Fila *et al.*, 2024; Frantzeskaki *et al.*, 2012). This results in network actors adhering to predefined pathways that prioritize immediate, concrete risks over long-term, context-specific strategies (Beitnes *et al.*, 2025). Collectively, these dynamics create a system in which adaptation is incremental by design, focused on fulfilling legislative requirements rather than enabling innovative or transformative action (Hebinck and Loorbach, 2024; O'Brien and Sygna, 2013).

5.2 Regional disparities and recommendations

The study also highlights disparities in how municipalities engage in networks. One might expect the larger municipalities, such as Tromsø, Alta and Harstad, to emerge as network hubs. As stipulated by Blåka *et al.* (2025), larger, central municipalities often pursue networks to gain strategic influence and legitimacy, following the expectation to act as regional leaders shaping regional development agendas. However, when it comes to climate adaptation, the larger municipalities in the case area do not act as regional leaders. Instead, they engage primarily in multi-level networks with other larger municipalities outside the study area, such as Bodø, Mo i Rana and Narvik, as well as in international collaborations such as the IMPETUS project (IMPETUS, 2026). This approach reflects the concept of homophily, whereby municipalities form relationships with others based on similar demographics and capacities (Dapilah *et al.*, 2020; Shyrokykh, 2022; Teles and Swianiewicz, 2018; Vindegg *et al.*, 2022). While this behaviour may initially benefit the larger municipalities, it excludes smaller ones in the region, leaving them without the advantages that a leading regional municipality could provide, further fragmenting the network landscape. By contrast, regions like Trøndelag, where Trondheim municipality plays a more active role in advancing regional climate efforts, demonstrate the potential benefits of strong regional leadership (Hauge *et al.*, 2018; Miljødirektoratet, 2026a).

Climate adaptation requires flexible, context-specific approaches (Noble *et al.*, 2015). While networks have the potential to support climate adaptation, their contribution depends on specific conditions. First, strength is achieved through formalized collaboration, which fosters binding and enduring relationships (Thomas, 2002). Second, duration depends on stable access to funding and personnel. For single-level networks, this may involve securing resources through the NEA fund or internal municipal budgets – both should receive political support to ensure sustainability (Hauge *et al.*, 2018). This is particularly challenging in northern Norwegian municipalities, where high staff turnover is compounded by the fact that climate adaptation is added to existing roles and functions. However, if networks can fund human resources dedicated to climate adaptation, this could strengthen participating municipalities' knowledge and coordination capacities (Teles and Swianiewicz, 2018). Third, the network's scope is critical. Networks must place CCA at the core of their agenda, an element consistently linked to effective network outcomes (Hauge *et al.*, 2019; Vindegg *et al.*, 2022). Furthermore, ensuring a diverse composition of participants can support both horizontal and temporal boundary spanning, contributing to more holistic and forward-looking adaptation strategies (Hebinck and Loorbach, 2024; O'Brien, 2009).

6. Conclusions

This study examined intermunicipal climate adaptation networks in Arctic Norway, focusing on how these collaborations shape adaptive responses across the region. From a boundary-spanning perspective, the analysis examined the extent to which networks facilitate cooperation across administrative, sectoral and temporal boundaries. Drawing on survey data to map existing single-level CCA networks, a thematic analysis was conducted across four dimensions: organizational form, adaptation focus, risk type and priority level. The survey identified a total of 32 networks, of which 18 were single-level. The network density analysis revealed connectivity level of 22.8%, indicating relatively weak interconnections. This suggests that such CCA networks are not widely used in Arctic Norway. Furthermore, while the networks contribute to certain forms of CCA, their focus remains narrow and largely siloed. The analysis indicates that national legislation has created path dependencies, shaping CCA efforts into risk-focused or spatial planning activities, thereby restricting creativity and limiting transformative approaches. As a result, adaptation efforts often overlook transboundary risks and broader social or systemic dimensions of change. Network formation is predominantly driven by geographical proximity and efficiency considerations, with the Lyngenfjord area hosting a significant proportion of identified networks. Although networks span horizontally across municipalities, their composition is largely homogeneous and temporal boundary spanning remains limited.

The practical implications of these findings suggest that the identified networks do not facilitate more innovative ways of working on CCA but rather function as optimization tools. Moreover, the absence of regional leadership from larger municipalities deepens the adaptive capacity divide across the region. Enhancing the scope, duration and strategic intent of intermunicipal networks, alongside clearer national coordination, will be essential for building more integrated and transformative local-level adaptation efforts in Arctic Norway.

While the study's findings are significant for identifying single-level CCA networks, including their challenges and opportunities, several issues remain outstanding and in need of further exploration. In particular, the large-scale survey approach inherently limits the ability to capture the nuances of individual networks, which could be better explored through in-depth qualitative methods. Capturing such details for the entire case area would require a longer study timeframe, as well as greater participation from multiple representatives within the same municipality to provide a more comprehensive perspective. Beyond such limitations, this study also identifies broader gaps in understanding how intermunicipal networks can address transboundary risks, encourage systemic approaches to adaptation and overcome the siloed nature of current efforts. Future research should explore these issues further, as well as how individual network participants perceive adaptation and change, and how climate adaptation work within networks can become more innovative and translate into actionable practices within municipalities. By addressing these gaps, future studies can provide deeper insights into fostering more effective and transformative intermunicipal collaboration for climate adaptation.

Ethics statement

This research involved the collection of survey data, and participation was voluntary. The project was approved by Sikt – the Norwegian Agency for Shared Services in Education and Research.

Data availability

Anonymized survey data supporting this study is available in the DataverseNO repository at https://doi.org/10.18710/F5VSUZ.

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Appendix

Table A1. Distribution of survey responses, including the number of participating municipalities, total number of identified networks and the number of identified single-level and multi-level networks. The distribution is shown for both Troms and Finnmark counties

Category	Troms	Finnmark	Total
Participating municipalities	14	10	24
Identified networks	24	8	32
Identified single-level networks	13	5	18
Identified multi-level networks	11	3	14

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