

UNIVERSITY OF COPENHAGEN

DEPARTMENT OF GEOSCIENCES AND NATURAL RESOURCE MANAGEMENT



Rural communities responding to territorial challenges in the Nordic Region

Ph.D. thesis by Leneisja Jungsberg

Name of Department: Geosciences and Natural Resource Management (IGN)

Section: Landscape Architecture and Planning

Author: Leneisja Jungsberg

Title: Rural communities responding to territorial challenges in the Nordic Region

Academic advisors: Lise Byskov Herslund
Kjell Nilsson

Date: 10th February 2022

Front page picture: Nanortalik, Greenland, photo by Leneisja Jungsberg

Citation: Jungsberg (2021) *Rural Communities responding to territorial challenges in the Nordic Region*. PhD thesis, October 2021, Department of Geosciences and Natural Resources Management, University of Copenhagen, Frederiksberg.

Preface & Acknowledgement

“The more I learn, the more I realise how much I don’t know.”

— Albert Einstein

It is a cloudy, windy and rainy September day in 2014. Two senior researchers and I are on our way to visit the defunct Nalunaq Goldmine in South Greenland. It closed a year earlier, and all of the infrastructure, including the harbour and the bridge to cross the river, has been dismantled. To get off the boat, we have to jump onto some rocks. We then start hiking through the wilderness to reach the former extraction site.

The gold mine is a couple of kilometres up a mountain. After a few hours, we reach the tunnels through which the mining vehicles used to enter the mountain. The tunnels are now closed, so we just observe everything from the outside. We take photos to document the mining operation’s impact on the landscape. On this field trip, I learned just how much a big mining project can affect a local community. It turned out to be a preview of my life at Nordregio, where I would start working full time about five months later.

Again and again, I am impressed by the initiatives and the stories that community members share about their local area, and about what nurtures (or doesn’t nurture) local development. The creativity in the many varied community responses makes this a fascinating subject. The more I learn about local and regional development, the more I recognise myself in Einstein’s quote. I feel humbled by the sheer number of challenges that exist and the diversity of community responses across the Nordic Region.

Acknowledgement

This PhD thesis would never have come together without the advice, input, and support from numerous people. First, I would like to express my deepest gratitude to my supervisors, Lise Byskov Herslund and Kjell Nilsson.

Thank you Lise for always providing constructive and highly useful feedback – which, helpfully, also arrived in a very timely fashion throughout the writing process. Furthermore, I always found our meetings to be an uplifting experience. You brought optimism even when the material looked less than promising. Thank you Kjell for suggesting the idea of writing a PhD while I was working at Nordregio. It took us three attempts to plan our projects and ensure that our finances were in place before the vision could be realised. I am also grateful for your persistence and your keen eye when it came to spotting and correcting important details.

This thesis is very much a collaborative project. This is reflected in the long co-author lists for each article. Working with research colleagues from different projects and institutions has been an educational experience, and I would like to express my thanks to all of the co-authors for their support. Without the participation of the community members, together with representatives from local, private, and public-sector bodies, as well as regional and national authorities, this research would not have been possible. Thank you all for your valuable time and for your participation, either in interviews or by collaborating on workshops or questionnaires as part of the fieldwork.

Thanks to all my amazing colleagues at Nordregio. It is hard to express how important it has been for me to be part of a such a warm and welcoming work environment. All of the encouraging words and the motivating and stimulating conversations have made the PhD journey joyful, even in demanding times. In particular, special thanks to the management team, Karen Refsgaard for hands-on help at critical moments, Rolf Elmer for inspiring anecdotes, and Åsa Hildestrand for her always encouraging energy.

In addition, special thanks to Rasmus Ole Rasmussen, who took me to the Nalunaq Goldmine and later facilitated my role at Nordregio, as well as my involvement in the Nunataryuk project. My condolences to Rasmus's family, as he passed away in April 2021. Warm thanks also to Hugues Lantuit for having faith in my participation during the Nunataryuk tender process.

Finally, big and heartfelt thanks to my family in Denmark. Thanks to my dear mum, who has a special talent for finding a positive and uplifting perspective on whatever problem I am currently facing. My father passed away in 2008, but served as an inspiration by always being passionate about his work, no matter what he was doing. Thanks to my big brother for offering concrete advice at key moments, and to my other siblings, nieces and nephews for encouragement and nice times together. Thanks also to some other people who are precious to me: Rune Christoffer Dragsdahl, Anna Isabella Christensen, Martina Stål, Stephanie Von der Tannen, Dean Bilfeldt and Jaroslav Kazejev. I am forever grateful for our relationships and the love and support you have shown me throughout the process of writing this PhD thesis.

Leneisja Jungsberg,
Skeppsholmen, Stockholm, 28th October 2021

Abstract

Rural territory makes up around 77% of the Nordic Region and is home to 25% of the population. Rural areas are an important source of food, timber, minerals, fresh water, and recreational spaces, but also struggle with depopulation, economic benefit retention from extractive resource industries and climate change-induced permafrost degradation. The aim of this study is to assess how rural communities respond to these territorial challenges in the Nordic Region. The research design is inspired by a mixed method approach, with data acquisition involving semi-structured interviews, community workshops, questionnaire data, register data and desktop research. This Ph.D. thesis is based on three different research projects that collaborate with community members and local authorities to support local development in rural areas.

The results show that many of the emerging rural community responses can be described as social innovations, and they are primarily driven by community members, local authorities and civil society organisations. Community members are rated as the most important when it comes to developing ideas, while local civil society organisations are rated as the most important in terms of decision-making. To ensure more local benefit retention from resource-based industries, local smart specialisation strategies, can contribute to community engagement by collaborating with small and medium-sized enterprises and entrepreneurs. A key outcome of the strategy process was enhanced knowledge of population change, land-use planning, and approaches to local economic diversification. The results from the adaptive capacity assessment to manage permafrost degradation show that community members and local authorities generally respond to permafrost degradation via autonomous and ad-hoc adaptation practices. Typical challenges include deformations and changes in ground structure, leading to slanting floors, doors or windows that do not close, and cracking windows due to differential settlement of houses. Furthermore, climate-driven projections show that 42% of Arctic permafrost communities will no longer be underlain by permafrost by 2050.

This study of rural community responses contributes to an understanding of the enabling factors that can address territorial challenges. Across the empirical examples, three enabling factors emerge as important for rural community responses: *civic agency*, *institutional organisation* and *long-term cooperation*. By assessing the presence of these enabling factors in place- and network-based local development, this study provides an approach to generate and sustain rural community responses that address territorial challenges in the Nordic Region.

Keywords: *rural communities, social innovation, strategic assessment, adaptive capacity, local development, territorial challenges, Nordic Region*

Table of content

1. INTRODUCTION.....	10
1.1 Research gap	11
1.2 Research questions.....	12
1.3 Overview of the thesis.....	13
2. THEORETICAL FRAMEWORK.....	14
2.1 Rural development theory and literature	14
2.2 Analytical perspectives to study rural development processes	17
Social innovation.....	17
Strategy assessment.....	17
Social capital	18
Adaptive capacity.....	19
Applying the theoretical and analytical perspectives	19
3. METHODOLOGY	22
3.1 Theory of Science	22
3.2 Projects supporting the PhD, personal & professional development	24
3.3 Methods and material in the empirical data collection.....	26
3.4 The Northern rural context.....	30
3.5 Methodological reflections.....	34
4. SUMMARY OF RESULTS.....	36
4.1 Paper I: Key actors in community-driven social innovation in rural areas in the Nordic countries.....	36
4.2 Paper II: Local smart specialisation: An approach to increasing preparedness in rural communities with resource-based industries in the Northern Periphery.....	38
4.3 Paper III: Social license to operate in the frame of social capital exploring local acceptance of mining in two rural municipalities in the European North	41
4.4 Paper IV: Population living on Permafrost	44
4.5 Paper V: Adaptive capacity to manage permafrost degradation in Northwest Greenland	46

5. DISCUSSION OF CROSS-CUTTING RESULTS	50
5.1 Civic agency.....	50
5.2 Institutional organisation.....	51
5.3 Long-term cooperation.....	52
5.4 Theoretical reflections on the analytical perspectives.....	53
5.5 Empirical contribution to address territorial challenges.....	59
6. CONCLUDING REMARKS.....	61
6.1 Implications of the study and policy relevance.....	63
REFERENCES	64
PAPERS	75
Paper I.....	76
Paper II.....	87
Paper III	113
Paper IV	121
Paper V:	139
APPENDICES	160
Appendix A: Questionnaire assessment of actor’s involvement in the social innovation.....	161
Appendix B: Questionnaire in Sodankylä & Storuman.....	163
Appendix C: Questionnaire in Qeqertarsuaq and Qaanaaq	173

1. Introduction

Rural communities in Nordic and Arctic regions are affected by global drivers such as increasing urbanisation, the presence of multinational industries, and climate change, leading to environmental vulnerability from, e.g. permafrost degradation. They are also experiencing a decrease in population due to the outmigration of young people pursuing education and work in larger urban areas (Bosworth et al. 2016a; Cheshire et al., 2015; Jungsberg et al., 2018). This can lead to a centralisation of public services, and a cutting or narrowing of the local supplies which puts residents of remote rural areas at a disadvantage (Copus et al. 2017; Georgios and Barraí 2021). The experience of alienation in rural communities is described via the concept of a geography of disadvantage and discontentment (Dijkstra, Poelman, and Rodríguez-Pose 2020; Larsson, Hedberg, and Holmberg 2020; McCann 2019; Quednau 2016).

Around Europe, differences in population composition, educational level and household income create a gap between citizen groups in rural and urban areas. These differences can also reduce society's social cohesion, and in some cases lead to democratic volatility (Cowie and Davoudi 2015; Dijkstra et al. 2020; McCann 2019). Rural areas in the Nordic countries have a significantly higher share of people aged 65+ compared to the working age population (16–64 years old). The share of population with tertiary education is 53% in urban areas, compared to 31% in rural areas, and the period 2011–2017 saw an increase in the income gap between rural and urban areas in the Nordic countries (Heleniak and Gassen 2020; Lundgren et al. 2020).

Rural areas account for 77% of the Nordic Region's territory but are home to just 25% of the population (OECD rural classification, see section 3.2). For many rural and remote communities, an abundance of natural resources is the foundation of the economy, and extractive resource industries can place stress on the local economy and labour market. In this case, it is important to focus on the possibility of retaining local benefits from industries operating in the area. In doing so, it is crucial to involve local authorities, in order to balance the different interests and build capacity among key actors in the community (Copus, Jungsberg, and Weber 2016; Dubois, Kristensen, and Teräs 2017; Jungsberg et al. 2020). A strategic approach that builds on the existing strengths of individuals, the cohesion of the local communities, and the attractiveness of the surrounding landscape may have a decisive impact on local rural and regional development (Healey 2009).

Climate change is affecting the landscape in the form of permafrost degradation in the Arctic parts of the Nordic Region (Ramage et al. 2021; Vanderlinden et al. 2020), which causes environmental stress for communities in, e.g. Greenland. Permafrost degradation puts pressure on buildings, infrastructure and the local economy, and causes changes in subsistence activity, which impacts the wellbeing of rural communities (Biskaborn et al. 2019; European Commission 2020; Hjort et al. 2018; Larsen et al. 2021; Timlin et al. 2021; Vanderlinden et al. 2020).

Rural communities apply a range of strategies to address various social, economic, and environmental impacts, and these vary from area to area. Rural communities' competences in creating change and development have been studied in the context of both endogenous and neo-endogenous development (Bock, 2016; Bosworth, et al., 2016b; Ray, 2006). However, the ability to meet challenges varies at local level (Bock, 2016; Copus et al., 2021; Hörnström et al., 2015), and in recent decades there have been high expectations regarding civil society's capacity to solve societal problems (Mårtensson et al. 1988:10–11; Pestoff 2012). While some rural areas develop successfully, others stagnate (Bock, 2016; Castro-Arce & Vanclay, 2020; Coffey & Polese, 1984; Kacar et al., 2016). This highlights the need to better understand these abilities and competences at community level, as well as the role of community in local development and adaptation to change. This is a key driver in studying the different approaches to local development initiatives, as well as the possibilities and challenges involved in creating social cohesion, supporting economic activity and mitigating permafrost degradation.

1.1 Research gap

Several studies have illustrated how collaboration between community members and representatives from civil society and the public and private sector can enhance local development (Bosworth, Annibal, et al. 2016; Brown 2008; Hemström and Palmer 2020). However, little attention has been paid to how local strategies can address territorial challenges and in particular on these three territorial challenges for rural in areas in the Nordic countries:

1. Demographic change in rural communities leading to high old age dependency rates, and a depletion of working age population and young families in rural areas. This presents a challenge to the entire Nordic welfare model, in the form of an increasing gap

between the costs of elderly care and the municipalities' tax income (Grunfelder et al. 2020).

2. Local economic development in rural areas with resource-based extractive industries. It can be a challenge to retain the value from these industries and this often constrains economic opportunities and reduce the diversity for the local labour market. The challenge here is to grasp the opportunities for retaining local benefits through closer cooperation with the extractive industry and by providing a strategic direction for territorial development in the area (Copus et al. 2016; Jungsberg et al. 2018).
3. Permafrost degradation is an ongoing challenge for many northern communities. Higher temperatures are triggering permafrost thaw, leading to a destabilisation of constructions and a reduction in the accessibility of country food (Larsen et al. 2021; Ramage et al. 2021). This places pressure on the communities and local institutions to increase their adaptive capacity in order to manage local changes in the environment.

Municipalities in the Nordic countries are often responsible for vast areas, yet they have relatively few human resources. It is therefore important to understand how the people in specific communities can become engaged in local strategy processes for enhancing and mobilising natural and financial resources in rural areas. This PhD thesis presents different local approaches to managing the above-mentioned territorial challenges. Some local approaches are led by community members, while others are initiated by local authorities, e.g. municipalities. The research interest lies in examining the dynamics behind strategies for addressing territorial challenges in rural communities in the Nordic countries.

A joint Nordic analysis is of interest from a political perspective, partly in the context of Nordic cooperation, but also due to similarities between Nordic welfare systems and the socio-economic profiles of rural areas and planning systems (Getimis 2012; Grunfelder et al. 2020; Knieling and Othengrafen 2009). This justifies a Nordic study of the factors behind successful rural initiatives, the community actors involved, and the steps taken. This will provide new knowledge on rural community responses to territorial challenges in the Nordic Region.

1.2 Research questions

The aim of this PhD thesis is to study how rural communities engage in various approaches to territorial challenges in the Nordic Region. The focus is on gaining knowledge regarding the role of different local actors (e.g. community members, public authorities, and private

businesses), to better understand how they affect local planning and strategy processes. The analysis of local processes is based on three clusters of research questions:

1. *How are community-driven social innovation (SI) projects initiated and implemented in rural areas in the Nordic Region? And what are the roles of different actors at different stages of the innovation process?* (Paper I)
2. *How and to what extent can a local strategy process strengthen preparedness to manage resource-based industries and meet territorial challenges related to demographic change and local economic development? And what creates trust in and acceptance of the mining companies locally?* (Papers II and III)
3. *How many people live on permafrost, and what are the projected impacts of a warmer climate on communities built on permafrost? What is the adaptive capacity to manage the experienced permafrost changes in Northwest Greenland?* (Papers IV and V)

1.3 Overview of the thesis

The thesis is organised into six chapters. The first, the introduction, describes the background of the study, as well as the research challenges, research gap, research questions and the study's significance. The second chapter presents the theoretical framework and the analytical perspectives used to study strategy and planning processes. The third chapter presents the methodology and an overview of the methods applied to collect the empirical data. The fourth chapter presents a summary of the five scientific papers in the PhD. For three of the papers, I am the first author, and these papers comprise the main contribution to understanding rural community responses to territorial challenges in the Nordic Region. For two of the papers (papers III and IV), I am second or third author. These papers provide a contextual understanding for assessing social capital via the lens of a social licence to operate for mining communities (paper III) and the number of settlements built on permafrost (paper IV). The fifth chapter presents a discussion of the cross-cutting results and reflects on the PhD thesis's theoretical perspectives and empirical contribution. Finally, the sixth chapter presents concluding remarks and the implications of the study for the development of sustainable rural policies in the Nordic countries.

2. Theoretical framework

The theoretical framework introduces key concepts relevant to the study of territorial challenges in the Nordic Region. *Section 2.1* presents concepts used to illustrate the underlying development dynamics for rural areas. *Section 2.2* introduces the analytical perspectives used to examine empirical examples of how rural communities respond to territorial challenges. *Section 3.3* illustrates the relations between the theoretical and analytical concepts and describes how these are applied in the PhD papers.

2.1 Rural development theory and literature

The concept of rural development emerged from socio-political debate, and is today defined as a multi-level, multi-actor and multi-faceted process (van der Ploeg et al. 2000; Shucksmith 2016). It encompasses a range of interconnected practices, such as landscape management, nature conservation, agri-tourism, organic farming and the production of high-quality and region-specific products (Bock, 2012; Bosworth, 2010; Castro-Arce & Vanclay, 2020; Primdahl et al., 2018). In rural development theory, a key focus has been on understanding the conditions for rural change. While economic growth is an important component of rural development, the development phenomenon as a whole cannot be reduced solely to this issue (Adamski and Gorlach 2007). The Brundtland report defines sustainable development as “... development that meets the needs of the present without compromising the ability of future generations to meet their own needs” (United Nations 1987), and presents the social, economic and environmental dimensions of sustainable development. The development dynamics I have studied in this PhD thesis involve social (paper I), economic (paper II and III) and environmental processes (paper VI and V) in rural areas in the Nordic Region.

A popular concept employed to understand development dynamics in rural studies is *endogenous development*, which is initiated and led by actors in the local community. Some scholars describe it as a ‘bottom-up’ development (Bosworth 2010; Cheshire et al. 2015). This is contrary to *exogenous development*, in which both the initiatives and the steering are external. Some scholars describe this approach as ‘top-down’ (Gkartzios and Scott 2014; Kacar et al. 2016). Adamski and Gorlach describe sustainable development as a balance between utilising the available natural resources in a given territory and utilising external resources such as technologies, networks, knowledge and financial capital (Adamski and Gorlach 2007a). They argue that sustainable development resolves the apparent conflict between exogenous and

endogenous developmental strategies, as sustainable development is essentially a matter of using one's own resources to secure external resources for the optimal enhancement and utilisation of local resources.

The discussion around balancing endogenous and exogenous strategies has led to the concept of neo-endogenous development, which combines local assets and external relationships and resources. This enhances our understanding of rural places as open to and to a large extent constituted through global flows and international relations, despite having their own unique, locally embedded strengths and resources (Adamski and Gorlach 2007b; Bosworth, Annibal, et al. 2016; Hadjimichalis and Hudson 2014; Shucksmith 2016). In other words, neo-endogenous development links local development to the globalisation process, and argues that effective external relationships with the public and private sectors can empower rural localities when anchored in community priorities (Bock, 2016; Kacar et al., 2016; Primdahl et al., 2018; Shucksmith, 2016).

The concept of neo-endogenous development illuminates a central challenge in rural development – namely, gaining local benefits from global flows. For decades, many rural territories struggled to retain value locally from their natural resource assets, as extractive resource industries have received most of the income generated by these assets. This challenge caught Mårtensson's attention back in 1988, and he was among the first scholars to argue that local communities in rural areas only have limited room for manoeuvre in certain sectors, such as natural resource management, primary industries, educational institutions and the construction sector, as these are regulated and mastered from larger urban centres (Copus et al. 2021; Mårtensson et al. 1988; Shucksmith 2016). Capital areas and regional centres also tend to have a greater concentration of political parties and decision-making, as well as labour unions and other interest groups (Mårtensson et al. 1988; Shucksmith 2016). Mårtensson developed two concepts to describe the territorial development in rural areas:

Territorial integration – the connection between humans in a specific territory, e.g. a local community or region (Mårtensson et al. 1988).

Functional integration – the connection between humans in a functional system, e.g. enterprises and activities (Mårtensson et al. 1988).

Increased centralisation of public administration has led to a lack of functional integration for many rural areas (Mårtensson et al. 1988). For many rural communities, national policy and

global market forces also add to the challenge of ensuring a local territorial development in which functional integration is retained locally. Castells offers a complementary perspective via which to understand this dynamic. He argues that a common challenge for many rural territories is the separation between the *space of flows* and the *space of places* (Castells 2007). While the *space of flows* links people, companies, and authorities in different places through interactive web-based and global economic networks, *the space of places* binds together local, place-based activities.

While the space of flows corresponds with functional integration, the space of places correlates with territorial integration. The main difference is the focus on technology and urbanisation in Castells' work. While the *space of flows* emphasises digital transactions and cash flows, *functional integration* emphasises the human connection in social and digital systems. As a consequence, the two concepts show two sides of a similar development dynamic. For the *space of places* and *territorial integration*, the emphasis for both concepts is on land use and the development of the physical territory, including economic activities connected to the land and the physical proximity of people in a specific area. Because of globalisation, the *space of places* has according to Castell, in several instances, become disconnected from the *space of flows*. This can lead to a lower degree of integration between functional and territorial systems. Over time, this can create tensions, e.g. when a large-scale resource-based industry extracts value from a place without any recognisable economic gain returning to the local community (Dale, Bay-Larsen, and Skorstad 2018; Suutarinen 2015; Tolvanen et al. 2019; Umander, Norlén, and Jungsberg 2017).

The concept of neo-endogenous development offers an approach that embeds and integrates the functional with the territorial, and the *space of flows* with the *space of places*. The aim of neo-endogenous development is to bring together local and external partners (space of flows and functional integration) while also applying and engaging the natural assets and resources available locally (territorial integration and the *space of places*). Therefore, neo-endogenous development can be place-based, taking its point of departure in the local territory (Gill 2010), while also being embedded in a social system that connects local enterprises, public-sector representatives and civil society with a broader network of regional, national and international representatives. When studying how rural communities respond to territorial challenges, theoretical notions regarding neo-endogenous/endogenous and the space of flows/places

provide valuable concepts with which to understand how local actors are able to collaborate with external actors to attract resources from the functional network and the space of flows.

2.2 Analytical perspectives to study rural development processes

The perspectives applied in the PhD are drawn from various theoretical fields occupied with community development, organisational theory, strategy-making, social innovation, social capital and adaptive capacity assessments. Together, they comprise a toolbox that has been applied in the different papers to assess and analyse rural community responses to territorial challenges in the Nordic Region. In the next sections, I will briefly present the four central analytical perspectives applied in this PhD thesis.

Social innovation

Social innovation is widely used to understand rural development dynamics (Bock 2016; Castro-Arce and Vanclay 2020; Georgios and Barraí 2021; Neumeier 2012). I apply it as an analytical perspective to study local development projects in rural areas (paper I). In this thesis, I define social innovation (SI) as a process that leads to novel, place-based and community-produced solutions to social problems (Jungsberg et al. 2020). SI depends on certain preconditions, including social capital, the presence of social networks that bind the community together, and outreach to potential partners. The SI concept is also related to ‘neo-endogenous’ growth, which requires a fine balance between local initiatives and resources and an appropriate external input of capital, expertise and human resources. By showing that SI is generated within a complex web of different geographic contacts and social connections, the concept therefore stresses the interaction between local areas and their wider environment.

Strategy assessment

The strategic approach may entail a focus on paving the way for local and global connections in order to create legitimacy, connect stakeholders and revise democratic traditions (Healey 2013). Strategic planning may involve choices, valuations, judgements, decisions and the selection of relevant implementation measures (Gunder, Madanipour, and Watson 2018). A strategy may be a response to changing contextual parameters, with a view towards contributing to the field of the strategic effort (Healey 2009, 2011). According to Healey, strategy-making consists of four interactive dimensions: *mobilising attention*, *scoping the situation*, *enlarging intelligence* and *creating frames and selecting actions* (ibid). A strategy that draws upon

specific local momentum can have a transformative local effect. As such, each dimension of the strategy can have a transformative capacity, but some flexibility may be required in order to reorient to emerging themes locally.

In paper II, I combine the strategic dimensions with an approach based on an assessment of process and outcome criteria. These criteria are developed from research in consensus-building, complexity science and communicative rationality (Innes and Booher 1999). The focus of the process criteria is on purpose, engagement, representation and high-quality information. The outcome criteria focus on achieved learning, new ideas, social and political capital, and flexible institutions and practices (ibid). Combining the strategic dimensions with the process and outcome criteria provides a solid framework with which to assess rural community responses. This shows that a local strategy is not only about producing an agreement, but is also an exercise in experimentation, learning, willingness to change and consensus-building. When applying the process and the outcome criteria together with the dimensions, the assessment shows to what degree both the process and the outcome have contributed to added value for local development.

Social capital

Research in rural development is also occupied with understanding the role of social capital and human empowerment (Bærenholdt 2002; Cheshire et al. 2015; Lang and Fink 2019; Neumeier 2012). Social capital describes relations of trust, reciprocity and exchange (Adger 2009; Putnam 2000). It emanates from Bourdieu's sociological work on the different forms of capital (economic, cultural and social), and how these define the positions and possibilities of the various actors in any field (Bourdieu 1986; Siisiäinen 2003). Building on Bourdieu's understanding, we might argue that the concept of social capital illustrates a level of property that manifests through personal relationships, networks and individual positions within specific social fields (Eloire 2018).

Another key aspect of social capital is that it is based on trust, social norms and social networks of citizen activity (Putnam 2000). Putnam's research illustrates how dense networks of interaction foster general reciprocity and trust that can produce both private and public goods (Putnam 2000). When studying network activities, we might distinguish between *bonding ties*, referring to strong ties among people who are alike; and *bridging ties*, referring to activities that develop between people and groups who are different and whose ties are not that close (Putnam

2002). In paper III, we draw on a social capital perspective to examine differences in the degree of local acceptance of mining companies in two municipalities in the Northern Periphery.

Adaptive capacity

Adaptive capacity has its roots in organisational theory and has attracted considerable attention due to the work of the Intergovernmental Panel on Climate Change (IPCC). The IPCC defines adaptive capacity as a system's ability to cope with risks and opportunities related to change (Engle 2011; Smit and Wandel 2006). The adaptive capacity concept informs research to improve the understanding of vulnerability in a local context – for example, an assessment of low adaptive capacity indicates a highly vulnerable community (Engle 2011). In paper IV, we draw on the concept of adaptive capacity to discuss the different expected impacts of permafrost degradation, depending on the potential hazard zone in which the communities are located, as well as the community's size and economic situation. In paper V, I use adaptive capacity as a framework to assess the ability to respond to permafrost of two municipalities in Greenland. The framework consists of three parts, involving an assessment of the community awareness and local knowledge; the institutional organisation in place to manage thawing permafrost; and the scientific knowledge that informs decision-making regarding permafrost degradation.

2.3 Applying the theoretical and analytical perspectives

The analytical approaches have been chosen to facilitate understanding of the diversity of rural areas and the range of territorial challenges. The analytical perspectives focus on how rural communities respond to territorial challenges through the lenses of social innovation, strategy assessment, social capital and adaptive capacity, to assess different types of rural community responses. In rural development theory and literature, the concept of neo-endogenous development, combined with the understanding of the difference between territorial and functional integration (Mårtensson et al. 1988) and *the space of flows* as well as *space of places* (Castell 2007), provides a frame via which to understand rural development dynamics. Table 1 shows the linkages between the papers, the theoretical concepts for the current territorial development processes and the analytical perspective applied.

In paper I, the theoretical concepts encompass neo-endogenous development as well as the territorial and functional integration. Although the paper does not explicitly use the terms territorial and functional integration, it encapsulates the development process very well by

emphasising the need for both territorial and functional integration. By applying the social innovation perspective, the paper presents empirical examples of how people build new collaborations, develop new, territorial, locally anchored projects and enhance their network across sectors.

In paper II, the main challenge concerns rural communities’ ability to retain benefits from extractive resource-based industries. The theoretical concept applied stems from Castells’ notions of the *space of flows* and the *space of places* to understand the local mechanisms and identify the options for integrating more of the companies into the community, in the *space of flows*. The analytical perspective for paper II consists of strategy assessment. This perspective is based on a set of criteria applied to the work carried out in two municipalities to overcome territorial challenges concerning global mining companies and their (lack of) local involvement.

Papers	Theoretical concepts for territorial development processes	Analytical perspectives
I	Neo-endogenous development, territorial and functional integration in rural communities struggling with demographic decline	Social innovation
II	Space of flows and space of places, territorial and functional integration for rural communities with extractive resource industries	Strategy assessment
III	Endogenous and neo-endogenous development, space of flows and space of places for rural communities with extractive resource industries	Social capital
IV	Territorial integration for permafrost communities	Adaptive capacity
V	Territorial integration, endogenous development in permafrost communities in Northwest Greenland	Adaptive capacity

Table 1: Overview of theoretical concepts and analytical perspectives.

In Paper III, the main focus is on examining the different relations regarding local community members’ acceptance of mining companies. Here, the relevant theoretical concepts are endogenous and neo-endogenous development, combined with the *space of flows* and the *space of places*. They are not mentioned explicitly in the paper, but they describe the background challenges associated with the social license to operate for international companies extracting mineral resources in rural areas. The analytical perspective applied is that of social capital to

study the responses from two municipalities in terms of their attitudes towards mining companies operating or prospecting locally.

In paper IV, the focus is on calculating the number of inhabitants living on permafrost in the Arctic and the number of people impacted by permafrost thaw. Here, the implicit theoretical frame is territorial integration, which becomes an underlying concept that encapsulates the importance of the connections between people and the territory as the frozen ground thaws – and, in some areas, completely vanishes. The analytical perspective is adaptive capacity, which frames the discussion on impacts. The impacts depend on the permafrost type, the community size and economic situation. In this context, the concept of territorial integration underlines the importance of the local response to permafrost changes.

In paper V, the underlying theoretical concepts include territorial integration and endogenous development. Although they are not mentioned explicitly in the paper, the themes they represent are present in the local approach to dealing with permafrost as a challenge to the community. The analytical perspective consists of adaptive capacity across three dimensions: *community awareness*, *institutional organisation* and *scientific knowledge to inform decision-making*. The research behind this paper shows that both community members and local institutions engage in local and place-based ad-hoc solutions to adapt to permafrost degradation.

The combination of theoretical concepts to understand territorial development processes and analytical perspectives provide a foundation from which to understand the results across the PhD papers. To supplement the theoretical concepts on rural development dynamics, I also draw on Whetten's (1989) reflections on what constitutes a theoretical contribution. He argues that a theoretical contribution must consider two aspects: 1) *what* factors (variables, constructs, concepts) are examined and how they can be considered part of the explanation of the study objective or social phenomena of interest; and 2) *how* the identified factors are related. Theoretical insights emerge from a demonstration of how empirical material can constitute a new understanding of the phenomena of study (Whetten 1989). In section 5, *Discussion of cross-cutting results*, I discuss the main mechanisms that are evident in the papers and which enable community responses to territorial challenges in the Nordic Region.

3. Methodology

The first part of the methodology presents the theory of science underpinning the research in the PhD thesis (*section 3.1*). The following sections provide a description of the research projects supporting the PhD papers, as well as my personal and professional development (*section 3.2*), methods and materials in the empirical data collection (*section 3.3*), the Northern rural context (*section 3.4*) and methodological reflections (*section 3.5*).

3.1 Theory of Science

The theory of science that underpins this PhD thesis is social constructivism. Lester Frank Ward was among the first to use the phrase social construction, but it was only following the publication of Berger and Luckmann's *The Social Construction of Reality* (1966) that it became a mainstream approach to science. According to Berger and Luckman, the scientific sociologist must ask how the reality of people is created, and they were among the first to develop an epistemological approach showing that people construct knowledge to understand phenomena in the society (Berger and Luckmann 1966). My work is inspired by this approach, and by the understanding that perception creates knowledge, which ultimately defines how we understand and interpretate the social sphere.

The social constructivist approach was further developed by Bruno Latour, Steve Woolgar and Karin Knorr Cetina. They show how scientists make sense of their observations (Latour and Woolgar 1986) and propose how science is fabricated out of organisation, norms, social structure and circumstance (Knorr Cetina 1999). This approach offers several relevant points for reflection, not only in connection with the production of knowledge, but also in my field of study focusing on rural communities. The factors I observe as influencing the research are the project management and budget planning, and communication with study participants. One example is the importance of local contacts in communities, which saves a considerable amount of time in terms of creating field access. In this regard, I have been privileged to carry out my research in a field in which I had both a personal and a professional network.

In connection with analysing rural transformation, I took inspiration from the sociological debate around agent and structure. While agents represent individuals, structure represents society's norms, legal framework, etc. Drawing on Giddens' work on social constructivism, it is the agents and their practices that reproduce structures depending on circumstances (Giddens 1987). Social structure is made up of rules (present in the agents' heads) and the agents'

practices. In his theory, Habermas focused on individuals' self-emancipation from societal domination. His approach was to evaluate the self-formation of social groups that can change social structures (Habermas 1991). The role of social groups is also a key finding in Bruno Latour's research on the social worlds. He shows that, for the agents, reality consists of constantly shifting relationship networks. The theory suggests that these networks are what create our reality, and that nothing exists outside of them (Latour 2007).

Goffmann contributed to the field of social constructivism through his study showing how human behaviour depends on personal scenarios and relationships. He used many metaphors from the field of dramatology and acting to argue that agents play different roles depending on the public space and audience (Goffman 1959). While Giddens, Habermas and Goffman all emphasise the opportunities of individuals (agents) to generate social change, other scholars such as Durkheim would emphasise the determinism of the social structure. Durkheim argues that agents' actions are reactions to stimuli and are predetermined by the social rules. The social rules emerge from social institutions, e.g. schools and political, democratic and cultural values, which shape the agenda in a given location (Durkheim 1984). Bourdieu positions himself between the positions of determinism and the agent's creation of social structures, as he shows the importance of social capital and that the ability of individuals differ depending on, e.g. their social network. He argues that it is the agent's social capital, i.e. their socially ingrained skills, habits and social network, that makes this possible (Bourdieu 1986). In my research, I recognise the importance of Bourdieu's work on social capital, but I also see the full spectrum in terms of agents' ability to create change, i.e. in local initiatives responding to a territorial challenge. However, I also see that many societal structures related to local employment, national investment priorities, and environmental change such as permafrost degradation shape the agents' possibilities to act locally.

With this approach, I also acknowledge that people are influenced by their values, life experiences and social network, as well as topical issues in local and national media. The study object consists of people's experiences and perspectives concerning their own and others' engagement in rural responses, development initiatives, strategic planning and adaption to permafrost degradation. By employing a social constructivism perspective, I acknowledge that the knowledge collected is the reality as it is captured by the participants in the study. In social constructivism, knowledge is created and sustained through social processes (Simonsen and Hansen 2004). In the field of rural development and planning, there is increasing agreement that community-based and interactive research methods are important for addressing society's

emerging sustainability challenges (Lang et al., 2012). With this perspective, the research process of collecting data through interviews, questionnaires and workshops should also be acknowledged as part of the construction that generates the knowledge (Latour 2007).

From my perspective, the most important message in the philosophy of science in social constructivism is that all *social phenomena* are historically and socially created. As both the society and the social phenomenon are created by people's actions, this implies that they can also be changed by means of a different set of actions (Fuglsang and Bitsch Olsen 2012; Mariussen and Uhlin 2006). The implication for this study focusing on rural community responses is that it shows that people can change their circumstances. The *social constructivism* approach therefore entails a transformational perspective for local and regional change.

3.2 Projects supporting the PhD, personal & professional development

The research design is influenced by the contexts of different research projects that examine numerous forms of rural community responses to territorial challenges. The data acquisition was guided by my involvement in three projects. In the next section, I will give a brief introduction to the background of these projects. A common denominator in the study is the applied research component. Each paper is based on a broader set of research assignments that are beyond the scope of this PhD study. My published papers are based on the empirical material collected in the projects, and my involvement in these projects also reflects my personal and professional development since I started working for Nordregio in 2014.

The first project in which I was involved was *Territorial Social Innovation in the Nordic Countries and Scotland*. This project was commissioned by the Nordic Working Group on Demography and Welfare 2013–2016, under the Nordic Council of Ministers' Committee of Senior Officials for Regional Policies. Throughout the project, we collaborated with a working group comprising civil servants from the Nordic countries' national authorities. The working group's interest lay in understanding how social innovation can address the demographic challenges faced by rural communities across the Nordic countries. They provided context-specific input that accommodated perspectives from both welfare policy and rural development. The project resulted in many outcomes, including policy papers on the national contexts, an online tool with learning outcomes from the different examples of social innovation, and advice for further fundraising for rural communities.

My role in this project was as a project researcher. I was responsible for writing about the Danish policy context for social innovation and collecting data regarding the Danish cases. The project group came together to collectively reflect on the results, and a key focus in our work was how we could support the rural areas with the lessons learned from the cases concerned. Unfortunately, the budget did not allow for time to write an academic article about the findings. The paper was not part of the commission from the working group, but purely emerged from an academic interest in trying to understand the initiation and implementation phase, as well as the shift in actors engaged in the process. Once my PhD was approved, I was able to use Nordregio-funded PhD hours to draft the academic article that was eventually published in *Journal of Rural Studies*.

The second project in which I was involved was the EU Interreg project *Regional Innovation in the Nordic Arctic and Scotland with a Special Focus on Regions with Large-Scale Projects* (REGINA). The participants in this project comprised municipalities, regional authorities and research partners from Scotland, Norway, Greenland, Sweden and Finland. The researchers were specialists in the areas of local and regional economic development, resource-based industries' extraction of natural resources, and demographic change. In the REGINA project, we developed a series of tools and an overall analytic framework to reduce the vulnerability and increase the preparedness of small communities in remote areas of the Nordic Arctic and Scotland facing the development – or closing-down – of large-scale, resource-based industries.

As one of the project partners withdrew shortly after the project start, I became responsible to support all of the municipal partners in the development of a *local smart specialization strategy*, including the collection of local data. During the project, I also worked closely with the project manager at Nordregio, and in periods of his absence, I took the lead in finalising deliverables and communicating with the Northern Periphery and Arctic Programme secretariat about the project progress. Paper III emerged from the results of the questionnaire, which I was heavily involved in coordinating and processing. After the closure of the project, I started writing Paper II as I had questions regarding the actual outcomes of this three-year project, and the long-term consequences for the local preparedness in terms of managing resource-based industries.

The third project in which I was involved was the EU Horizon project *Nunataryuk*, focusing on socio-economic impacts from permafrost degradation. Nunataryuk means “land-to-sea” in Inuvialuktun, one of the Inuit languages spoken in Northwest Territories and Nunavut in Canada. This is a region where the land meets the Arctic Ocean, and this project combines

permafrost research with modelling and socio-economic analysis, and includes stakeholders from all across the Arctic region. Part of the research was carried out in collaboration with representatives from Arctic coastal communities and indigenous societies. The aim was to develop mechanisms for applying innovative, evidence-based interventions that could enable sustainable development in the Arctic. The idea for paper IV came from the interdisciplinary collaboration, when we realised that we were among the first to combine permafrost data with demographic data.

In the Nunataryuk project, I was heavily involved in the tendering phase, together with a senior colleague. However, he ended his contract when we received the funding, so it was natural that I should guide the project as the day-to-day project manager. My role was to coordinate five research deliverables from Work Package 7, which Nordregio was leading. I guided the process of combining demographic data and permafrost data, collaborated with my colleagues and led the work to publish the *Atlas of Population, Society and Economy in the Arctic* (Jungsberg et al. 2019). I also played a key role in managing the Greenlandic stakeholder activities, and facilitated workshops in Ilulissat and Qeqertarsuaq. The Nunataryuk project entailed fewer deliverables and more time to do general research. However, I still coordinated the different inputs and supported my colleagues, who also contributed to the deliverables specified in our contract with the EU commission.

Common to all three projects is that there were many tasks that were not synced with the research needed to write the PhD thesis. Furthermore, I was also part of several projects that did not contribute to data relevant to my PhD thesis, but which gave me insights into the research carried out in rural and Arctic areas. These included the Nordic working group for Sustainable Regional Development in the Arctic (2013–2016) and the Nordic Thematic Group for Rural Development in the Nordics (2017–2020), as well as some small consulting jobs with, e.g. Oxford Research on small and medium enterprise development in the Arctic regions.

3.3 Methods and material in the empirical data collection

The methods employed to answer the study's empirical enquiry combine both qualitative and quantitative methods, including semi-structured interviews, community workshops, questionnaire data, register data and desktop research. As described in the previous section, all

of the projects contributed data, and through the research collaborations, I was also afforded access to data relevant to the articles.

Qualitative semi-structured interviews were used to examine the experiences of key actors engaged in local development. Each interview was recorded, transcribed and coded according to the paper's thematic focus. In paper I, I was responsible for the Danish interviews (3) conducted via online meetings (60-75 minutes), and one interview in the Faroe Islands (75 minutes) that I conducted face to face (during a study trip with another project).

I received the remaining interviews (14) from the project members once I had decided to draft the academic article. The qualitative interviews were supplemented with a short questionnaire summarising the interviewees' assessment of the importance of different actors' involvement in the SI (see appendix A). The answers were scored 0–5 depending on the perceived importance of the actor's contribution to ideas, resources and decision-making. This data is presented in the form of radar charts, to support visualising the findings from the qualitative research.

In paper II, I conducted two online interviews (60 minutes) aimed at assessing the local smart specialisation process. The interviews were with two local project managers in Storuman and Sodankylä in the REGINA project. I used the interviews to validate the findings from the strategy assessment, informed by the theoretical work from Healey and from Innes and Booher (Healey 2009; Innes and Booher 1999).

In paper V, I conducted 22 interviews focusing on community members' approaches, as well as institutional strategies dealing with permafrost degradation (paper V). The 22 interviews (30–45 minutes) were collected using the field assistants' network in the community, as well as a snowball sampling approach, in which local people gave us further recommendations for local contacts. The interviews informed the study of the impact of permafrost on seasonal livelihood activities, technical constructions and the local people's perception of important opportunities and challenges for community development. The qualitative data were also used to nuance the questionnaire data regarding people's experiences of the impact of permafrost thaw on the physical environment, hunting and harvesting, housing and the economy.

Questionnaire data was used to collect the viewpoints of a larger group of people in the local communities. The questions focused on the perception of the social impact of mining activities

(paper III) and permafrost degradation (paper V). Questionnaires on mining developments were conducted in Storuman and Sodankylä (see appendix B). In Storuman, the questionnaire was carried out between January and June 2017 in the eastern part of the municipality. This area was selected because it is the location of ongoing mining or mineral projects, in various phases. The local project manager posted the questionnaire to 571 respondents living in the villages of Pauträsk, Barsele and Högländ. The recipients were also able to answer via the municipality's website, using a personal password given to everyone. A total of 217 responses were received, 175 of which arrived by mail. I and a colleague processed the questionnaire results in Excel spreadsheets.

In Sodankylä, the questionnaire was carried out in the municipality in February 2018. The local project manager in Sodankylä engaged the community members to respond to the questionnaire either online or via mail. The local project manager also presented and discussed the questions from the questionnaire at five village meetings near existing or planned mining areas. A total of 160 responses were received – 54 via mail and 106 via the online questionnaire. Research partners from Lapland University processed the data from both questionnaires using the Statistical Package for the Social Sciences (SPSS) program.

In Greenland, two different questionnaires were carried out, one in Qeqertarsuaq in Disko Bay and one in Qaanaaq, the northernmost town (paper V, see appendix C). The questionnaires were translated into Greenlandic and administered by two local field assistants in a face-to face setting. I gave the field assistants an introduction and in Qaanaaq we administered all 45 questionnaires together, while in Qeqertarsuaq the field assistant worked well alone and therefore conducted 98 of the questionnaires herself. In Qaanaaq, 10% of the adult population answered the questionnaire. As of 2019, the town was home to 646 inhabitants, of whom 450 were above 18. The number of respondents (n=45) therefore represents 10% of all adults. The questionnaire was carried out between February and June 2020. In Qeqertarsuaq, 15% of the adult population answered the questionnaire. As of 2019, the town was home to 854 inhabitants, of whom 653 were above 18. The number of respondents (n=100) therefore represents 15% of all adults. I processed and analysed the data using Excel.

Community workshops were held to discuss local opportunities and challenges. Four community workshops were carried out: one in Storuman Municipality, Sweden (20 participants), one in Sodankylä Municipality, Finland (30 participants), one in Qeqertarsuaq, Greenland (10 participants), and one in Ilulissat, Greenland (12 participants). The workshops

in Storuman and Sodankylä brought together participants from local civil society organisations, and public- and private-sector bodies, thereby involving a variety of perspectives on the most important priorities for local development (paper II). Local project leaders organised and hosted the community workshops. They followed a similar methodology in both municipalities, one that was jointly developed by the project team at Nordregio and Norwegian research partners from Nordland University. The method followed a step-by-step approach, including: a) a few short presentations that set the stage; b) opportunities and challenges from the stakeholders' perspectives; c) democratic ranking of the opportunities and challenges by importance; and d) group discussion. Due to lack of time and resources, I did not participate in the community workshop, but had very close dialogue with the local project managers regarding the preparation, implementation and reporting of the workshop.

The community workshops in Ilulissat and Qeqertarsuaq brought representatives from the community, hunters and fishermen, the local housing agency, the private sector, the municipality, the energy agency, and tourism and local educational institutions. The first group discussion centred around setting priorities. We posed the following questions: a) *What are the most important issues now and for the next 10-20 years?* b) *What do you perceive as the biggest risk now for the community?* and c) *What are the most important opportunities and challenges for local economic development?* In Qeqertarsuaq, there was a higher participation of hunters and fishermen, and fewer institutional representatives – which is to be expected, as this is a smaller community. I organised both workshops and facilitated them together with a colleague from Akureyri University, who is also a partner in the Nunataryuk project.

Register data was used to calculate current and projected settlements on permafrost and the population change in Storuman and Sodankylä municipalities (papers II and IV). In this study, settlements are defined according to the National Statistical Institutes (NSI) in the Nordic and Arctic countries, respectively. Two main sources of demographic data are population census and administrative and register data at settlement level. The data sources were the national statistical institutes, and the study used the latest available data for the area – paper II used 2018 data (Storuman and Sodankylä municipalities), while paper IV used 2016 and 2017 data (Arctic Circumpolar Region).

For the Arctic Circumpolar Region, the number of people and settlements impacted by permafrost thaw by mid-century is a function of two factors: projected permafrost extent and demography. To estimate the future of permafrost settlements, we used the projected permafrost

extent modelled by Hjort et al. (2018), using representative concentration pathways (RCPs) 4.5 for the year 2050.

Desktop research and literature review have been central to building upon existing studies that examine local strategy-making in managing the three territorial challenges – demographic change, local economic development and permafrost degradation – in rural areas in the Nordic countries. The review looked at academic peer-reviewed literature and grey literature, such as working papers, local development plans, and newspaper articles in local languages in the study communities. Depending on the thematic areas, the focus was on keywords such as social innovation projects in specific areas (paper I), local strategies in specific areas (paper II), and written material on the social impact of permafrost degradation (paper V). For the overall literature review, I carried out searches on Scopus and Google Scholar using the search terms (including truncation*): Local AND communities AND respon* AND territor* AND challeng* AND Nordic (I also replaced Nordic with searches specifically for Denmark or Sweden or Finland or Norway or Iceland or Greenland or Faroe Island or Åland).

3.4 The Northern rural context

The Nordic Region comprises the five Nordic countries (Finland, Sweden, Norway, Denmark and Iceland) together with the three autonomous areas (Åland, the Faroe Islands and Greenland). To assess the Northern rural geographic context, I have applied a rural-urban typology, based on the indicators and categorisations devised by the Organisation for Economic Cooperation and Development (OECD). These categories are selected according to local population density, the proximity of main cities and the remoteness of communities compared with predominantly urban regions. The study areas for the five papers are all located in rural and/or intermediate regions. Settlements in both rural and intermediate regions can face similar challenges, including school closures, deterioration of public transport, lack of employment opportunities for and outmigration of young people (Grunfelder et al. 2020; OECD 2017).

Rural challenges such as outmigration, low educational attainment, skewed gender ratios and high old-age dependency rates are also present in what I in this study describe as the Northern Periphery and Arctic. Simultaneously, these areas are often characterised by an abundance of natural resources, accompanied by low population density and vast distances, which means that

the accessibility of many Arctic settlements is dependent on the existing land, sea and aviation infrastructure.

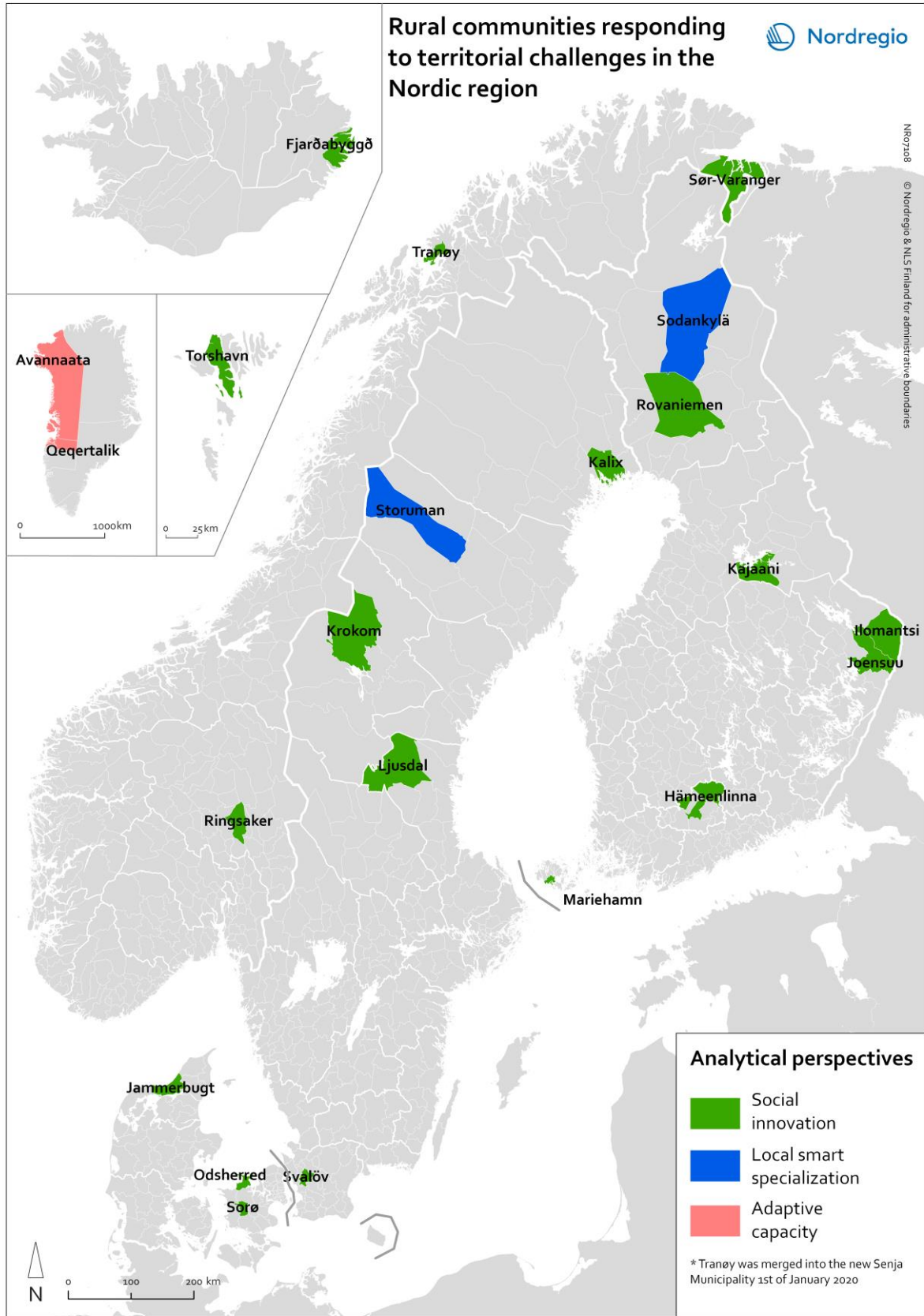
In the national statistical institutes in the Nordic countries, settlements are defined as statistical build-up areas and localities using the following terms: Denmark: *by*; Finland: *taajama*; Norway: *tettsted*; Sweden: *tätort*; Iceland: *þéttbýli*. In the autonomous territories of the Faroe Islands and Greenland, a settlement may be defined as a village or town depending on the size of the settlement or its administrative role. A settlement is understood as an independent inhabited place – which indicates that, statistically, settlements with one inhabitant exist. Rather than the term settlement, I use the term community to refer to a collective of people who share a common territorial area as their base of operation for daily activities. This includes individual community members, local public-sector authorities, and private-sector and civil society organisations. The main criteria for being part of a rural community is physical proximity – i.e. the institutions, residents, businesses, and organisations that live in and operate from the same settlement.

It is common to also use the word *community* in the context of describing a group of people who share common values and beliefs, close and informal relationships, territorial proximity, organised interactions and cultural similarities (and interact only digitally, e.g. online community). However, when choosing to describe community with the criteria of physical proximity, it is not necessary for individual members of a community to share similar values or culture or participate in organised interaction. Community is therefore an aggregated term that, in some cases, may cover different perspectives, e.g. regarding the role of resource-based industries and whether they should be included as a priority in local economic development.

Map 1 shows analytical perspectives applied in the different study areas, including the 18 community-driven social innovation projects in rural and intermediate regions in the five Nordic countries (paper I); the local smart specialisation and social licence to operate in two municipalities defined as rural and peripheral in Sweden and Finland (papers II and III); and the study on adaptive capacity for permafrost degradation in the Arctic Region and Northern Greenland (papers IV and V). The selection of the study areas has been guided by the different aims for the research projects. In the research on social innovation, the aim was to identify good examples to understand the local mechanisms that were crucial in supporting social innovation. In this case, one could argue that they fall under what Flybjerg mentions as *extreme cases*

(Flyvbjerg 1988, 2010) as these are not representative for rural areas, but a collection of what could be considered as the most successful initiatives in the Nordic Region.

For the studies focusing on local smart specialisation and social licence to operate, the two municipalities are generally representative in terms of the challenges they face in retaining economic benefits from extractive resource-based industries. Storuman and Sodankylä municipalities were selected as cases through the tendering phase for the REGINA project, and based on their local business and labour market structure and networks among my research colleagues at Nordregio. For the study focusing on adaptive capacity, the choice was obvious, as Greenland is more impacted than other Nordic areas when it comes to permafrost degradation. The study communities in focus became Qeqertarsuaq in Qeqertalik municipality and Qaanaaq in Avannaata municipality. In Qeqertarsuaq, we found contacts via the Copenhagen University research station, located 1 km from the community, and in Qaanaaq we received contact suggestions through our network in Ilulissat.



Map 1: Study area and analytical perspectives

3.5 Methodological reflections

This study combines many different methods to generate varied data that can be used to analyse how rural communities respond to territorial challenges in the Nordic Region. In the study on community responses, I have combined different data sources to validate findings. One example concerns the issue of depopulation, which was raised as a challenge in a local community workshop. We combined this material with register data examining the population change in the area. Throughout the studies, I have reflected on the validity of this data, and whenever possible applied supplementing data that could confirm or reject the findings. This is in line with the methodological recommendations to ensure a high-quality data (Flick, Kardoff, and Steinke 2004).

Using qualitative data, community workshop data, questionnaire data and register data has proved optimal for examining local dynamics. However, there are certain limitations in terms of the potential for making comparisons across case study areas. Since the papers differ in their methodological approaches, the main value of compiling them is to see each paper as a study result and thereby discuss the cross-cutting themes that arise from the data collection. As described in the method description, I collected some data myself, and gained access to other data as a member of the research team, e.g. the questionnaire data and the community workshops in Storuman and Sodankylä. From my perspective, the broader research collaboration has given me access to more data than I would have been able to collect on my own during a PhD study. As I have collaborated closely with the local project managers who have provided data, I have a high degree of trust in the quality of the data generated during the local smart specialisation process.

In terms of my field access, since doing my master's thesis I have established quite a good network in Greenland, and this has been extended during my work at Nordregio. It has not been my experience that my gender has impacted my access to the field in Greenland. During my collaboration with two field assistants in Qeqertarsuaq and Qaanaaq I experienced some challenges in terms of engaging people. Many community members were not interested in participating in interviews or the questionnaire, and we had some struggles increasing the numbers (particularly in Qaanaaq) of people who could contribute with their knowledge. Still, the local collaboration was generally very successful, as the two field assistants did an excellent

job of collecting questionnaire answers from 15% of the adult population in Qeqertarsuaq and 10% of the adult population in Qaanaaq (Jungsberg et al. 2021).

Common to all the research papers is a problem-oriented approach to the different challenges faced by rural communities. While basic research primarily seeks to understand the world, applied and more policy-oriented research is dedicated to problem-oriented work (Dotti 2018). All the PhD papers are generated via research projects with partners working in both science and practice. This collaboration between diverse forms of knowledge informs the different analytical concepts that frame the rural communities' responses to territorial challenges. Practice partners have been involved in interpreting the relevance of the concepts of social innovation, local smart specialisation, social licence to operate and adaptive capacity in a local context.

The collaboration with different kinds of practice partners, such as regional planners, public servants and community inhabitants, has also led to some challenges. There have in some cases been different interests that presented challenges in terms of maintaining the academic focus. Furthermore, my intention was that my research would be of value to the communities, but in some cases I felt that my interest was different from that of the people I interviewed. In Qaanaaq, for example, the study participants talked about their defective houses. In such situations, I felt rather useless conducting academic research into adaptive capacity. On many occasions, I wondered how I could be more helpful, and whether I next time could bring some tins of fresh house paint, as many houses were clearly in need of some maintenance.

The methods and analytical perspectives comprise a toolbox with which to examine rural community responses to territorial challenges. The knowledge produced provides different perspectives on rural communities' approaches to local challenges. One implication of both the applied approach and the collaborative character of the PhD study is that it facilitates closer contact with the local development practice in rural communities. Overall, this thesis has been written as part of different projects, in collaboration with community members and local authorities. One purpose has also been to support local development in the communities and provide concrete advice, i.e. policy recommendations to decision-makers in national and regional authorities.

4. Summary of results

The results comprise the research findings presented in five articles. In three of the articles, I am the lead author, and these comprise the primary contribution of the PhD thesis (papers I, II and V). In two of the articles, I have contributed as second or third author, and these articles provide further insights into the research field of social capital (paper III) and population living on (paper IV). The common denominator for the three primary articles and two supplementing articles is the rural communities' ongoing practices in response to territorial challenges, in the form of local strategies, social innovation, and adaptive capacity practices in the Nordic and Arctic Region.

4.1 Paper I: Key actors in community-driven social innovation in rural areas in the Nordic countries

Authors: Leneisja Jungsberg, Andrew Copus, Lise Byskov Herslund, Kjell Nilsson, Liisa Perjo, Linda Randall, Anna Berlina

Journal: Journal of Rural Studies, Volume 79, pages 276–285

Published: <https://www.sciencedirect.com/science/article/pii/S0743016718311574>

In many European countries, demographic change has led to increased centralisation and funding cuts in rural regions, but also a corresponding rise in civil society actors assuming responsibility for services, infrastructure and local assets (Bernal 2019; Cheshire et al. 2015; Coffey and Polese 1984; Fougère, Segercrantz, and Seeck 2017; Harris and Albury 2009; Pestoff 2012). Many of the emerging community solutions can be described as social innovations (SI). SI activities are associated with new social interactions that reach beyond the rural community's geographic area. These new social interactions involving actors from different geographical areas create an opportunity to address unmet social needs (Bock 2012; Bosworth, Rizzo, et al. 2016; Neumeier 2017; Noack and Federwisch 2019).

There is evidence that SI involves multiple institutions, norms, and practices. In this way, SI shifts our perspective from fixed actors in separate rural areas towards a more fluid image of shifting actors, relations and functional networks operating across different geographic areas, beyond the local and rural. SI is connected to qualities such as community participation and

empowerment. The main difference between rural development per se and SI in rural development is that SI needs to be perceived as novel for the community involved in its creation (Bock, 2016; Neumeier, 2017). This perceived novelty can be related to new partnerships and collaboration across different geographical borders (ibid). SI has been studied both empirically and theoretically as a driver of social change (Bernal 2019; Howaldt et al. 2018; Lindberg 2017). However, SI processes in rural areas throughout the Nordic countries have not been analysed in earlier research.

Results & discussion

The 18-community driven SIs examined in the study can be divided into three broad categories: 1) local fora for community development and capacity-building; 2) creative approaches to service provision; and 3) provision of community spaces and activities. All of the SI projects have a novel approach and succeed in establishing a new collaboration model, in which the public sector, civil society actors, commercial providers and service users find new ways for the different actors to work together.

The initiation phase of the SI includes everything from the initial idea right up to what could be considered regular operations. In all cases, SI initiatives were triggered by regional vulnerabilities such as demographic changes and/or challenges posed by shrinking public budgets. The challenges themselves were varied and included service closure (or threat of closure), ageing populations and decline, and local authority mergers. Although all of these factors have been significant drivers, it is important to acknowledge that these conditions in and of themselves do not necessarily lead to community-driven SI. Certain preconditions need to be in place before SI projects can lead to change. These include the presence of human and social capital, the presence of social networks that bind the community together, and connections to (potential) external partners.

The respondents rated the importance of civil society involvement in the initiation phase. One key result is the way the respondents articulate how the SI process engages people from the community. They underline the importance of connections between all actors locally, i.e. community members, civil society organisations and the local public sector. Community members were rated most important actor in relation to developing ideas, while local civil society organisations were rated most important in decision-making. The local public sector is rated as the most important in terms of providing resource support during the initiation phase.

After this phase, a shift occurs, and ‘civil society organisations’ are rated as the most important actor in relation to developing ideas, managing decision-making and collecting resources during the implementation phase.

Conclusions

Most of the examples describe how members of the community work together to develop an idea, and as part of that collaborate beyond the local area to establish new initiatives. Of the 18 SI initiatives, eight became established associations, six became social enterprises, two set up public-private co-operatives, and two became community development trusts. The study also shows that many SI examples rely on a few passionate individuals – which constitutes a risk that must be assessed as part of rural development policy. This calls for a focus on building up local capacity to ensure that the established SIs can continue to make a long-term contribution to rural development.

4.2 Paper II: Local smart specialisation: An approach to increasing preparedness in rural communities with resource-based industries in the Northern Periphery

Authors: Leneisja Jungsberg, Lise Byskov Herslund, Kjell Nilsson, Karina Umander, Anna Kantola, Jukka Teräs, Ryan Weber

Journal: European Journal of Spatial Development, Vol 71.

Published: <http://norden.divaportal.org/smash/get/diva2:1499839/FULLTEXT01.pdf>

A common challenge for Northern communities is how to retain local benefits from resource-based industries. Local economies are often dominated by the extraction of natural resources by large-scale industries, which influences opportunities for local development (European Commission 2016; Jungsberg et al. 2018). Besides the lack of economic diversification, communities in sparsely populated areas of the Northern Periphery also struggle with population decline (Copus et al. 2016; Knobblock and Pettersson 2010).

One approach to support territorial development is the European Union’s concept on *Smart Specialisation* that is a cornerstone of their efforts to guarantee fair territorial development opportunities for all regions (McCann and Ortega-Argilés 2016). The Smart Specialisation

Strategy (S3) is a core part of the European Union's policy on regional growth and prosperity (European Commission 2018). The Northern Periphery's regions are vast, with municipalities that encompass both coastal and inland settlements, as well as mountainous areas with mining activities. Some municipalities are equivalent in size to a whole European country, which makes the local aspect even more important. A local version of the regional approach to *Smart Specialisation* is the *Local Smart Specialisation* (LS3). LS3 differs from the regional approach by working closely with local authorities and stakeholders to help rural communities deal with resource-based industries and create local economic diversification.

In this context the European Union's Northern Periphery and Arctic Programme highlights preparedness as a priority. Preparedness is defined as the ability to plan for local development, and the programme adopts a strategic approach to retaining benefits from resource-based industries operating in the area. Local smart specialisation (LS3) is one approach aimed at supporting local territorial development. Because of the vast geographic size of many municipalities, a local municipal focus is beneficial. To date, no studies have examined a local smart specialisation (LS3) strategy in the Northern Periphery. To fill this gap, this paper assesses the process and outcome from the development of an LS3 in Storuman municipality in Sweden and Sodankylä municipality in Finland over a three-year period.

Results & discussion

The results illustrate how the LS3 steps correspond with Healey's research on strategy-making (Healey 2009). All four strategic dimensions – *mobilising attention*, *scoping the situation*, *enlarging intelligence* and *selecting actions* – were represented in the LS3 work. *Mobilising attention* focused on the motivation to work with territorial challenges concerning economic diversification and demographic decline. *Scoping the situation* brought attention to the local stakeholders' perspectives. In Storuman, local stakeholders reported that better local use of natural resources, local training and education, and more local cooperation were important opportunities. In Sodankylä, the local stakeholders mentioned new jobs, more work for small business and service providers, and vocational education as key opportunities.

Enlarging intelligence focused on bringing in new knowledge through cooperation between local project leaders, researchers, local people and planners. Knowledge was generated in areas corresponding to the territorial challenges of demographic change, land-use planning, and local economic development. This was the most comprehensive strategic dimension of the LS3 work.

In total, 24 publications were produced, including working papers, academic articles and policy briefs presenting good practices and new knowledge on strategic approaches aimed at building preparedness.

Creating frames and selecting actions focused on prioritising actions and presenting findings from the LS3 to the municipal board and leadership group, to facilitate discussion of future directions. This dimension highlighted a key difference between Sodankylä and Storuman. In Sodankylä, the municipal board decided at an early stage to closely follow the strategy process in order to develop a ‘mining programme’ that would guide cooperation between private mining companies, local public-sector bodies and civil society. The intention behind the mining programme was that it should become a policy document with a set of guidelines for collaboration that also could be used after the LS3 work was finalised. In Storuman, the management team followed the step-by-step process laid out in the LS3 plan. However, the work focusing on policy options was not included in Storuman municipality’s strategic plan for 2020–2023 (Storumans Kommun 2019).

The results of the assessment, based on Innes and Booher’s (1999) process and outcome criteria, show that the LS3 in both municipalities score 5 out of 7 on process criteria, and 4 out of 7 on outcome criteria. The five process criteria fulfilled were that the LS3 had a broad representation of community members, managed to engage participants, presented high-quality information about the mining operation, and the process involved new collaboration between mining companies and the municipality. The four outcome criteria fulfilled in Sodankylä and Storuman showed that new ideas were developed and that learning had taken place beyond the two municipalities (neighbouring municipalities got to know about the process and were interested in the approach). The outcome criteria also showed that information for local stakeholders was produced successfully, and that the institutions in the area became more flexible and increasingly networked throughout the strategy process. Neither Storuman nor Sodankylä fulfilled the outcome criteria ‘ends stalemate situation’. The situation between reindeer-herders and mining companies in the area remains rather tense, as this is a long-term historic conflict that cannot be resolved by a three-year process.

Conclusion

The objective of this paper was to assess the strategic dimensions and the process and outcome of local smart specialisation (LS3) in two municipalities in the Northern Periphery: Storuman (Sweden) and Sodankylä (Finland). The LS3 builds on notions around gaining value from external networks, the space of flows, and becoming active in functional integration.

All strategic dimensions were present in the LS3 process. Overall, the assessment showed positive impacts from the LS3 activities, the aim of which was to reduce vulnerability and increase the municipalities' preparedness for managing large-scale industries. One key outcome was increased knowledge about population change, land-use planning and the local retention of economic benefits. The dialogue between local stakeholders in these focus areas provided value for future activities aimed at supporting local territorial development. However, shortcomings were also noted, primarily related to lack of continuity and limited potential for long-term impact. One way to improve the LS3s could be to incorporate plans for continuation from the outset so that resources are allocated for continuing the activities on collaboration and implementation.

4.3 Paper III: Social license to operate in the frame of social capital exploring local acceptance of mining in two rural municipalities in the European North

Authors: Leena Suopajärvi, Karina Umander, Leneisja Jungsberg

Journal: Resources Policy, Volume 64.

Published: <https://doi.org/10.1016/j.resourpol.2019.101498>

As a response to assess community acceptance of natural resource extraction, a key term developed is Social Licence to Operate (SLO). The SLO term is useful for studying the extent to which rural communities impacted by resource-based industries accept local activities by these industries (Jijelava and Vanclay 2017; Prno 2013; Tarras-Wahlberg 2014). A company can gain a social licence to operate by establishing reciprocal relations with the host community. This will eventually consolidate residents' trust and lead to cumulative positive effects on wellbeing in the community (Jijelava and Vanclay 2017; Litmanen, Jartti, and Rantala 2016).

One characteristic of good relations is reciprocity, and that relations between the company and the community are based on each other's interest (Litmanen et al. 2016; Prno 2013). SLO concerns the daily operations of companies in their localities, especially in terms of ensuring fair, open and reciprocal relations with local stakeholders. The literature suggests that the term 'social' refers to distributional justice, including local benefit provision and a sense of fairness regarding the company's activities (Jijelava and Vanclay 2017; Moffat and Zhang 2014).

The aim of this article was to study the meaning of 'social' in SLO. To accomplish this, we linked the SLO concept to the social capital approach, which emerged at the end of the 20th century as a lens through which to discuss the effects of the industrialisation and modernisation of social life. The social capital approach deepens the community perspective by including factors such as prosperity and local networks, with a view towards fostering reciprocity and trust (Eloire 2018; Siisiäinen 2003). To apply these ideas to our research aim, we discussed the mining-related history in the localities, the social compositions of the communities, the various relations within the communities, and the relations between the communities and the operating companies.

The study focused on two rural communities where mining activities were taking place: Storuman in Sweden and Sodankylä in Finland. Questionnaires of mining developments were conducted in both municipalities. The respondents were asked to evaluate the impacts of mining on the local community, to express their perceptions of mining, and to assess the environmental impacts of mining and the degree of local acceptance.

Results

While social relations are central to the social capital concept, SLO is built on interactional trust, which emerges through dialogue and reciprocity in encounters with the company. The quality of the interaction with a company, in terms of positive and pleasant engagement, enhances trust. This idea can support the connections between social capital and SLO. The respondents in Storuman and Sodankylä evaluated the mining companies in terms of their engagement in developing the community, the sufficiency and reliability of their information, and the options for residents to participate in mining-related decisions in the municipality.

In Sodankylä, respondents rated the performance of three companies: Anglo American (Sakatti project), Boliden (Kevitsa mine) and Rupert Resources (Pahtavaara mine). Of these, the weakest performer was Rupert Resources – at the time of the questionnaire, its activities in the Pahtavaara mine were on hold. Boliden and Anglo American received better ratings and both companies received a satisfactory rating in terms of reliability, sufficiency in information, activeness and timeliness of communication and cooperation, as well as interaction with local residents. At the time, Anglo American was conducting its environmental impact assessment for the Sakatti project and involving local people in this process. In total, 85% of the respondents in Sodankylä indicated their acceptance of the mining activities.

In Storuman, 30% of the respondents indicated their acceptance of the mining activities. However, the most striking issue was that a high percentage of respondents chose not to respond to questions concerning company performance. In the case of the Dragon mine and processing plant at Pauträsk, 46–52% of respondents avoided the question related to company performance (e.g. residents' opportunities to participate in decision-making, the reliability and sufficiency of information). In Barsele, where the company Agnico Eagle was engaged in mineral exploration, the no-answer rate was 35–39%. In Högland, where Tertiary Mineral was planning to establish a mine, more than half of the respondents (54–60%) didn't reply. These rates are noticeably high in comparison to the generic questions on mining and its impacts, where only a small percentage did not reply. That said, it seems that the companies operating in the area had failed to establish a relationship of trust with local residents. In addition, the majority of those who responded to the questionnaire argued that the company's engagement in developing the municipality was weak. Finally, even though communication should be an integral part of gaining a social licence to operate, the reliability and sufficiency of information was deemed weak in all cases.

One reason that the companies have been unable to build a relationship of trust with the local residents might be the fact the mines employ a relatively small number of people. Only nine respondents (4%) responded that they or someone else in their household worked in a mine. A quarter of the respondents stated they or someone else in their household owned property close to an existing or planned mine. While social acceptance of mining was high in Sodankylä, and the mining companies' performance was considered relatively good, many respondents in

Storuman were unable to evaluate the companies' performance. If mining companies do not interact with local communities, they are unlikely to gain a social licence to operate.

Conclusions

In line with the concept of social capital, a company can gain a social licence to operate by creating reciprocal relations with the host community, which eventually consolidates the trust of local residents and leads to cumulative positive effects on wellbeing in the community. Furthermore, the study showed that good company performance and positive interaction with the local community are also factors that contribute to local acceptance. The case studies show that the company's presence in the local community is important.

In Storuman, the respondents were unable to evaluate the performance of the local mining companies simply because they did not know what the companies were doing. This contributed to a lower social licence to operate in Storuman (43%) compared to Sodankylä (85%). However, the difference may also be attributed to the different phases of the mining operations in both communities. In Storuman, instead of actual mining operations, there were various projects in the prospecting or planning phase. Several companies have operated in the area, but apparently there has been no long-term interaction between the industry and the residents. In fact, most people did not know exactly which companies were operating locally. In Sodankylä, the mining and mineral prospecting had been highly visible in the local and regional media, and had been part of local life for more than a decade. As such, the community knew about the development of the mining projects.

4.4 Paper IV: Population living on Permafrost

Authors: Justine Ramage, Leneisja Jungsberg, Shinan Wang, Sebastian Westermann, Hugues Lantuit, Timothy Heleniak.

Journal: Population and Environment, Vol. 43, P. 22–38

Published: <https://link.springer.com/article/10.1007/s11111-020-00370-6>

The remarkable rise in air surface temperature observed in the Arctic is causing dramatic changes in the components of the cryosphere, including permafrost (Van Everdingen 2005).

Permafrost is ground (rock, soil sediment or rock) that remains at or below 0°C for at least two consecutive years (AMAP 2018; Gruber 2012). Seventy percent of the pan-Arctic residential, transportation and industrial infrastructure lies in areas with high potential for near-surface permafrost thaw by 2060 (Hjort et al. 2018). The changing environmental conditions not only damage infrastructure, but also impact the livelihoods and cultural activities of populations living on permafrost (Allard et al. 2012; Biskaborn et al. 2019; Hjort et al. 2018; Ingeman-Nielsen et al. 2018). Because these communities have a strong relationship with the land, the sea, and traditional activities such as hunting and fishing, permafrost changes present extensive territorial challenges for the local population (Anisimov et al. 2001; Armitage et al. 2011; Sharma 2010).

To understand the forthcoming challenges related to permafrost thaw in the Arctic, it is relevant to estimate the number of people who will be impacted. In this paper, we provide data on the number of people residing in the Arctic circumpolar permafrost region (ACPR). We combine administrative boundaries with current permafrost extent to define permafrost settlements and calculate the population living on permafrost. To fully grasp the risk of the anticipated change in permafrost in the ACPR, we combine a model that projects permafrost extent to 2060 with population projections from regional and national statistical institutes. The outcome forecasts the possible impacts of permafrost loss on the population in the ACPR by 2050.

Results

The key findings show that there are 1,162 permafrost settlements in the ACPR, accommodating almost 5 million inhabitants. 18.6% of permafrost inhabitants live in zones with continuous permafrost. Of all permafrost settlements, 32.6% were coastal and home to 1,099,186 people, most coastal of them in zones of sporadic permafrost. Climate-driven permafrost projections suggest that by 2050, 42% of the permafrost settlements will become permafrost-free due to degradation. Among the remaining permafrost settlements, 42% are in hazard zones in which the consequences of permafrost thaw will be most severe. In total, 3.3 million people in the ACPR currently reside in settlements where permafrost will degrade and ultimately disappear by 2050.

By 2050, 1.7 million people will live in 628 permafrost settlements. Today there are some settlements located in permafrost areas in Sweden, Finland, and Iceland, but by 2050 there will no longer be any permafrost settlements at all in these countries. For the remaining Nordic

permafrost settlements, e.g. in Greenland, the consequences of permafrost thaw will vary depending on the hazard zone in which they are located. The study shows that coastal settlements are proportionally more vulnerable to permafrost thaw than inland settlements (all settlements in Greenland are considered coastal). Coastal settlements will suffer from both ground subsidence and coastal erosion. While ground subsidence is a parameter included in the permafrost projection model, coastal erosion is not.

Conclusions

As a result of permafrost thaw, the total number of inhabitants on permafrost is projected to decrease by 61.2%, from 4.9 million to 1.7 million by 2050. Permafrost will degrade and ultimately disappear in 534 settlements, impacting the life of 3.3 million inhabitants in the ACPR. By 2050, any settlements remaining on permafrost will have to adapt to permafrost thaw, as 42% will be located in high-hazard zones. The impacts will vary depending on the future climate trajectory, the permafrost type and the hazard zones in which settlements are located, as well as the extent to which settlements can adapt before the thaw.

4.5 Paper V: Adaptive capacity to manage permafrost degradation in Northwest Greenland

Authors: Leneisja Jungsberg, Lise Byskov Herlund, Kjell Nilsson, Shinan Wang, Soňa Tomaškovičová, Karl Madsen, Johanna Scheer, Thomas Ingeman-Nielsen.

Journal: Polar Geography

Published: <https://www.tandfonline.com/doi/full/10.1080/1088937X.2021.1995067>

In past generations, permafrost conditions have not been a cause of concern. Communities and lifeways have been built with little consideration of the subsurface, or on the assumption that permafrost would endure in perpetuity (Anisimov et al. 2001; Larsen et al. 2021; Shiklomanov et al. 2017; Streletskiy et al. 2019; Streletskiy, Shiklomanov, and Nelson 2012). Studies on the social impacts of permafrost degradation illustrate that more efforts are needed to increase the geographic coverage of observations, improve projections at local level and reduce uncertainties (AMAP 2018; European Commission 2020).

To prepare for future changes, the Arctic Council has recommended increasing the documentation of adaptation responses for Arctic communities. Several communities in Canada and Alaska have already developed strategic plans on adaptation planning for permafrost (Allard et al. 2012; Bonnett and Birchall 2020; Hong, Perkins, and Trainor 2014). Findings from research in Northwest Greenland estimate that there are 200 potential areas at risk of rock slope instability as a result of permafrost thaw. Of these, 18 risk areas are in the vicinity of human settlements and infrastructure, and as such these communities are at risk of permafrost degradation-induced rockslides (GEUS 2018; Schultz-Nielsen 2019).

This article examines the adaptive capacity for managing experienced permafrost changes in Northwest Greenland. The analysis builds on a theoretical framework that encompasses three dimensions informed by adaptive capacity studies: *community awareness of permafrost change*; *institutional organisation of adaptation measures for permafrost*; and *scientific knowledge to inform decision-making on permafrost*.

Results

Community awareness of permafrost change: The study illustrates how experiences of changes in the permafrost intertwine with different aspects of everyday life. Inhabitants in Qeqertarsuaq in Greenland report several impacts from the changes in the frozen ground. The results from the questionnaire illustrate the extent to which respondents perceive permafrost degradation to be an important or very important challenge to their physical environment (54%), hunting and harvesting (55%), economy (51%) and housing (52%). However, the most common answer is “don’t know”, which gives the impression that the respondents do not understand the connection between the changes and the permafrost. Nonetheless, the qualitative empirical data illustrates how the inhabitants experience a diverse range of different impacts, ranging from minor to extensive damage.

The community’s observations of permafrost degradation include changes in vegetation, an increase in wetland areas, deepening of the active layer, slumping and coastal erosion. The physical environment is a prerequisite for hunting and fishing, which are highly important for the Inuit people. Several of the Inughuit inhabitants explain how they experience issues with their houses following the summer period. Typical challenges include deformations and

changes in ground structure, leading to slanting floors, doors or windows that no longer close, and cracking windows due to the houses' differential settlement.

Institutional organisation of adaptation measures for permafrost thaw: The municipality, together with the Government of Greenland, is responsible for all public infrastructure. Public infrastructure consists of roads, airstrips, harbours, buildings and houses, as well as sewer systems, drainage and water pipes. Interviewees employed by the Avannata and Qeqertalik municipalities mention roads as one of the biggest challenges. Roads often 'sink' due to permafrost degradation, and are repaired with temporary measures such as additional layers of asphalt (some roads now have more than a metre of asphalt, as it keeps sinking). However, this is a short-term solution that needs to be repeated on a regular basis.

Although the local authorities in Qeqertalik and Avannaata are aware of changes in the permafrost, many other development issues are high on the agenda, as stated in their strategic plans. These priorities include economic development (e.g. extending the tourism industry), local democracy and citizen engagement, waste management and local environment, access to water and sanitation, and lower social inequality. In both municipalities, permafrost is mentioned as one challenge among many others.

Scientific knowledge to inform decision-making on permafrost: Scientific knowledge is relevant for understanding the ongoing changes. Active layer thickness and ground temperature are used to monitor these changes, and modelling programs are used to generate projections. Some knowledge is of purely scientific interest, and does not lend itself to being translated into planning purposes. For this section, however, we examine the knowledge generated by both physical science and modelling that the institutional organisations could use to build adaptive capacity. The data modelled in Qaanaaq and Qeqertarsuaq show a deepening of 0–10 cm. However, this estimate remains too coarse to be truly useful for applications at the local scale. As such, there does not appear to be sufficiently consistent knowledge to form a regional database to support local planning.

Conclusions

This study has assessed the adaptive capacity to manage permafrost change by applying a theoretical framework encompassing three dimensions. *Community awareness of permafrost change* shows that community members engage in an autonomous adaptation, e.g. the

individual homeowners mend damages themselves, but also rely on support from family and friends. In cases of modest damage, they often accept living with various small defects, but when it comes to more serious issues, such as severely destabilised foundations, the communities come together to help each other repair the damage. *Institutional organisation of adaptation measures for permafrost* shows that although the municipalities are aware of the impact of permafrost thaw, many other issues are high on their agenda, as stated in the strategic plans. The municipalities also engage in short-term solutions to repair roads and other public infrastructure. These competing priorities may partly explain the short-term responses, as there are many other issues that require public resources. *Scientific knowledge to inform decision-making* on permafrost shows the gap between the available scientific knowledge vs. the type of information needed to make strategic, long-term decisions. The town planners and engineers require specific, local information for building design and construction, typically obtained from field sampling and observations. However, climate projections are typically based on modelling products that are only available at a much coarser scale. This data offers less value in a practical setting, when working with long-term development and planning, and generally reduces the adaptive capacity to manage permafrost change.

5. Discussion of cross-cutting results

The discussion focuses on whether the cross-cutting results can contribute to a theoretical understanding of the mechanisms behind rural community responses to territorial challenges in the Nordic Region. Whetten (1989) argues that it is important to examine the *What* and the *How* to understand underlying mechanisms. When reviewing the empirical material, it points towards three factors that can explain *what* constitutes the rural community responses. The three main factors I have identified as driving rural responses across the papers are *civic agency*, *institutional organisation* and *long-term cooperation*. In the next three sections, I will discuss why these factors are central and how they relate to the rural communities' ability to respond to territorial challenges such as demographic change, economic benefit retention and permafrost degradation.

5.1 Civic agency

The empirical material across the papers illustrates the important role played by local citizens in developing local responses. For this study, I apply a definition from the *International Encyclopedia of Civil Society*, which defines *civic agency* as a “human predisposition toward, and a capability for, leading life together with others in a society with concern for the whole” (Fowler and Biekart 2020). In some cases, community members engage in adaptation practices for themselves; in other cases, certain community members drive an initiative for the entire local area. This result is also in line with the existing literature that describes the importance of human and social capital (Adger 2009; Cajas-Santana 2014; Lang and Fink 2019; Neumeier 2017; Unceta, Castro-Spila, and García Fronti 2017).

However, the empirical material also shows the importance of specific individuals – known as ‘fiery souls’ – who function as local facilitators. They are often those who make things happen, and are frequently active in the initiation phase, during which they contribute by proposing ideas, raising funds and promoting decision-making. In papers I and III, we see the importance of fiery souls, as they create social networks that bind the community together and communicate with external partners. ‘Fiery soul’ is a common expression in the Nordic countries – *ildsjæl* (DK), *eldsjäl* (SE), *ildsjel* (NO), *tulisielu* (FI), *brennandi áhuga* (IS), *Eldsál* (FO) and *Ilungersuussisoq* (GL) – and has a similar connotation and meaning in each language. The term describes a hard-working individual who creates agency within a community, one who is passionate, who takes the initiative, believes in the cause, and makes things happen. In the

Finnish language, the term carries additional nuance, which suggests that it can *also* mean a person with a hot temper. In Icelandic, it is not something you *are*, but rather something you *have*, e.g. a burning enthusiasm.

Paper I emphasises the role of fiery souls in the social innovation initiatives. In paper II, the local project leader for the LS3 is enabled by their three-year employment at the municipality to take the position of a fiery soul who makes things happen, connects people and builds networks. In paper III, the role of the local contact – a driven individual who builds bridging bonds between the resource-based industries and the community members – is emphasised as part of establishing a social licence to operate. Paper V shows how community members adapt to permafrost degradation. People in the communities help each other to mend various damages, e.g. using a jack to add soil and rocks to a house’s foundation, thereby making it more stable. While the civic agency was characterised by the involvement of fire souls in papers I, II and III, paper V illustrates a more network-based civic agency, where people support and help each other in the community.

5.2 Institutional organisation

The institutional organisation can either stimulate or obstruct the rural community’s responses to local territorial challenges. The institutions covered in the field of study are local public-sector bodies, municipalities, municipal boards, research institutions and NGOs. They may be either locally embedded or external to the community. Another way of understanding institutions is as “stable patterns of behaviour that define, govern, and constrain action” (Oxford 2021). The results in paper I illustrate the extent to which the local public sector was considered a facilitator of ideas and a decision-maker, by providing resources during the initiation and development phases of SI projects. In the SI examples with a focus on social services, the local public sector was the most engaged actor during the initiation phase. In Finland, for example, the local public sector hosted a workshop to develop the *May I Help You?* initiative. The idea was to bring together young people – particularly those at risk of social exclusion – and elderly people who need assistance with everyday tasks.

In paper II, the institutional organisation in Storuman and Sodankylä municipality influenced the development of the LS3. In Sodankylä, the municipal board decided, at an early stage in the LS3, to develop a mining programme aimed at supporting local preparedness. This programme continued to steer the cooperation between private companies, the local public sector and civil

society even after the LS3 process had ended. In Storuman, on the other hand, the management team followed the step-by-step process. However, the recommendations developed in the LS3 were not included in Storuman municipality's strategic plan for 2020–2023 (Storumans kommun, 2019). This exclusion of the LS3 process from the strategic plan led to a lack of both coherence and continuity, which indicates a weaker institutional organisation in Storuman.

Institutionally informed decision-making depends on knowledge-sharing about social, economic, and environmental changes in the local area. In some cases, however, there is insufficient knowledge on which to make informed decisions. For Avannaata municipality, the lack of projections at local level for permafrost data presents a challenge to the local and national institutions' ability to plan adaptation activities. In addition, managing permafrost thaw is not the responsibility of one institution, but impacts several different public and private entities. Flexible institutions and practices are among the outcome criteria used to assess strategies (Innes and Booher 1999), and several researchers have demonstrated the importance of institutional capacity (Bronen and Chapin 2013; Ford and King 2015; Gupta 2010). The results presented across the PhD articles describe several instances in which local authorities provide a supportive environment for local strategy-making. Because many rural development initiatives rely on a few passionate individuals, it is even more important that new initiatives are embedded in an *institutional organisation* that can help ensure continuity.

5.3 Long-term cooperation

Unlike the two other factors – *civic agency* and *institutional organisation* – which are well documented, there has been less emphasis in the academic literature on *long-term cooperation*. In this study, I define long-term cooperation as cooperation that lasts five or more years. Long-term cooperation can help secure the legitimacy of SI initiatives and build broader capacity to mitigate outmigration in rural areas. One shortcoming illustrated in papers II, III and V is the lack of long-term efforts. In paper II, we see that the LS3 was developed over a time-limited period, and many activities ceased when the project funding ended. This included the employment of the two project managers who were responsible for carrying out each of the steps in the LS3 process. As a result, both municipalities became vulnerable, as the human capacity built up over the three-year period disappeared.

This meant there was a lack of new resources to implement and develop the competences and knowledge needed to address negative population change in the municipalities. The potential

for attracting new people diminished once the cooperation between local, regional, and national contacts established throughout the project period ceased. In paper III, we see that SLO is also dependent on long-term cooperation, as shown in the cases of Sodankylä and Storuman. The questionnaire results indicate a higher SLO rate in Sodankylä. One obvious reason for this is that mining activities have been present in Sodankylä for longer than they have in Storuman.

Retaining economic benefits also depends on long-term cooperation. Ensuring the continuation of local business networks strengthens the communities' capacity for economic resilience. This is evident in the cases of the mining companies, which extract finite resources that are dependent on global market prices. This makes it relevant for rural communities to have rich economic diversity at local level, so that they are able to cope with the sudden loss of mining activities. In paper V, the town planners and engineers need specific local information to make strategic long-term decisions for the localisation of new buildings and construction work. However, there is a gap in the knowledge available to make informed decisions that can mitigate the impacts of climate change on infrastructure and ecosystem services. Future projections are typically based on modelling products that are only available at a coarser scale than the local level, which complicates long-term adaptation planning.

5.4 Theoretical reflections on the analytical perspectives

The results illustrate both functional and territorial integration (Mårtensson et al. 1988), as well as activities linked to the space of flows and space of places (Castells 2007). Several of the community responses aim to link the territorial with the functional, and to connect local actors to actors in regional, national and global networks. This is evident in paper I, in the SI initiatives; in papers II and III, in the community workshops and the bridging of relations between the mining companies and local companies; and in papers IV and V, in the connections between the research community and the municipality regarding permafrost data. The study therefore confirms the importance of balancing internal and external resources as a key to rural development. This is in line with the research on the neo-endogenous approach to rural development, which shows how the combination of internal and external human and financial resources is essential in rural community responses (Adamski and Gorlach 2007; Bosworth, Annibal, et al. 2016; Ray 2006).

While the physical land and territory is central in a *place-based* approach, the activities that link people, companies and organisations are central to *network-based* development. Across the papers, the three factors – *civic agency*, *institutional organisation* and *long-term cooperation* – function as drivers for rural community responses and are embedded within both place-based and network-based local development. The PhD papers present different analytical perspectives that are used to assess the rural community responses. In Table 2, I summarise the territorial challenges, the analytical perspectives, the local results and activities, the enabling factors and the actors involved. I have also rated the presence of the enabling factors in the community responses. The rating is based on my interpretation – ranging from *weak* to *medium* to *strong* – of the presence of the three enabling factors (see column 4, table 2).

Territorial challenge	Analytical perspective	Local results & activities	Enabling factors	Actors
Demographic change (<i>Paper I</i>)	Social innovation	Collaboration models, new social services, provision of community spaces and activities	Civic agency (<i>strong</i>) Institutional organisation (<i>medium</i>) Long-term cooperation (<i>medium</i>)	Community members, civil society organisations, local public sector, regional, national, and international authorities
Local economic development (<i>Papers II and III</i>)	Strategy assessment and social capital	Community workshops, SME and entrepreneurship network collaboration, enhancing local relations to mining industries	Civic agency (<i>Medium</i>) Institutional organisation (<i>Medium</i>) Long-term cooperation (<i>weak</i>)	Municipality, local private sector, community members, civil society organisations
Permafrost degradation (<i>Papers IV and V</i>)	Adaptive capacity	Autonomous adaptation responses. Estimate of settlements at risk by 2050.	Civic agency (<i>strong</i>) Institutional organisation (<i>medium</i>) Long-term cooperation (<i>weak</i>)	Community members, municipalities, government and science institutions

Table 2: Summarising territorial challenges, analytical perspectives, results, enabling factors and actors

In the first row of table 2, I summarise how rural communities respond to demographic change by developing new collaboration models, new social services and the provision of community spaces and activities. The actors participating are community members, civil society organisations, local public-sector bodies, and regional, national, and international authorities. For social innovation, *civic agency* is rated as strong. The empirical findings illustrate strong citizen activity in most of the social innovation examples – even those in which there is strong cooperation with local public-sector bodies, the dominance of community members and civil society is notable. The presence of the *institutional organisation* is rated as medium, as this factor is less emphasised. Instead, what is central to SI is the general collaboration between the different actors. Nonetheless, the *institutional organisation* matters in terms of whether the SI

becomes an association, a social enterprise, public-private cooperative or a community development trust. *Long-term cooperation* is rated as medium, as the SI examples studied are initiatives that are implemented and sustained locally, but often driven by a few passionate individuals.

In the second row, I summarise how rural communities create local economic development by facilitating community workshops to discuss opportunities and challenges, and organise SME and entrepreneurship meetings to enhance collaboration with the international mining industries operating in the area. Based on Healey's strategic dimensions (2009), combined with Innes and Booher's process and outcome criteria (1999), civic agency is rated as having a medium presence. *Civic agency* is mentioned in two of the four strategic dimensions, namely *mobilising attention* (among fellow citizens) and *scoping the situation* (understanding the main issues at stake for different groups). The process and outcome criteria include several criteria aimed at evaluating the involvement and creation of *civic agency*. The factor *institutional organisation* is rated as having a strong presence, as the strategy work, as per Healey's framing, often stems from an institutional setting. The institutional organisation is also recognised, and a key focus, in Healey and Booher's process and outcome criteria. The last enabling factor, *long-term cooperation*, is rated with a weak presence, based on the outcome from the strategic assessment. By applying the strategic dimension approach, as well as the outcome and process criteria, the study could illustrate the shortcomings in terms of the continuation of activities after the end of the projects in Storuman and Sodankylä.

Another analytical perspective with which to address the challenge of local economic development is the concept of social capital. This perspective is rated with a strong presence in terms of *civic agency*. Social capital emphasises and evaluates the level of civic agency by, e.g. assessing levels of local trust and collaboration. It can be argued that social capital is connected to the understanding of development as driven by the citizens, and is therefore an endogenous, 'bottom-up' process. Social capital provides information about the citizens' positions and possibilities in the social sphere by examining their level of personal relationships and networks. However, there is less focus on the institutions' role and the long-term cooperation aspects, and therefore *institutional organisation* and *long-term cooperation* are rated as having a medium presence and weak presence, respectively. Nonetheless, this analytical perspective is broadly acknowledged as important. The Nordic countries have in the past implemented policies that support social networks as a means of generating social capital, as part of efforts

to address uneven regional development. One instrument in this work consists of support for bridging activities between business contacts. In this case, along with the case in Sodankylä, we argue that *bridging* produces social capital and therefore constitutes part of the local and regional rural responses to economic development.

In the third row, I summarise how rural communities respond to permafrost degradation through autonomous and ad-hoc adaptation practices. As shown in the study, we estimate that 42% of the permafrost settlements will become permafrost-free due to degradation by 2050. In Northwest Greenland, the adaptive capacity in two communities is rated as a strong in terms of *civic agency*. In the community context, we can observe a sense of local connectedness, network, social agency and problem-solving capacity. *Institutional organisation* is rated as a medium enabling factor. There are certain adaptation responses, but they create short-term solutions, and many other institutional responsibilities are considered a higher priority than permafrost degradation. Finally, *long-term cooperation* is rated as a weak enabling factor, as there is only limited capacity to gain the (scientific) knowledge available to support local planning decisions. Local projections on, e.g. active layer change in the permafrost are relevant for long-term city planning and for implementing long-term solutions aimed at repairing permafrost-induced infrastructure damages.

To sum up, the results show that most responses are embedded within a neo-endogenous rural development approach, and that connections are created both between actors from the community and externally. Finances are sourced within the communities as well as regionally, nationally and internationally in SI projects. New bridging relations with representatives from the mining companies build social capital, and SME and entrepreneur networks collaborate and support each other to develop their businesses. In permafrost communities, knowledge of permafrost conditions is sourced from research in which the samples are sourced locally, but the analysis is performed in external locations. Despite collaboration and exchanges of information between researchers and municipality employees, it is not always easy to align the research interest (which generates funding) with the knowledge that is most relevant for the municipality and the local institutions.

Assessing the presence of *civic agency*, *institutional organisation* and *long-term cooperation* across the analytical perspectives can provide insights into the implications of each perspective in the context of research into rural development. However, other types of enabling factors may also be used to measure the community responses for rural development. This makes it

interesting to discuss what other studies suggest about these enabling factors. Emmerson et al. (2012) introduces a logic model as a conceptual guide or road map for programme evaluation. The model places emphasis on differentiating between process and productivity performance. Both process performance and productivity performance can be studied at the group or system unit of analysis (ibid). This is very much in line with Innes and Booher (1999) and their framework for assessing strategic performance, which measures both the process and outcome of a collaborative planning effort. In Healey's approach, the three first strategic dimensions also bring awareness to the process, while only the last dimensions emphasise results and actions (Healey 2009).

This framework approach, considering process and outcome, is very much present in paper II. However, there are also aspects of this in paper I, where the social innovation initiatives are assessed in the initiation and development (process) and implementation (outcome) phases. Paper III assesses the interaction between the mining companies and the two communities (Storuman and Sodankylä) – in other words, a process evaluation. Still, the results from this process evaluation indicate the extent of the mining companies' social licence to operate. Emmerson's model for assessing collaborative performance is similar to Innes and Booher's framework in terms of the focus on social capital, conflict management and better knowledge management. However, Emmerson also includes a category on 'potential data sources' to assess the availability of data. This category is particularly relevant at the beginning of the assessment, when considering data sources. In this PhD study, however, the development of data and relevant sources was to a large extent predefined in the research projects that funded the study.

Furthermore, Emmerson also describes four stages of collaborative engagement: 1) formation, where the focus is on getting participants together, agreeing on a common goal, deciding what to do and building relations; 2) stabilisation, in which participants work to gain external legitimacy for their efforts, and develop and nurture their skills; 3) routinisation, where cooperation becomes the norm and participants develop rules and guidelines for continued cooperation; and 4) extension, where the collaborative effort becomes seen as a viable operation. Given that any collaborative effort will go through certain stages in the cooperation, this underlines the point made under '*long-term cooperation*', that it takes time to formalise, stabilise, and build the routines necessary to implement a community-driven initiative.

The different approaches to assessing rural community responses bring different nuances in terms of what is important in a community response. Generally, enabling factors are more

present in studies that are occupied with adaptation, resilience and vulnerability (Engle 2011; Gupta 2010; Hinkel 2011; Keskitalo et al. 2011; Wall and Marzall 2006). However, there is a multiplicity with regard to terminology – often, terms such as dimension, criteria, definition, indicator, etc. are used, rather than the terminology associated with enabling factors. According to one review in the field, there are currently 64 indicator-based indices or frameworks in use (Siders 2019). On the one hand, the lack of debate across the literature could be seen as a weakness (ibid), but on the other hand, it illustrates how many studies take their point of departure in local settings and develop their framework from this approach. One study suggests that variety, learning capacity, room for autonomous change, leadership, resources and fair governance are important factors in assessing the inherent characteristics that institutions must possess to enable their adaptive capacity (Gupta 2010).

From the literature search, there appears to be a lack of studies showing enabling factors for rural development in the Nordic Region. The enabling factors derived in the cross-cutting results of the PhD papers are identified based on an inductive approach, where the results from the empirical data bring certain results that are generalised. Naturally, the study design is also influenced by certain theoretical concepts, as presented in the theoretical framework. However, these do not define the findings of the three enabling factors: *civic agency*, *institutional organisation* and *long-term cooperation*. All in all, the approach is therefore not purely inductive, but also abductive, as the study uses the theoretical concepts as a foundation from which to examine rural community responses to territorial challenges in the Nordic Region.

5.5 Empirical contribution to address territorial challenges

The thesis's theoretical and empirical contribution consists of the application of the different analytical concepts and their strengths and weaknesses when examining rural development dynamics in the Nordic Region. Each concept is informed by knowledge from the collected empirical material, comprising interview data, qualitative data, community workshop data, questionnaire data and register data – all of which provide information about rural community responses.

When it comes to demographic change, there are 18 examples of initiating and implementing social innovation projects that make local communities more attractive. Most examples are initiated from *civic agency*, with support from local *institutional organisations*, in the form of

public sector bodies and local authorities. When the initiatives are implemented, they are also sustained for a longer period, thereby fulfilling the requirement for *long-term cooperation*. One example is the *Skovgård model*, where the local community collectively takes over private institutions and establishes enterprises that enable people with disabilities to contribute to local rural development. Another example is *Kalix Övre Bygd*, where the community established an association that runs a local shop and provides a range of public services in the fields of elderly care, childcare and education.

Territorial challenges triggered by resource-based industries extracting value from the area can be addressed with locally guided strategic work. The local smart specialisation strategy (LS3) process illustrates how the Storuman and Sodankylä municipalities worked with the community to engage in a bottom-up approach that brings together local stakeholders to discuss how to increase local benefit retention. The results show that the LS3 process strengthens local territorial preparedness by creating *civic agency* and *institutional organisation*, but also illustrate the need to improve the potential for *long-term cooperation*. The ability to continue strategic work depends upon the priorities of local, regional and national decision-makers. One way to improve LS3, therefore, would be to incorporate plans for continuation from the outset, to ensure that resources are allocated to implement some of the ideas generated by the LS3 process.

Given that climate change is an ongoing challenge, it is predicted that permafrost degradation will continue. Assessing the adaptive capacity to manage the predicted risks also supports the northern communities' adaptation preparedness. In order to address the issues regarding destabilising infrastructure and reduction in country food accessibility, the analytical concept emphasises the importance of *civic agency* as part of the adaptation; of *institutional organisation* to repair and accommodate for at-risk community infrastructure; and of a perspective based on *long-term cooperation*. The need for scientific knowledge on local scale is also emphasised, in order to make relevant projections in Northern Greenland.

The knowledge generated by this PhD thesis is context-dependent, as it compiles analytical perspectives and empirical examples that study the phenomenon of rural community responses to territorial challenges in the Nordic Region.

6. Concluding remarks

This study contributes with empirical examples of rural communities responding to three different territorial challenges in the Nordic Region. In response to territorial challenges regarding demographic change, rural communities are working together to develop SI projects. In those rural communities, the initiation phase of the SI projects is mostly driven by community members, local public-sector bodies and civil society organisations. During the implementation phase, it is primarily the civil society organisations that manage the day-to-day operation of the established initiatives. Many of the SI projects are developed as a response to an ageing and declining population, service closures (or the threat of closures) and administrative reforms. The SI initiatives illustrate the capabilities of *civic agency* in a rural innovation context. However, the *institutional organisation* and *long-term cooperation* perspectives are also present when it comes to establishing SI initiatives. Initiating and sustaining community-driven SI projects requires that local actors are able to develop ideas, collect resources and manage decision-making.

In response to territorial challenges relating to local economic development in the Nordic Region, two municipalities, Storuman (Sweden) and Sodankylä (Finland), have engaged in a local smart specialisation strategy (LS3) process. In Sodankylä, the LS3 resulted in a mining programme for 2018–2021. This created preparedness through dialogue between local stakeholders about the future development of resource-based industries in the area. In Storuman, the LS3 contributed knowledge about local economic benefit retention. This led to better knowledge-based preparedness among both planners and the municipality's management group and political leadership. The work also involved an assessment of how people in the local communities perceived the companies' social licence to operate (SLO). In Sodankylä, mining was widely accepted (85%), whereas in Storuman, less than one-third (30%) of the residents were in favour. Based on our findings, company performance does matter, but it is far from being the only condition of the SLO. For example, trust plays an important part in gaining the licence, but it does not arise solely from providing adequate information and participatory possibilities. The LS3 activities encouraged both *civic agency* and *institutional organisation*. However, shortcomings were also noted, primarily related to a lack of continuity and *long-term cooperation*, which limited the potential for addressing territorial challenges regarding local economic diversification. One way to improve LS3 would be to incorporate plans for

continuation from the outset, to ensure that resources are allocated to implement some of the ideas generated by the LS3 process.

Permafrost degradation constitutes a territorial challenge for northern communities. The first-ever demographic assessment of the population living on permafrost shows that in 2017, close to five million inhabitants lived in 1,162 permafrost communities in the Arctic Circumpolar Region. Due to permafrost degradation, many of these inhabitants will live in permafrost-free areas by 2050. The total number of inhabitants on permafrost is projected to decrease by 61.2% – from 4.9 million to 1.7 million by 2050. Permafrost will degrade and ultimately disappear in 534 permafrost settlements, impacting the life of 3.3 million inhabitants. We have studied two permafrost communities, Qeqertarsuaq and Qaanaaq, in Northern Greenland, where community members and local institutions are already adapting to permafrost degradation. The study shows strong *civic agency*, as the individual homeowners carry out repairs themselves, but also rely on support from family and friends. The municipality's main adaptation strategy is to build on bedrock wherever possible, rather than in permafrost zones. In other words, the town plans are determined by the landscape. The municipality also engages in autonomous adaptation practices, in the form of repairing roads and other public infrastructure on an ad-hoc basis. Such repairs are often short-term solutions that need to be repeated on a regular basis. The town planners and engineers require specific, local information for building design and construction, typically obtained from field sampling and observations. However, there is a gap between the available scientific knowledge and the type of information needed to make strategic, long-term decisions. Long-term climate adaptation solutions usually require future projections, which are often based on modelling programs that operate on a much coarser scale. The study highlights a need to strengthen dialogue between researchers and the municipality, to develop meaningful and societally beneficial future research questions.

6.1 Implications of the study and policy relevance

Rural areas are the source of almost all the resources that make modern society function – food, fresh water, energy, timber, metals, minerals, etc. They also offer national parks, natural beauty, and opportunities for recreation and travel, and are home to wildlife and indigenous cultures. In short, rural areas are vital to the prosperity and wellbeing of the Nordic Region. However, in recent decades, the economic benefits of globalisation and digitalisation have been disproportionately flowing to metropolitan areas. Population decline, high levels of old-age dependency, lack of infrastructure and lack of high-speed broadband access are impeding the potential of rural communities. Even though rural places are not without their challenges, this thesis illustrates how the factors of *civic agency*, *institutional organisation* and *long-term cooperation* can make a positive difference in developing strategies to foster local development in rural areas. These factors are also relevant when designing rural policies to make rural communities more prosperous and increasing their ability to offer greater wellbeing to residents.

The results point towards the need to support community members' capacity to engage in collaborative processes that support *civic agency*, and the importance of ensuring a legal framework for *institutional organisation* – e.g. the local public sector supporting rural social innovation projects or leading a local smart specialisation strategy. Finally, the importance of *long-term cooperation* is of relevance at policy level, as many rural development projects are of limited duration, and this can be a barrier to ongoing stakeholder coordination as well as the opportunity to retain local economic benefits from resource-based industries. In municipalities struggling with permafrost degradation, the *long-term perspective* is highly important when it comes to obtaining more detailed data about projected changes.

The COVID-19 pandemic has revealed that opportunities for long-distance work can have a potential positive impact on rural communities. During the pandemic, many families have expressed interest in moving away from densely populated areas and toward rural ones. This creates opportunities to develop innovative, lively, diverse and multi-functional rural environments. In this context, policy support for the wide range of actors who can work together to build a sustainable rural future should be coupled with investments aimed at ensuring better local benefit retention, along with improved physical and digital infrastructure. This would help to provide a stable foundation for rural communities in the Nordic countries to address demographic change, economic benefit retention and permafrost degradation.

References

- Adamski, T., & Gorlach, K. (2007). Neo-Endogenous Development and the Revalidation of Local Knowledge. *Polish Sociological Review*. No. 160 (2007), pp. 481-497.
- Adger, W. N. (2009). Social Capital, Collective Action, and Adaptation to Climate Change. *Economic Geography*, 79(4), 387–404. <https://doi.org/10.1111/j.1944-8287.2003.tb00220.x>
- Allard, M., Lemay, M., Barrette, C., L'Hérault, E., & Sarrazin, D. (2012). Chapter 6. Permafrost and climate change in Nunavik and Nunatsiavut: Importance for municipal and transportation infrastructures. In *Assessing the Vulnerability of Ministère des Transports du Québec Infrastructure in Nunavik in a Context of Thawing Permafrost and the Development of an Adaptation Strategy* (pp. 171–197).
- AMAP (2018). Adaptation actions for a changing Arctic—Perspectives from the Baffin Bay/Davis Strait Region. *Arctic Monitoring and Assessment Program (AMAP)*.
- Anisimov, O., Maximov, T., Shiklomanov, N. I., & Streletskiy, D. (2001). Global and regional implications of Arctic change: Contrasting international and Russian perspectives. *Nature Communications*. <https://www.nature.com/articles/35073746>
- Armitage, D., Berkes, F., Dale, A., Kocho-Schellenberg, E., & Patton, E. (2011). Co-management and the co-production of knowledge: Learning to adapt in Canada's Arctic. *Global Environmental Change*, 21(3), 995–1004. <https://doi.org/10.1016/j.gloenvcha.2011.04.006>
- Bærenholdt, J. O. (2002). Coping strategies and regional policies—Social capital in the Nordic peripheries. Nordregio policy paper. Nordregio. Stockholm.
- Bernal, L. A. (2019). Social Innovation Route: A Method to Innovate with the Territories. In *Ecosystem and infrastructures for Social Innovation* (pp. 150–155).
- Biskaborn, B. K., Smith, S. L., Noetzli, J., Matthes, H., Vieira, G., Streletskiy, D. A., Schoeneich, P., Romanovsky, V. E., Lewkowicz, A. G., Abramov, A., Allard, M., Boike, J., Cable, W. L., Christiansen, H. H., Delaloye, R., Diekmann, B., Drozdov, D., Etzelmüller, B., Grosse, G., Lantuit, H. (2019). Permafrost is warming at a global scale. *Nature Communications*, 10(1), 264. <https://doi.org/10.1038/s41467-018-08240-4>
- Bock, B. (2012). Social innovation and sustainability; how to disentangle the buzzword and its application in the field of agriculture and rural development. *Studies in Agricultural Economics*, 114(2), 57–63. <https://doi.org/10.7896/j.1209>

- Bock, B. (2016). Rural Marginalisation and the Role of Social Innovation; A Turn Towards Nexogenous Development and Rural Reconnection. *Sociologia Ruralis*, 56(4), 552–573. <https://doi.org/10.1111/soru.12119>
- Bonnett, N., & Birchall, S. J. (2020). Coastal communities in the Circumpolar North and the need for sustainable climate adaptation approaches. *Marine Policy*, 104175. <https://doi.org/10.1016/j.marpol.2020.104175>
- Bosworth, G. (2010). Commercial Counterurbanisation: An Emerging Force in Rural Economic Development. *Environment and Planning A: Economy and Space*, 42(4), 966–981. <https://doi.org/10.1068/a42206>
- Bosworth, G., Annibal, I., Carroll, T., Price, L., Sellick, J., & Shepherd, J. (2016a). Empowering Local Action through Neo-Endogenous Development; The Case of LEADER in England: Empowering local action. *Sociologia Ruralis*, 56(3), 427–449. <https://doi.org/10.1111/soru.12089>
- Bosworth, G., Rizzo, F., Marquardt, D., Strijker, D., Haartsen, T., & Aagaard Thuesen, A. (2016b). Identifying social innovations in European local rural development initiatives. *Innovation: The European Journal of Social Science Research*, 29(4), 442–461. <https://doi.org/10.1080/13511610.2016.1176555>
- Bourdieu, P. (1986). The forms of capital. *Handbook of Theory and Research for the Sociology of Education*.
- Bronen, R., & Chapin, F. S. (2013). Adaptive governance and institutional strategies for climate-induced community relocations in Alaska. *Proceedings of the National Academy of Sciences*, 110(23), 9320–9325. <https://doi.org/10.1073/pnas.1210508110>
- Brown, V. (2008). A Collective Social Learning Pattern. 14. *Proceedings of the 13th European Conference on Pattern Languages of Programs*.
- Cajaiba-Santana, G. (2014). Social innovation: Moving the field forward. A conceptual framework. *Technological Forecasting and Social Change*, 82, 42–51. <https://doi.org/10.1016/j.techfore.2013.05.008>
- Castells, M. (2007). Space of flows, space of places: Materials for a theory of urbanism in the information age. *In Rethinking technology: A reader in architectural theory*. Routledge.
- Castro-Arce, K., & Vanclay, F. (2020). Transformative social innovation for sustainable rural development: An analytical framework to assist community-based initiatives. *Journal of Rural Studies*, 74, 45–54. <https://doi.org/10.1016/j.jrurstud.2019.11.010>

- Cheshire, L., Esparcia, J., & Shucksmith, M. (2015). Community resilience, social capital and territorial governance. *Journal of Depopulation and Rural Development Studies*, 18, 7–38. <https://doi.org/10.4422/ager.2015.08>
- Coffey, W. J., & Polese, M. (1984). The concept of local development: A stages model of endogenous regional growth. *Twenty Third European Congress of the Regional Science Association*.
- Copus, A., Jungsberg, L., & Weber, R. (2016). The 6-Step Model for Local Smart Specialisation Strategies. REGINA working paper. Nordregio. Stockholm.
- Copus, A., Kahila, P., Dax, T., Kovács, K., Tagai, G., Weber, R., Grunfelder, J., Meredith, D., Ortega-Reig, M., Piras, S., Löfving, L., Moodie, J., Fritsch, M., & Ferrandis, A. (2021). European shrinking rural areas: Key messages for a refreshed long-term vision. *TERRA: Revista de Desarrollo Local*, 8, 280. <https://doi.org/10.7203/terra.8.20366>
- Copus, A., Perjo, L., Berlina, A., Jungsberg, L., Randall, L., & Sigurjónsdóttir, H. (2017). Social innovation in local development: Lessons from the Nordic countries and Scotland. Nordregio working paper. Nordregio. Stockholm.
- Cowie, P., & Davoudi, S. (2015). *Reconsidering Localism*. Routledge Publishing.
- Dale, B., Bay-Larsen, I., & Skorstad, B. (2018). *The Will to Drill Mining in Arctic Communities*. Springer Polar Series.
- Dijkstra, L., Poelman, H., & Rodríguez-Pose, A. (2020). The geography of EU discontent. *Regional Studies*, 54(6), 737–753. <https://doi.org/10.1080/00343404.2019.1654603>
- Dotti, N. F. (2018). Knowledge, Policymaking and Learning for European Cities and Regions. *Edward Elgar Publishing*. <https://www.elgaronline.com/view/edcoll/9781786433633/9781786433633.xml>
- Dubois, A., Kristensen, I., & Teräs, J. (2017). Outsmarting geography: Implementing territorial innovation strategies in sparsely populated regions. *European Planning Studies*, 25(8), 1316–1333. <https://doi.org/10.1080/09654313.2017.1320355>
- Eloire, F. (2018). The Bourdieusian Conception of Social Capital: A Methodological Reflection and Application. *Forum for Social Economics*, 47(3–4), 322–341. <https://doi.org/10.1080/07360932.2015.1028084>
- Engle, N. L. (2011). Adaptive capacity and its assessment. *Global Environmental Change*, 21(2), 647–656. <https://doi.org/10.1016/j.gloenvcha.2011.01.019>

- European Commission. (2016). Northern Periphery and Arctic Cooperation programme 2014-2020. Accessed 15th August 2020 (Northern Periphery and Arctic Programme: <https://www.interreg-npa.eu>)
- European Commission. (2018). Strengthening Innovation in Europe's Regions (Regional and Urban Policy). Accessed 3rd April 2020 European Commission Smart Specialisation Platform: <https://www.s3.me/en/smart-specialisation>
- European Commission. (2020). Understanding the threat of Arctic permafrost thaw. Horizon 2020. Accessed 6th January 2021: <https://ec.europa.eu/research-and-innovation/en/projects/success-stories/all/understanding-threat-arctic-permafrost-thaw>
- Flick, U., Kardoff, E., and Steinke, I. (2004) A Companion to Qualitative Research. SAGE Publishing.
- Flyvbjerg, B. (1988) 'Case Studiet Som Forskningsmetode'. *Institut for Samfundsudvikling Og Planlægning Ålborg Universitetscenter*.
- Flyvbjerg, B. (2010) 'Fem misforståelser om casestudiet'. P. 463–88 in *Kvalitative metoder: En grundbog*, Hans Reitzels Forlag. København.
- Ford, J. D., & King, D. (2015). A framework for examining adaptation readiness. *Mitigation and Adaptation Strategies for Global Change*, 20(4), 505–526. <https://doi.org/10.1007/s11027-013-9505-8>
- Fougère, M., Segercrantz, B., & Seeck, H. (2017). A critical reading of the European Union's social innovation policy discourse: (Re)legitimizing neoliberalism. *Organization*, 24(6), 819–843. <https://doi.org/10.1177/1350508416685171>
- Fowler, A., & Biekart, K. (2020). Civic Agency. In R. A. List, H. K. Anheier, & S. Toepler (Eds.), *International Encyclopedia of Civil Society* (pp. 1–6). Springer International Publishing. https://doi.org/10.1007/978-3-319-99675-2_69-1
- Fuglsang, L., & Bitsch Olsen, P. (2012). Videnskabsteori i samfundsvidenskaberne: På tværs af fagkulturer og paradigmer. *Roskilde Universitetsforlag*.
- Georgios, C., & Barraí, H. (2021). Social innovation in rural governance: A comparative case study across the marginalised rural EU. *Journal of Rural Studies*, S0743016721001765. <https://doi.org/10.1016/j.jrurstud.2021.06.004>
- Getimis, P. (2012). Comparing Spatial Planning Systems and Planning Cultures in Europe. The Need for a Multi-scalar Approach. *Planning Practice and Research*, 27(1), 25–40. <https://doi.org/10.1080/02697459.2012.659520>

- GEUS (2018). 6 Supplerende kort over kritiske lokaliteter. *De Nationale Geologiske Undersøgelser for Danmark og Grønland*.
- Giddens, A. (1987) *Social Theory Today*. Stanford University Press.
- Gill, I. (2010). Regional development policies: Place-based or people-centred? Accessed 8th April 2020 <https://voxeu.org/article/regional-development-policies-place-based-or-people-centred>
- Gkartzios, M., Scott M. (2014) 'Placing Housing in Rural Development: Exogenous, Endogenous and Neo-Endogenous Approaches'. *Sociologia Ruralis* 54(3):241–65. doi: 10.1111/soru.12030.
- Goffman, E. (1959) *The Presentation of Self in Everyday Life*. Doubleday.
- Gruber, S. (2012). Derivation and analysis of a high-resolution estimate of global permafrost zonation. *The Cryosphere*, 6(1), 221–233. <https://doi.org/10.5194/tc-6-221-2012>
- Grunfelder, J., Norlén, G., Randall, L., & Gassen, N. S. (2020). *State of the Nordic Region 2020*. Nordic Council of Ministers. <https://doi.org/10.6027/NO2020-001>
- Gunder, M., Madanipour, A., & Watson, V. (Eds.). (2018). *The Routledge handbook of planning theory*. Routledge, Taylor & Francis Group.
- Gupta, J. (2010). The Adaptive Capacity Wheel: A method to assess the inherent characteristics of institutions to enable the adaptive capacity of society. *Environmental Science & Policy*, 13.P 459-471.
- Habermas, J. (1991) *The Structural Transformation of the Public Sphere: An Inquiry into a Category of Bourgeois Society*. MIT Press.
- Hadjimichalis, C., Hudson, R. (2014) Contemporary Crisis Across Europe and the Crisis of Regional Development Theories. *Regional Studies* 48(1):208–18. doi: 10.1080/00343404.2013.834044.
- Harris, M., & Albury, D. (2009). The Innovation imperative. *NESTA - National Endowment for Science, Technology and the Arts*.
- Healey, P. (2009). In search of the 'strategic' in spatial strategy making. *Planning Theory and Practice*, 10(4), 439–457. <https://doi.org/10.1080/14649350903417191>
- Healey, P. (2011). Planning Theory - By Philip Allmendinger: Book reviews. *International Journal of Urban and Regional Research*, 35(5), 1088–1090. https://doi.org/10.1111/j.1468-2427.2011.01080_3.x

- Healey, P. (2013). Circuits of Knowledge and Techniques: The Transnational Flow of Planning Ideas and Practices: The transnational flow of planning ideas and practices. *International Journal of Urban and Regional Research*, 37(5), 1510–1526. <https://doi.org/10.1111/1468-2427.12044>
- Heleniak, T., & Gassen, N. S. (2020). The demise of the rural Nordic region? Analysis of regional population trends in the Nordic countries, 1990 to 2040. *Nordisk Välfärdsforskning / Nordic Welfare Research*, 5(01), 40–57. <https://doi.org/10.18261/issn.2464-4161-2020-01-05>
- Hemström, K., & Palmer, H. (2020). On participatory research, knowledge integration and societal transformation. Book chapter in *Anatomy of a 21st century sustainability project: The untold stories* (pp.29–37) Chalmers University of Technology, Gothenburg.
- Hjort, J., Karjalainen, O., Aalto, J., Westermann, S., Romanovsky, V. E., Nelson, F. E., Eitzelmüller, B., & Luoto, M. (2018). Degrading permafrost puts Arctic infrastructure at risk by mid-century. *Nature Communications*, 9(1), 5147. <https://doi.org/10.1038/s41467-018-07557>
- Hong, E., Perkins, R., & Trainor, S. (2014). Thaw Settlement Hazard of Permafrost Related to Climate Warming in Alaska. *Arctic*, 67(1), 93–103. JSTOR.
- Hörnström, L., Perjo, L., Johnsen, I. H., & Karlsdóttir, A. (2015). Adapting to, or mitigating demographic change? Nordregio Working Paper. 2015:1
- Howaldt, J., Kaletka, C., Schröder, A., & Zirngiebl, M. (2018). Atlas of Social Innovation. New practices for a better future. European Commission Research & Innovation.
- Ingeman-Nielsen, T., Lemay, M., Allard, M., Barette, C., Bjella, K., Brooks, H., Carbonneau, A.-S., Doré, G., Foged, N., Lading, T., L'Hérault, E., & Mathon-Dufour, V. (2018). Built Infrastructure. In *Adaptation actions for a changing Arctic—Perspectives from the Baffin Bay/Davis Strait Region* (pp. 261–305).
- Innes, J. E., & Booher, D. E. (1999). Consensus Building and Complex Adaptive Systems: A Framework for Evaluating Collaborative Planning. *Journal of the American Planning Association*, 65(4), 412–423. <https://doi.org/10.1080/01944369908976071>
- Jijelava, D., & Vanclay, F. (2017). Legitimacy, credibility and trust as the key components of a social licence to operate: An analysis of BP's projects in Georgia. *Journal of Cleaner Production*, 140, 1077–1086. <https://doi.org/10.1016/j.jclepro.2016.10.070>

- Jungsberg, L., Copus, A., Herslund, L. B., Nilsson, K., Perjo, L., Randall, L., & Berlina, A. (2020). Key actors in community-driven social innovation in rural areas in the Nordic countries. *Journal of Rural Studies*, 79, 276–285. <https://doi.org/10.1016/j.jrurstud.2020.08.004>
- Jungsberg, L., Copus, A., Nilsson, K., & Weber, R. (2018). Demographic change and labour market challenges in regions with large-scale resource-based industries in the Northern Periphery and Arctic. REGINA Working paper. Nordregio. Stockholm.
- Jungsberg, L., Turunen, E., Heleniak, T., Wang, S., Ramage, J., Roto, J. (2019) *Atlas of Population, Society and Economy in the Arctic*. Nordregio. doi: 10.30689/WP2019:3.1403-2511
- Kacar, B., Curic, J., & Ilic, S. (2016). Local economic development in theories of regional economies and rural studies. *Ekonomika Poljoprivrede*, 63(1), 231–246. <https://doi.org/10.5937/ekoPolj1601231K>
- Keskitalo, H. C., Dannevig, H. Hovelsrud, G., West, J., Swartling, Å., (2011) Adaptive Capacity Determinants in Developed States: Examples from the Nordic Countries and Russia. *Regional Environmental Change* 11(3):579–92. doi: 10.1007/s10113-010-0182-9.
- Knieling, J., & Othengrafen, F. (2009). *Planning cultures in Europe: Decoding cultural phenomena in urban and regional planning*. Ashgate PubCompany.
- Knoblock, E. A., & Pettersson, Ö. (2010). Restructuring and risk-reduction in mining: Employment implications for northern Sweden. *Fennia - International Journal of Geography*, 188(1), 61–75.
- Knorr Centina, K. (1999) *Epistemic cultures: how the sciences make knowledge*. Cambridge, Mass: Harvard University Press.
- Lang, D. J., Wiek, A., Bergmann, M., Stauffacher, M., Martens, P., Moll, P., Swilling, M., & Thomas, C. J. (2012). Transdisciplinary research in sustainability science: Practice, principles, and challenges. *Sustainability Science*, 7(1), 25–43. <https://doi.org/10.1007/s11625-011-0149-x>
- Lang, R., & Fink, M. (2019). Rural social entrepreneurship: The role of social capital within and across institutional levels. *Journal of Rural Studies*, 70, 155–168. <https://doi.org/10.1016/j.jrurstud.2018.03.012>
- Larsen, J. N., Schweitzer, P., Abass, K., Doloisio, N., Gartler, S., Ingeman-Nielsen, T., Ingimundarson, J. H., Jungsberg, L., Meyer, A., Rautio, A., Scheer, J., Timlin, U., Vanderlinden, J.-P., & Vullierme, M. (2021). Thawing Permafrost in Arctic Coastal Communities: A Framework

- for Studying Risks from Climate Change. *Sustainability*, 13(5), 2651.
<https://doi.org/10.3390/su13052651>
- Larsson, Y., Hedberg, P., & Holmberg, S. (2020). *Ökad polarisering mellan landsbygd och storstad 1986-2019?* Göteborg Universitet & SOM-Institutet.
- Latour, B., (2007) *Reassembling the Social: An Introduction to Actor-Network-Theory*. OUP Oxford.
- Latour, B., Woolgar, S., (1986) *Laboratory Life: The Construction of Scientific Facts*. Princeton University Press.
- Lindberg, M. (2017). Promoting and Sustaining Rural Social Innovation. *European Public & Social Innovation Review*, Vol. 2. P 30-41.
- Litmanen, T., Jartti, T., & Rantala, E. (2016). Refining the preconditions of a social licence to operate (SLO): Reflections on citizens' attitudes towards mining in two Finnish regions. *The Extractive Industries and Society*, 3(3), 782–792.
<https://doi.org/10.1016/j.exis.2016.04.003>
- Lundgren, A., Nilsson, K., Norlén, G., & Tapia, C. (2020). Klimatomställningen och relationen stad och land (p. 29). Nordregio Working Paper.2020:7.
- Mariussen, Å., & Uhlin, Å. (2006). Trans-national practices—System thinking in policy making. Nordregio. Stockholm.
- Mårtensson, B., Alfredsson, B., Dahlgren, L., & Graham, L. (1988). Det hotade lokalsamhället: Om sårbarhet, strategier och självtillit. *Statens råd för byggnadsforskning*.
- McCann, P. (2019). Perceptions of regional inequality and the geography of discontent: Insights from the UK. *Regional Studies*, Vol. 54. No 2, 256-267.
- McCann, P., & Ortega-Argilés, R. (2016). Smart Specialisation: Insights from the EU Experience and Implications for Other Economies. *Investigaciones Regionales – Journal of Regional Research*, 36, P 279-293.
- Moffat, K., & Zhang, A. (2014). The paths to social licence to operate: An integrative model explaining community acceptance of mining. *Resources Policy*, 39, 61–70.
<https://doi.org/10.1016/j.resourpol.2013.11.003>
- Neumeier, S. (2012). Why do Social Innovations in Rural Development Matter and Should They be Considered More Seriously in Rural Development Research? - Proposal for a Stronger Focus on Social Innovations in Rural Development Research: Social innovations in rural

- development. *Sociologia Ruralis*, 52(1), 48–69. <https://doi.org/10.1111/j.1467-9523.2011.00553.x>
- Neumeier, S. (2017). Social innovation in rural development: Identifying the key factors of success. *The Geographical Journal*, 183(1), 34–46. <https://doi.org/10.1111/geoj.12180>
- Noack, A., & Federwisch, T. (2019). Social Innovation in Rural Regions: Urban Impulses and Cross-Border Constellations of Actors: Social innovation in rural regions. *Sociologia Ruralis*, 59(1), 92–112. <https://doi.org/10.1111/soru.12216>
- OECD. (2017). OECD Territorial Reviews: Northern Sparsely Populated Areas. OECD. <https://doi.org/10.1787/9789264268234-en>
- Oxford (2021). Institutions. *Oxford Encyclopedia bibliography*. Accessed 2nd October 2021: <https://www.oxfordbibliographies.com/view/document/obo-9780199756384/obo-9780199756384-0132.xml>
- Pestoff, V. (2012). *New Public Governance, Co-production & Third Sector Social Services*. Institute for Civil Society Studies, Stockholm.
- Primdahl, J., Kristensen, L. S., Arler, F., Angelstam, P., & Christensen, A. A. (2018). Rural landscape governance and expertise: On landscape agents and democracy. In *Defining Landscape Democracy. A Path to Spatial Justice* (p. 12). Edward Elgar Publishing.
- Prno, J. (2013). An analysis of factors leading to the establishment of a social licence to operate in the mining industry. *Resources Policy*, 38(4), 577–590. <https://doi.org/10.1016/j.resourpol.2013.09.010>
- Putnam, R. D. (2000). *Bowling Alone: The Collapse and Revival of American Community*. Simon and Schuster.
- Putnam, R. D. (2002). Democracies in Flux: The Evolution of Social Capital in Contemporary Society. In *Democracies in Flux*. Oxford University Press <https://doi.org/10.1093/0195150899.003.0001>
- Quednau, R. (2016). The Geography of Disadvantage. Strong Towns. <https://www.strongtowns.org/journal/2016/8/18/the-geography-of-disadvantage>
- Ramage, J., Jungsberg, L., Wang, S., Westermann, S., Lantuit, H., & Heleniak, T. (2021). Population living on permafrost in the Arctic. *Population and Environment*, Vol, 43. P 22-38.
- Rasmussen, L. H., Zhang, W., Hollesen, J., Cable, S., Christiansen, H. H., Jansson, P.-E., & Elberling, B. (2018). Modelling present and future permafrost thermal regimes in Northeast

- Greenland. *Cold Regions Science and Technology*, 146, 199–213.
<https://doi.org/10.1016/j.coldregions.2017.10.011>
- Ray, C. (2006). Neo-Endogenous Rural Development in the EU. In *The Handbook of Rural Studies* (pp. 278–291). SAGE Publications Ltd. <https://doi.org/10.4135/9781848608016.n19>
- Schultz-Nielsen, J. (2019). Her er der fare for alvorlige fjeldskred. Published 4th January. Sermitsiaq.
- Sharma, S. (2010). Assessing diet and lifestyle in the Canadian Arctic Inuit and Inuvialuit to inform a nutrition and physical activity intervention programme: Nutrition transition in Arctic Canada. *Journal of Human Nutrition and Dietetics*, 23, 5–17.
<https://doi.org/10.1111/j.1365-277X.2010.01093.x>
- Shiklomanov, N. I., Streletskiy, D. A., Grebenets, V. I., & Suter, L. (2017). Conquering the permafrost: Urban infrastructure development in Norilsk, Russia. *Polar Geography*, 40(4), 273–290.
<https://doi.org/10.1080/1088937X.2017.1329237>
- Shucksmith, M. (2016). *Routledge International Handbook of Rural Studies* (1st ed.). Routledge.
<https://doi.org/10.4324/9781315753041>
- Siders, A. R. 2019. ‘Adaptive Capacity to Climate Change: A Synthesis of Concepts, Methods, and Findings in a Fragmented Field’. *Wiley Interdisciplinary Reviews: Climate Change* 10(3): e573. doi: 10.1002/wcc.573.
- Siisiäinen, M. (2003). Two Concepts of Social Capital: Bourdieu vs. Putnam. *International Journal of Contemporary Sociology*, 26. P 183-203.
- Simonsen, K., Hansen, F., (2004) ‘Kapitel 6 Realisme versus Konstruktivisme’ in *Geografiens videnskabsteori*. Roskilde Universitetsforlag.
- Smit, B., & Wandel, J. (2006). Adaptation, adaptive capacity and vulnerability. *Global Environmental Change*, 16(3), 282–292. <https://doi.org/10.1016/j.gloenvcha.2006.03.008>
- Storumans Kommun. (2019). Strategisk plan 2020-2023. Antagen av Kommunfullmäktige 2019-06-11 § 65.
- Streletskiy, D. A., Shiklomanov, N. I., & Nelson, F. E. (2012). Permafrost, Infrastructure, and Climate Change: A GIS-Based Landscape Approach to Geotechnical Modeling. *Arctic, Antarctic, and Alpine Research*, 44(3), 368–380. <https://doi.org/10.1657/1938-4246-44.3.368>
- Streletskiy, D. A., Suter, L. J., Shiklomanov, N. I., Porfiriev, B. N., & Eliseev, D. O. (2019). Assessment of climate change impacts on buildings, structures and infrastructure in the Russian regions

- on permafrost. *Environmental Research Letters*, 14(2), 025003.
<https://doi.org/10.1088/1748-9326/aaf5e6>
- Suutarinen, T. (2015). Local natural resource curse and sustainable socio-economic development in a Russian mining community of Kovdor. *Fennia – International Journal of Geography*.
<https://doi.org/10.11143/45316>
- Tarras-Wahlberg, N. H. (2014). Social license to mine in Sweden: Do companies go the extra mile to gain community acceptance? *Mineral Economics*, 27(2–3), 143–147.
<https://doi.org/10.1007/s13563-014-0053-9>
- Tolvanen, A., Eilu, P., Juutinen, A., Kangas, K., Kivinen, M., Markovaara-Koivisto, M., Naskali, A., Salokannel, V., Tuulentie, S., & Similä, J. (2019). Mining in the Arctic environment – A review from ecological, socioeconomic and legal perspectives. *Journal of Environmental Management*, 233, 832–844. <https://doi.org/10.1016/j.jenvman.2018.11.124>
- Umander, K., Norlén, G., & Jungsberg, L. (2017). Social Impacts of Mining in Storuman Municipality: Results of a survey to local residents. Storuman municipality & Nordregio.
- Unceta, A., Castro-Spila, J., & García Fronti, J. (2017). The three governances in social innovation. Innovation: *European Journal of Social Science Research*, 30(4), 406–420.
<https://doi.org/10.1080/13511610.2017.1279537>
- United Nations. (1987). Our Common Future. Accessed 12th September 2021: <http://www.un-documents.net/our-common-future.pdf>
- van der Ploeg, J. D., Renting, H., Brunori, G., Knickel, K., Mannion, J., Marsden, T., de Roest, K., Sevilla-Guzman, E., & Ventura, F. (2000). Rural Development: From Practices and Policies towards Theory. *Sociologia Ruralis*, 40(4), 391–408.
<https://doi.org/10.1111/1467-9523.00156>
- van Everdingen, R. O. (2005). Multi-language Glossary of Permafrost and Related Ground-ice. International Permafrost Association, Terminology Working Group.
- Vanderlinden, J. P., Jungsberg, L., Ramage, J., Codier, M., Wang, S., Doloisio, N., Gartler, S., Meyer, A., & Vullierme, M. (2020). Report on the social representation of permafrost thawing, including economic impact within Arctic communities: A qualitative and quantitative analytical framework. Nunataryuk Project Report.
- Whetten, D. A. (1989). What Constitutes a Theoretical Contribution? *Academy of Management Review*, No 4, P 490-495.

Papers

Paper I

***Title** Key actors in community-driven social innovation in rural areas in the Nordic countries*

***Authors:** Leneisja Jungsberg, Andrew Copus, Lise Byskov Herslund, Kjell Nilsson, Liisa Perjo, Linda Randall, Anna Berlina*

***Journal:** Journal of Rural Studies, Volume 79, pages 276–285*

***Published:** <https://www.sciencedirect.com/science/article/pii/S0743016718311574>*



Key actors in community-driven social innovation in rural areas in the Nordic countries

Leneisja Jungsberg^{a,c,*}, Andrew Copus^b, Lise Byskov Herslund^a, Kjell Nilsson^c, Liisa Perjo^d, Linda Randall^c, Anna Berlina^c

^a Copenhagen University, Institute for Geosciences and Natural Resource Management, Department for Architecture and Planning, Rolighedsvej 23, 1958 Frederiksberg C, Copenhagen, Denmark

^b The James Hutton Institute, Craigiebuckler Aberdeen AB15 8QH Scotland Invergowrie, Dundee, DD2 5DA, Scotland, UK

^c Nordregio, Box 1658, SE-111 86, Stockholm, Sweden

^d IVL Swedish Environmental Research Institute, Box 210 60 100 31, Stockholm, Sweden

ARTICLE INFO

Keywords:

Community-driven social innovation
local development
demographic change
service provision
rural challenges

ABSTRACT

Rural areas in the Nordic countries often face challenges such as demographic change and the closure of public services. To address this situation, some rural communities have developed solutions which can be characterised as social innovation. This paper analyses 18 such community-driven social innovation projects across the Nordic countries and seeks to examine the importance of different actors in the initiation and implementation phases of such projects.

Based on qualitative analysis, focusing on the different stages of community-driven social innovation, the paper assesses the importance of different actors in developing each of the projects. The analysis demonstrates the relative importance of community members, civil society organisations, the local public sector, the private sector, and regional and national authorities, in terms of their respective involvements in the initiation and implementation processes for these projects.

The key findings from this paper emphasise the differences between initiation and implementation for each of these community-driven social innovation projects. The initiation phase is highly dependent upon community members, civil society organisations and the local public sector, whereas it is primarily civil society organisations which dominate the implementation phase. Central to initiating and sustaining community-driven projects is the capacity of local actors to develop ideas, to find resources and to manage decision-making.

1. Introduction

Rural areas in the Nordic countries have experienced a significant decline in population in recent decades. This often distorts the age, gender, and socio-economic balance by depleting the number of young, well-educated, and economically active people living in those rural areas (Grunfelder et al., 2020; Hörnström et al., 2015; Lindberg, 2017; Tietjen, 2017). Although Nordic countries are well known for their welfare state models (based on universal access to services such as healthcare and education), the high cost of sustaining these models for a widely dispersed and shrinking population remains a challenge (Copus et al., 2017; Hörnström et al., 2015; Shucksmith and DavidBrown,

2016). This shift also means that actors other than those from the public sector gain a larger role in rural development initiatives. In most countries increased centralisation and funding cuts have led to a decrease in public sector involvement in rural areas, but also a corresponding rise in civil society actors assuming responsibility for services, infrastructure and local assets (Bernal and Avella, 2019; Cheshire et al., 2015; Coffey and Polese, 1984; Fougère et al., 2017; Harris and Albury, 2009; Pestoff, 2012).

Despite the ongoing challenges that continue to exacerbate the rural-urban divide in Nordic countries (Barenholdt, 2002; Grunfelder et al., 2020; Tietjen, 2017; Wittorff Tanvig, 2015), new solutions and projects are also emerging – ones that support rural community development.

* Corresponding author. Copenhagen University, Institute for Geosciences and Natural Resource Management, Department for Architecture, and Planning, Rolighedsvej 23, 1958 Frederiksberg C, Copenhagen, Denmark.

E-mail addresses: leneisja.jungsberg@nordregio.org (L. Jungsberg), andrew.copus@hutton.ac.uk (A. Copus), lihe@ign.ku.dk (L.B. Herslund), kjell.nilsson@nordregio.org (K. Nilsson), liisa.perjo@ivl.se (L. Perjo), linda.randall@nordregio.org (L. Randall), anna.berlina@nordregio.org (A. Berlina).

<https://doi.org/10.1016/j.jrurstud.2020.08.004>

Received 24 September 2018; Received in revised form 19 June 2020; Accepted 11 August 2020

Available online 30 August 2020

0743-0167/© 2020 The Authors. Published by Elsevier Ltd. This is an open access article under the CC BY license (<http://creativecommons.org/licenses/by/4.0/>).

Some of these could appropriately be described as social innovation (SI). While rural communities are connected to specific geographical areas where people live, work, shop and participate in recreational activities, SI activities are associated with new social interactions which reach beyond the geographic area of the rural community (Bosworth et al., 2016a, 2016b; Howaldt and Schwarz, 2017; Noack and Federwisch, 2019). New social interactions and collaborations involving actors from different geographical areas elevate the ability of rural communities to address unmet social needs and challenges through the establishment of SI and to create a transformative social change (Bernal and Avella, 2019; Bock, 2016; Howaldt et al., 2018; Richter, 2019; Ziegler, 2017).

SI is connected to qualities such as community participation and empowerment (Edwards-Schachter and Tams, 2013; Lindberg, 2017). This is the result of a collaborative process (one person alone cannot bring about a social innovation), and that process in turn brings together partners across sectors, disciplines and specialities from government, civil society and the private sector (Howaldt et al., 2018; Neumeier, 2012; Ziegler, 2017). In this way, SI shifts our perspective away from fixed actors in separate rural areas, towards a more fluid image of shifting actors, relations and functional networks operating across different geographical areas, beyond the local and the rural (Bock, 2012, 2016; Lang and Fink, 2019). There is also evidence that SI involves multiple institutions, norms, and practices, and that there is a connection between SI activities and those which are already very much part of the European Union (EU) policy concept of Community-Led Local Development (CLLD) and LEADER (Copus, 2016).

The main difference between rural development per se, and SI in rural development specifically, is that SI needs to be perceived as novel by the community involved in its creation (Neumeier, 2012). This perceived novelty can also be due to new partnerships and collaboration across different geographical areas. SI has been studied empirically and theoretically as a driver of social change. However, SI processes in rural areas throughout the Nordic countries have not been analysed in earlier research (Cajaiba-Santana, 2014; Howaldt et al., 2018; Nordic Council of Ministers, 2015). This study proposes to fill that gap by examining the dynamic among the actors involved in initiating and implementing SI projects in rural areas across the Nordic countries. Its contribution includes a systematic analysis of the SI process, based on studying actors' involvements and partnerships as they initiate and implement SI. It is guided by two research questions:

- a) How are community-driven SI projects initiated and implemented in rural areas in the Nordic countries?
- b) What are the roles of different actors at different stages of the innovation process?

2. Materials and methods

Our study was commissioned by the Nordic Working Group on Demography and Welfare under the Nordic Council of Ministers' Committee of Senior Officials for Regional Policies. The working group consisted of representatives from each of the Nordic countries. They provided context-specific input, accommodating perspectives arising both from welfare policy and rural development. They also guided research design, addressing the need for greater knowledge of successful initiatives and enabling factors for SI in rural areas.

The working group also had a specific interest in understanding how SI can address demographic challenges faced by rural communities across the Nordic countries – including ageing populations, out-migration (particularly of young people), and limited access to services. A joint Nordic analysis is of interest from a political perspective, in the context of Nordic cooperation; and because of similarities between Nordic welfare systems, as well as the socio-economic profiles of rural areas and planning systems (Getimis, 2012; Grunfelder et al., 2020; Knieling and Othengrafen, 2009).

The examples chosen for this study had to fulfil two criteria. First,

they needed to involve a social process requiring significant levels of community spirit and cohesion and enhancing the capacity of a community to respond to future local challenges. Second, they had to differ from other rural development projects, in that they were perceived as novel within a local and institutional context.

2.1. Rural typology in the Nordic countries

All the social innovation initiatives selected for study were located in rural or remote areas and, as a result, help us understand SI in a Nordic rural context. We have used the urban-rural typology based on indicators and categorisations by the Organisation for Economic Cooperation and Development (OECD). These categorise rural areas according to local population density, the proximity of main cities, and the remoteness of communities compared with predominantly urban regions (Grunfelder et al., 2020). As illustrated in Map 1, all SI projects in this paper are located outside the capital region in their countries, in regions ranging from those which are predominantly rural to those characterised as intermediate. Communities located in both predominantly rural and intermediate regions can face similar challenges, including school closures, cuts in public transport, lack of employment opportunities, and the outmigration of young people.

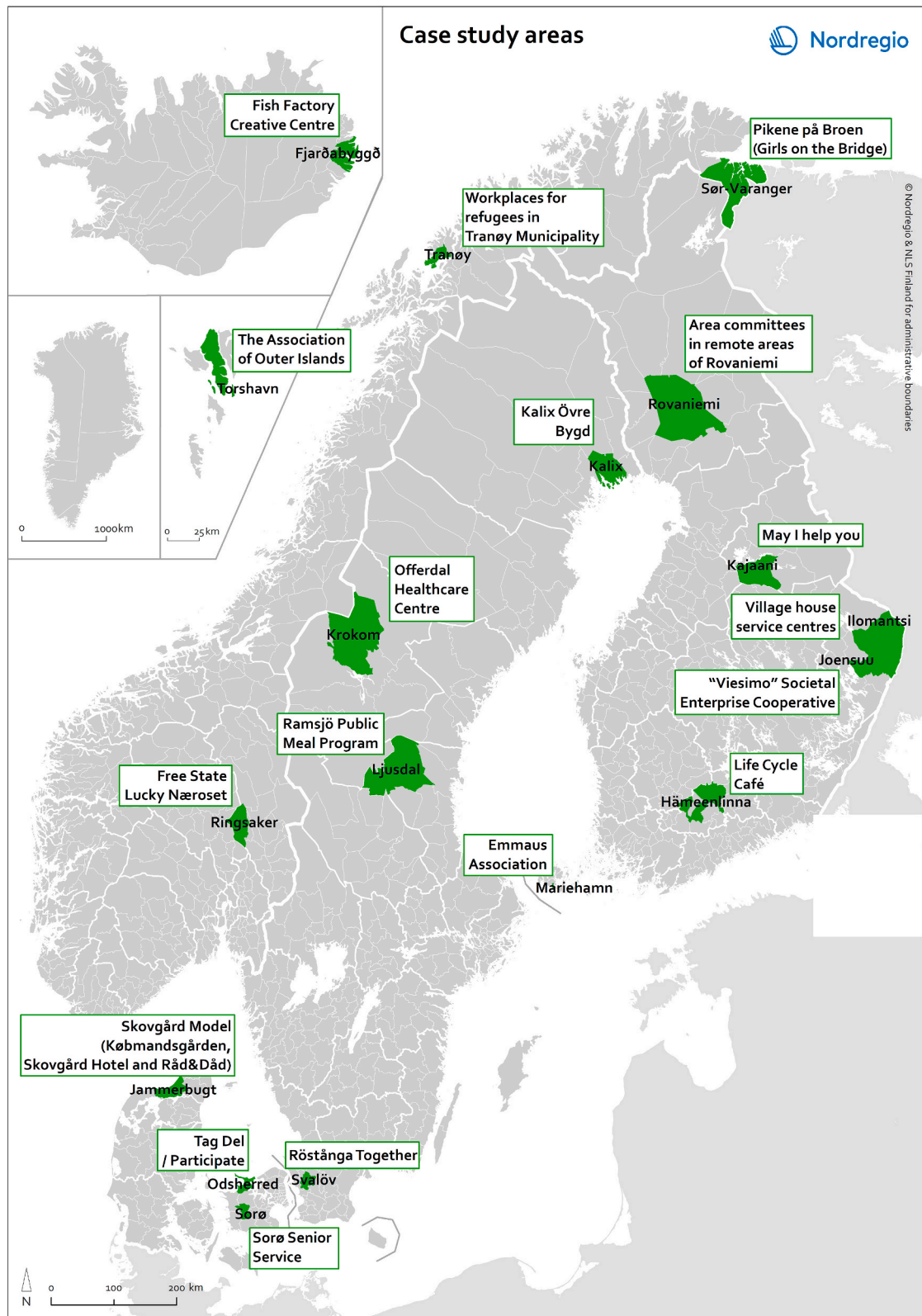
2.2. Research design

The research design builds on practical examples to understand the foundation of community-driven SI projects across the Nordic countries. The study applies a qualitative approach to examine the space and time dimensions of the innovation processes. Semi-structured interviews have been conducted with local project leaders and/or others who had been central to the community-driven SI process, in order to gather empirical information. Where possible, additional background documents have been used to inform the analysis. A detailed narrative for each SI project is available online.¹ The combined narrative and data-acquisition approach used here was inspired by the “social innovation biography” methodology developed and tested in the EU-funded SIM-PACT project (Terstriep et al., 2015; Terstriep and Rehfeld, 2014; Totterdill et al., 2016). This approach was chosen because it provides an in-depth “understanding of the development paths, knowledge trajectories and stakeholders at the micro-level” (Terstriep and Rehfeld, 2014:1), and also because it pays specific attention to the relationships and contextual setting of each SI initiative.

For each biography, the initial data acquisition involved desk research, following a qualitative interview and a short questionnaire summarising the interviewee's assessment of the importance of the different actors' involvement in the initiation and implementation phases of the project. The answer to each question in the questionnaire produced a score ranging from 0 to 3, depending on its perceived importance of ideas, resources, and decision-making. The score of all SI examples was added up, in order to illustrate the involvement of different actors. In calculating the average for the 18 SI projects, a trend emerged, revealing the varied involvement of actors at different stages in the SI process. The questions covered the different roles of various participants (civil society, public sector and private sector) in generating ideas and inspiration, in providing resources (including labour), and in making decisions at two different stages of the SI process: the initiation and implementation phases.

The involvement of civil society actors was broken down into two categories. The term “civil society (organisation)” was used to indicate community involvement rooted in an institutional framework (e.g. a village association), whereas “civil society (community)” was used to indicate the general involvement of community members not directly

^a <http://archive.nordregio.se/Publications/Publications-2016/Territorial-Social-Innovation/Nordic-case-examples-What-does-TSI-look-like/index.html>.



Map 1: Location of social innovation initiatives in rural areas of the Nordic countries.

connected to an organisation. Public sector actors were also broken down into two groups. “Public sector (local)” referred to the nearest local government entity (in the Nordic countries this is usually the municipality), while “public sector (regional/national/international)”, referred to public entities at the regional, national and international level. This division is based on the frequency of involvement by different public sector entities in SI activities. The data is presented in radar charts in the results section in order to support the findings of the qualitative analysis.

3. Framing community-driven SI in rural development research

In the literature, SI is related to what in recent years has become known as “neo-endogenous” growth. In very broad terms, this follows the rejection of the kind of top-down (exogenous) policies common at the end of the twentieth century, and the purely locally-based “endogenous” approaches that followed. Neo-endogenous development, by contrast, requires a fine balance between local initiative and resources on the one hand, and appropriate inputs of capital, expertise and sources of innovation on the other. These may be best accessed through networks that extend out into the wider world (Bock, 2016; Bosworth, 2010; Dubois et al., 2017; Ray, 2006; Shucksmith, 2016).

Neo-endogenous local development initiatives are thus only possible through meaningful interaction between local areas and their wider environments (Bosworth et al., 2016a, 2016b). Similarly, “social innovation can never be analysed as belonging only to ‘its’ place, the place where it was generated, but [must be conceived] as occurring within a complex web of spatial interconnections” (MacCallum and Haddock, 2016:7), and “it is evident that social innovation requires networking and building of relations across the borders of the place in question” (Bock, 2016:569).

However, certain preconditions need to be in place before SI projects can lead to change. These include human and social capital, the presence of social networks that bind the community together, and outreach to potential external partners (Cajaiba-Santana, 2014; Lang and Fink, 2019; Neumeier, 2012; Unceta et al., 2017). Other key factors for the success of SI initiatives include the establishment of new partnerships within the community, and the role of local facilitators (Moulaert et al., 2005, 2013). The success of an SI project also depends upon the degree of benefit it offers, its ease in terms of application, the foreseeability of its results, and local willingness to participate (Neumeier, 2017; Terstriepe et al., 2015).

3.1. Defining SI in community-driven rural development

SI is a “contested concept” (Bock, 2016:2). Research in this field offers many definitions; some of them vague and inclusive, others “tighter” and more specific (Bock, 2012). According to Bock (2016), the term “social innovation” can be used to describe a change in “social relations, people’s behaviour, norms and values” and can therefore “refer to the effort, method, result or change initiated by collaborative actions” (Neumeier, 2012:54). This means that the SI project is generated by a social process rather than by an individual (Bosworth et al., 2016a, 2016b; Lindberg, 2017).

An SI process may or may not lead to the creation of a social enterprise (Copus et al., 2017). The main difference between a social enterprise and a commercial enterprise is that the commercial enterprise is driven primarily by profit-making through acts of trade, while the social enterprise takes the initiative in identifying and solving social challenges in a community (Crisan-mitra et al., 2011). Often, an SI initiative is triggered by a social need rather than by the pursuit of a distant goal (Cajaiba-Santana, 2014; Neumeier, 2012), and the people involved in the process of its initiation and development perceive the SI project to be new within their context. The process usually also entails a change in attitudes, behaviour and perceptions (Neumeier, 2012).

The collaborative process involved is also acknowledged in the most

frequently quoted definition of SI, namely: “Social innovations are innovations that are social in both their ends and their means” (Caulier-Grice et al., 2010; European Commission, 2011; Mulgan, 2007). This indicates that the process is as important as the result, and that the overall purpose of SI is to meet social needs, to create new collaborative models or social relationships that are good for society, and to enhance society’s capacity to take action (Caulier-Grice et al., 2010; Neumeier, 2012; Totterdill et al., 2017). Almost half of the initiatives mapped in a global study on SI show a direct user or beneficiary involvement. A central finding in this global mapping is the identification of the local competences and capacities involved in acting together (Howaldt et al., 2018).

Collaboration on SI is about creating social assets rather than material outcomes. This definition acknowledges both the process (as in the means) and the outcome (as in the ends) of SI. By building on this understanding, SI is defined in this paper as a process that leads to novel, community-produced solutions to social problems.

4. Results and analysis

The results section examines the 18 community-driven SI projects addressing demographic challenges faced in rural and remote areas of the Nordic Region. These 18 examples can be divided into three broad themes: local fora for community development and capacity building; creative approaches to service provision; and the provision of community spaces and activities. These examples, with short descriptions, are shown in Table 1.

As illustrated in Table 1, each SI initiative belongs to one or two categories. Our analysis uses examples of different SIs to illustrate key points from each of the categories, and to reveal nuances in the development process for these three categories. There are some differences in the way the actors are involved in the process, depending on the category. All the new “community development fora”, “local services” and “community spaces and activities” initiatives illustrate a significant local development which mitigates the impact of demographic change.

Even though the SI examples here are embedded differently, depending upon the local context (be they associations, social enterprises, co-operatives or committees), they can still facilitate or provide a mitigating effect in relation to rural challenges such as outmigration and an ageing population by offering new activities to stimulate local development. All the projects have a novel approach and succeed in establishing a new form of collaborative model: one that involves public and third sectors, commercial providers and service users finding new ways for the different actors to work together.

4.1. Getting started

The initiation phase includes everything from the initial idea right up to the start of what could be considered regular operations. In all cases, SI initiatives were triggered by regional vulnerabilities, such as the demographic shifts and challenges posed by shrinking public budgets. The challenges themselves were varied. They included service closures (or the threat of closure), ageing populations and population decline, local economic restructuring, and local authority mergers. Although these factors have each been significant drivers, it is important to acknowledge that such conditions, in and of themselves, do not necessarily result in community-driven SI. Each one of our examples illustrates a capacity to develop ideas, collect resources and manage decision-making. This leads on to the initiation phase, which is characterised by starting-up a new service, the formation of a new association, the opening of a new facility, or the commencement of a new activity.

Fig. 1 shows the involvement of different types of actor in the initiation phase. It sums up our assessment of different actors producing ideas, decision-making, and collecting resources in each of the 18 SI projects. The involvement of the different actors is valued on a scale from 0 to 3 by the key people involved in each SI initiative. By adding up

Table 1
18 examples of community-driven SI in the Nordic countries.

SI examples	Community development fora	Service provision	Community spaces and activities	Description
Viesimo Social Enterprise Co-operative, Finland		*		Secures services in rural areas through a user-based approach to service development.
Area Committees in Remote Areas of Rovaniemi, Finland	*	*		Enhances direct democracy by giving committees/local residents responsibility for budgets for local services.
May I Help You? Finland		*		Links young people, particularly those at risk of social exclusion, with elderly people who need assistance with everyday tasks.
Offerdal Healthcare Centre, Sweden		*		A resident-owned co-operative economic organisation providing healthcare services to local people.
Ramsjö Public Meals Programme, Sweden		*		A local entrepreneur who has taken over the public meals programme with amazing results.
Sorø Senior Service, Denmark		*		A network of volunteers who deliver groceries to elderly citizens in remote areas.
Kalix Övre Bygd, Sweden		*		An economic association that runs a local store and provides a range of public services in the fields of care for the elderly, childcare and education.
Emmaus Association, Åland		*		Addresses unemployment by acting as an intermediary between unemployed immigrants and local people who require assistance with various tasks.
Life Cycle Café, Finland		*	*	Provides a place where retired volunteers and school students can meet and teach each other new skills.
Village House Service Centres, Finland		*	*	Brings services to local residents through co-operation between the local authority, local people, local associations and businesses.
Workplaces for Refugees in Tranøy, Norway		*	*	Co-operation between a local entrepreneur and the Norwegian State Housing Bank to create homes and jobs for refugees.
Fish Factory Creative Centre, Iceland			*	An abandoned fish factory in Stöðvarfjörður has been transformed into a creative hub by a passionate group of people.
Pikene på Broen (Girls on the Bridge), Norway			*	A collective of curators and producers who are working to inspire cross-border co-operation and cultural exchange between Norway and Russia.
Skovgård Model (Købmandsgården, Skovgård Hotel and Råd&Dåd), Denmark			*	A model in which the local community collectively takes over private institutions and establishes enterprises that enable people with disabilities to contribute to local rural development.
Röstånga Together, Sweden	*		*	A community-owned social enterprise that provides a financial platform to support social and economic development locally.
Free State Lucky Næroset	*			Uses humour, imagination, originality and courage as tools to mobilise the local population and encourage joint action.
Tag Del/Participate, Denmark	*			An online space where communities can come together to solve the challenges they face.
The Association of Outer Islands, Faroe Islands	*			Addresses the issue of outmigration from the smaller Faroese islands by increasing social networking and knowledge-exchange among people living on the outer islands.

Initiation & development

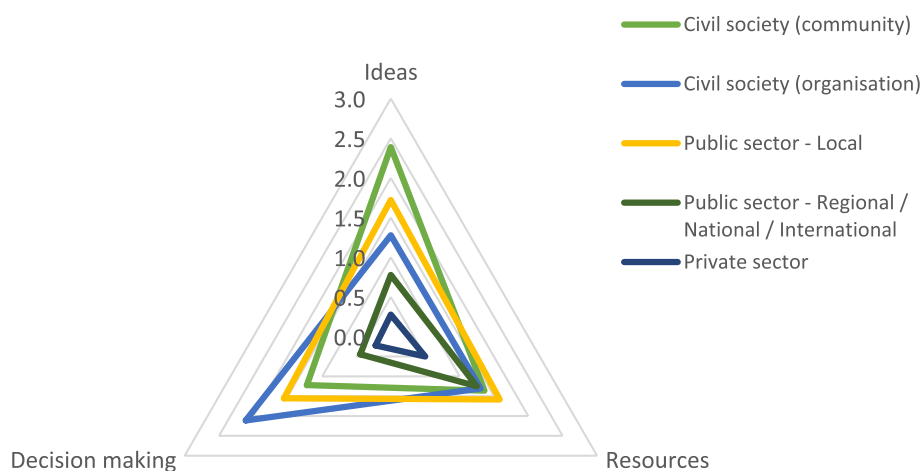


Fig. 1. Initiation and development phase: Illustration of the role of different actors in social innovation initiatives.

the total value and subsequently calculating an average, Fig. 1 illustrates the perceived involvement of civil society (community), civil society (organisation), public sector – local, public sector – regional/national/international, and private sector for all of the 18 examples.

Civil society (in the shape of the community) together with the local

public sector, are the most important actors during the initiation phase. In most cases, informants articulate this as a process that engages people from the community, and they underline the importance of connections between members of the community, civil society, and local government/the public sector. This engagement of people in the community in

the initiation phase can also be described as an endogenous development process.

4.1.1. Ideas for the initiation phase

The source of ideas is most likely to be individual members of the community, but local associations and the local public sector also play a role in many of these SI examples. For initiatives resulting in ‘community space and activities’ and ‘local fora for community development’ members of the community were the key actors – the ones who came up with the ideas. One example is the *Skovgård model*, which provides community space and activities based on efforts by members of the local community to reopen a local shop and hotel, while also building an inclusive community and involving disabled people actively in work and social life. Without the vision of members of the community (including some particularly driven, passionate individuals), this idea would never have been realised. A similar trend is seen in those SI projects which established ‘local fora for community development’. One example in this category is *Free State Lucky Næroset*, where residents of a village in Norway decided to set up their own form of local government. They used local cultural activities and roleplay, so that the values of humour, imagination, originality and courage were tapped in order to support a process to reverse the decline in population and to keep a local school open (a venture in which they succeeded).

In the SI examples which offered additional service provision, the local public sector was the most engaged actor during the idea phase. This type of SI initiative often focuses on end-user involvement and participation. In the example known as *May I Help You*, the idea emerged from workshops in the local community and hosted by the local public sector of developing a new way of bringing young people – particularly those at risk of social exclusion – together with elderly people who needed assistance with everyday tasks. Similarly, the *Ramsjö Public Meals Programme* was set in motion by local authority actors through an initiative to involve end-users in a thorough needs-assessment, with the aim of developing new service solutions. This process eventually led to a new approach to public meals provision, which has subsequently supported job creation through local entrepreneurship and enhanced the quality of the service provided.

For all projects, interviewees mentioned that a supportive attitude towards growing new project ideas among community members is an important factor in both the idea phase and the development phase. When experimenting with new modes of working, the social environment is also of great importance to the prospects of the idea developing into an actual, functioning project.

4.1.2. Resources for the initiation phase

Resources include knowledge, networks, funding and (volunteer) labour. Several interviewees also mention knowledge and funding from the local public sector to get initiatives off the ground. This was seen as crucial in providing the support needed to gain knowledge of legal procedures and to extend the social network involved. Those SI projects setting up and registering an association often combined membership fees and other fundraising activities to support their work financially. In a few examples, financial support was also received from the regional and/or national/international public sector (e.g. national or regional development grants, or the EU funded Leader programme).

In addition to knowledge, networks and funding, an important input during the initiation phase is volunteer labour. Active village associations and their volunteers are crucial, because many SI projects rely on the work of volunteers over a prolonged period. A committed “core” of volunteers is therefore often regarded as a necessity. Having active local inhabitants and associations involved is supportive for SI activities. The type and scale of the business and of the investments involved would rarely be profitable using a conventional business model, and as a result these social initiatives are heavily reliant on volunteers. Volunteers are, indeed, the single largest asset for many community-driven SI projects. Some such initiatives take the form of specific activities created through

personal encounters, organising workshops, trust-building exercises, and so on. Several of the initiatives (e.g. *Skovgård Hotel*, *Tag Del/Participate*, *Röstånga Together*) have thrived by raising share capital/crowdfunding. In many examples, therefore, a crucial step towards moving from the idea stage to the start-up phase of the SI project is the willingness of local members of the community to invest their time and effort in it.

In some cases, the private sector also provides key resources (such as sponsorship, grants or staff time) to organise events and activities that help to develop an initiative. However, the SI examples cited in this paper indicate that this is mainly provided when the key people in the community who are involved in the SI are also part of running a business. In rural communities, people often have several responsibilities (e.g. chairperson of the local handball club, mayor and parent coordinator) and most of our SI examples also reveal a high degree of dependence upon a few passionate souls leading the way during the initiation phase. In this initiation phase, the resources may consist of a combination of voluntary and charitable fundraising, public sector grants, fees charged for membership, or fees paid for services such as consultancy, catering, cultural activities and events.

4.1.3. Decision-making in the initiation phase

Decision-making is defined as the ability to make decisions driving a process towards results. The decisions can involve use of financial resources, labour, work and meeting places, infrastructure, structure of collaboration, events, and media outreach. Civil society organisations are the most likely to play a key role in decision-making, however, for several of the SI projects studied, members of the community were involved in the initial decision-making and then the local project manager collectively led the way forward through workshops and consultations. More generally, the results of the initiation phase illustrate the tendency of members of the community to band together and organise. All these SI examples went through a process of formalising their initiatives. This formalisation process mainly took on the most common legal forms – such as associations, civil society organisations, social enterprises, public-private partnerships, committees, community development trusts and co-operatives.

To emphasise the social value of SIs, it is necessary for them to specify, in some way, that the potential profits will be reinvested in order to generate even greater social value – rather than just turn a profit. Only one of the 18 SI examples had a high level of private sector involvement in decision-making. This SI is in *Tranøy in Northern Norway*, where a partnership between a social entrepreneur and the local council led to a company being established that built 36 homes for disadvantaged people and refugees, followed by a cleaning company that provided jobs for six refugees.

Decision-making in the initiation phase usually involves considering which legal entity it is best to establish, so that appropriate support can be given to the next step in implementing the SI project. In several cases, the community was part of this decision-making process. Those individuals leading the initiation of an SI initiative locally usually also take on a key function in the civil society organisations set up. This step is a precondition for starting to get the work recognised as an SI activity, and to provide foundations for the implementation phase.

4.2. Implementation and day-to-day operations

The previous section uncovered the fact that, in the initiation phase, there is often a high level of dependence on community members, civil society organisations and the local public sector. They are the important actors in getting an initiative off the ground. Demographic changes, including outmigration, ageing and the closure (or threat of closure) of services such as local schools, can all be conditions that generate impetus for the initiation of an SI project.

This section will focus on the implementation phase. Its aim is to understand the way SI projects operate in practice, particularly in

relation to the contributions made by different actors. Fig. 2 shows the degree of involvement of different types of actors in the implementation and operation phase.

As Fig. 2 demonstrates, there is a substantial shift in the type of actors who are likely to contribute to the implementation and operation stage of a project, compared to those who will contribute to the initiation phase. The most substantial changes are the increased significance of the role of civil society organisations and the larger role played by the private sector. To understand the nature of these shifts, it is important to emphasise that it is not necessarily the case that new actors from civil society organisations and the private sector have come on board at this stage in the process. In fact, in many cases, it is the same community actors who are involved but the nature of their involvement changes, due either to the establishment of a civil society organisation, or that of a social enterprise.

4.2.1. Ideas for the implementation and day to day operation

Ideas in the implementation and day-to-day operational phase change in character as the focus now moves to the ideas required for daily problem-solving, rather than for developing a new concept. In nearly all our SI examples, it is seen as crucial that a project manager plans, guides and supports a well-designed and well-structured approach to the task of implementation, in order to ensure a continuous, smooth process. A clear allocation of tasks, time and competences is important for the SI project to fully establish itself in the field. A key competence is the ability to communicate the contribution of SI by developing ideas for good and effective outreach stories. Several of the SIs made good progress after attracting media attention that lead to publicity for the projects outside its local area in the implementation phase.

Ideas generated during the implementation phase also includes new approaches to establish platforms for collaboration. These can include both traditional purchaser-provider models and other partnerships developing new services together. One example of this is *Sorø Senior Service* in Denmark, where a volunteer group collaborates with the municipality (local public sector) providing a grocery shopping service for elderly residents. The idea emerged as there was already a social network locally and through a conversation with some of the elders' they saw a need for some of them to get groceries delivered to their home. The social network in the group is an important factor for the volunteers' participation, but the service would not have been developed without the idea to ask for a meeting place and the possibility to receive petrol money from the municipality.

Another idea for a new collaboration model is the *Rovaniemi Area Committee Model*, funded by Rovaniemi municipality in Finland. Here,

the area committees are responsible for the provision of certain public services (education, culture, sports, youth services, healthcare information, day care, home care and local development), as well as budgeting for these services. The underlying idea is that there is a need for knowledge about local conditions and needs, so that effective solutions can be found for facing the challenges of service provision in rural and remote areas with ageing populations.

In general, during the implementation phase, the ideas generated are usually about new models of collaboration, generating day-to-day operating structures problem-solving, business planning, and outreach activities.

4.2.2. Resources for the implementation phase and day-to-day operations

Ensuring revenues from several different sources is an important strategy during the implementation phase. Most SI projects therefore focus on multiple sources of income and diverse economic activities. Those SI examples established as an association were more likely to depend upon a membership fee, combined with annual public-sector grants. In the Faroe Islands, the Association of Outer Islands was established to continue a network developed through a project initiated by the public sector. Over the years it has depended on public grants to provide support for its activities on behalf of the outer islands, however, the last few years they also generated some income from membership fees which also can be an efficient way for an association to become financially viable.

All the social enterprises in the study are funded by a combination of voluntary and charitable fundraising, public sector grants, and fees charged for services. For three of them, Skovgård Hotel, Viesimo Social Enterprise Co-operative, and Röstånga Together, the most important income is fees levied for service provision. However, for Viesimo Social Enterprise Co-operative, and Röstånga Together the income from service provision is also complemented with charitable fundraising and volunteer labour.

For the SI examples that enhance service provision, the available resources appear to remain constant. One way these resources are procured is by providing a service on behalf of a local council. For example, *Offerdal Healthcare Centre*, a resident-owned co-operative, provides healthcare services in a rural region, is contracted by the municipal council to deliver its healthcare services. The municipal council has public procurement principles based on quality and other values rather than just cost. This enabled the healthcare centre to obtain a public procurement contract. Similarly, the service centre in *Kalix Övre Bygd* signed an agreement with Kalix Municipality to allow for the outsourcing of tasks associated with homecare service provision for the centre.

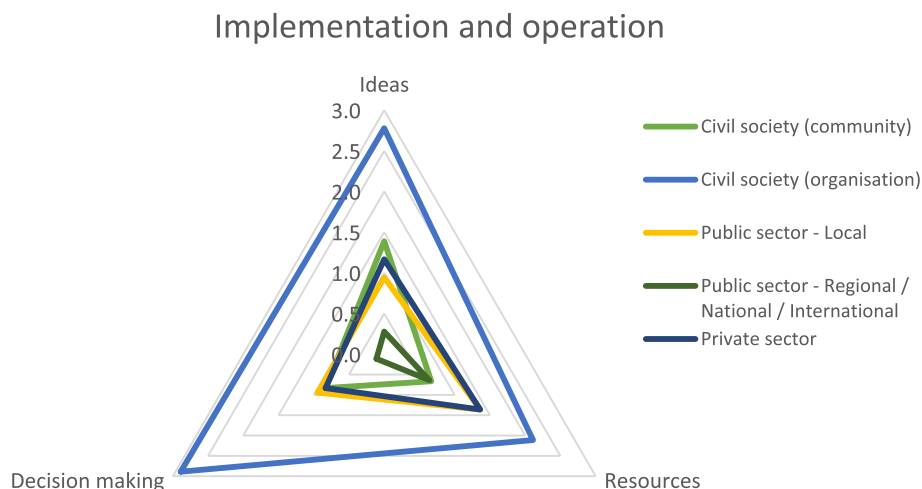


Fig. 2. Implementation and operation: Illustration of the role of different actors in social innovation initiatives.

4.2.3. Decision – making in the implementation phase and day to day operation

When making decisions, many of the SI initiatives act in partnership with local public sector or other support organisations. Nearly all of the SIs were able to employ a part-time or full-time project manager to oversee implementation of the concept, the continuous engagement of members of the community, the building of local capacity, the management of a business plan and administration, and so on. Informants emphasise the importance of day-to-day decision-making for efficient implementation, maintaining local engagement and structuring the workload. This is crucial for the civil society organisations in the implementation and day-to-day operation phases of the project.

The social enterprises that were established were in some cases initiated by the public sector, while in other cases they were galvanised by members of the community. In Finland, the public sector initiated *Viesimo Social Enterprise Co-operative*, a social enterprise, and later passed it over to a local civil society organisation to run and manage its implementation and day-to-day operations. Another example is *Röstånga Together*, a community-owned social enterprise initiated by citizens after the end of a Leader programme project. Through the community's collective effort, they established an enterprise which provided local development in terms of public services, cultural activity and businesses.

Several initiatives that became social enterprises helped maintain services otherwise threatened with closure due to restructuring, or the drawing back of the state. However, here it is important to point out that the legal and tax framework for social enterprises varies between countries. In recent years, different Nordic countries have adopted a variety of approaches to try to make the legal and business environment friendlier for SI projects and social entrepreneurship. In Finland, for example, a Social Enterprise Mark was introduced as a label in 2011, in order to make social enterprises more distinctive in the marketplace. In Denmark, a law² setting up a national register of social enterprises was passed in 2014. In Sweden, there is a similar register, but only of social enterprises working with labour market integration for migrants (Nordic Council of Ministers, 2015; Wilkinson, 2015).

The role of the public sector in decision-making is significantly reduced as projects proceed from the initiation phase to the implementation phase. Overall, the role of the local public sector in implementing the SI examples studied here ranges from no involvement at all, to the provision of minor funding, to the provision of free premises for the development of partnerships with civil society actors or social enterprises. Public sector involvement in implementation is not uniform. However, as noted above, the role of the sector during the implementation phase appears minor compared with that of the initiation phase.

5. Discussion of the importance of community-driven SI examples for rural development policy in the Nordic countries

Understanding the details of various actors' involvements in the different phases of our SI examples provides us with a better understanding of the conditions necessary to initiate and implement SI projects in rural areas. These SI projects in Nordic countries require a fine balance between, on one hand, local initiative, and resources, and on the other hand, the input of capital, expertise and sources of innovation accessed by networks stretching beyond the local community. The empirically specified SI examples in this study confirm the importance of changeable roles and show how the actors' activities shift from the initiation phase to the implementation phase.

The examples we have studied in this paper show that local public sector actors, along with civil society organisations and members of the community, each play key roles in facilitating the development

processes involved. This supports our original contention that, at least in the Nordic context, SI is a hybrid phenomenon with no fixed sectoral boundaries (Caulier-Grice et al., 2010). While the growing interest in SI may, as Harris and Albury (2009) suggest, have some connection to “a growing recognition of the inherent limits of the state” (Harris and Albury, 2009:17), it is not necessarily synonymous with the complete withdrawal of the state from its responsibilities in the way that Bock (2016) implies. Instead, the preconditions for SI in the Nordic countries appear to be characterised by changing roles for different actors. In some cases, this may involve co-operation between civil society actors and the local public sector to build up new and creative ways to provide services or collaborative fora for local development. In other cases, it may involve people in a community banding together to create an initiative that meets a need that does not fall within the remit of the state.

The empirical examples illustrate how SI projects involving service provision have greater involvement by public sector actors than those involving community development fora, or community space and activities. While the local public sector often plays an important role in the initiation phase of our SI examples, corresponding involvement is far less in the implementation phase. Although some SI processes in this study are led by local authority actors, these same actors work closely with members of the community to develop services that respond as effectively as possible to local needs and conditions. For example, *May I Help You*, *Rovaniemi Area Committee Model* and *Ramsjö Public Meals Programme* are SI examples of local authority actors initiating a process in which end-users are involved in a thorough needs assessment in order to develop new services.

The results show that partnerships reaching beyond the community are important when it comes to reaping the full benefit of social innovation, and that this is in line with previous findings which demonstrate that SI requires interaction between many actors (Howaldt et al., 2018:13). From the 18 SI examples in our study, the collaboration involved results in different legal forms – with eight establishing an association, six becoming social enterprises, two setting up as public-private co-operatives, and two becoming community development trusts. It is relevant to make a distinction between the initiation and implementation phases of SI activities. While there is a high influence of ‘civil society as community’ in the initiation phase, the ‘civil society as organisation’ is dominating the SI implementation phase.

Our analysis provides nuance to the picture, illustrating the variety of actors involved, as well as the importance of both the local public sector and social networks. The 18 SI examples demonstrate a similar trend across the Nordic countries regarding how the community-driven SIs are initiated and implemented. The actors involved in the process also illustrate a similar trend towards engagement. This implies that rural policy in all Nordic countries could benefit from enabling local actors to engage to a greater extent in regional, national and international networks. In several of the examples, the local authorities provided a supportive environment through education and training, with the aim of upskilling local people and providing access to spaces and infrastructure such as youth centres and community centres. This is the sort of thing that can help secure the legitimacy of SI initiatives, building that broader capacity and helping them thrive in the long term. Many SI examples rely on a few passionate individuals, and this entails a risk that must also be assessed as part of rural development policy. It is crucial to build up broad, local capacity to ensure that SIs continue to make a long-term contribution to a socially sustainable development.

6. Conclusions and implications

The contribution that this study makes is to provide a set of empirical examples illustrating a shift in the involvement of various actors in the initiation and implementation phases of community-driven SI projects. When considering all 18 SI examples from across the Nordic region, it would appear that civil society organisations play an important role throughout the process. During the initiation phase, however, our

^b L 148 Forslag til lov om registrerede socialøkonomiske virksomheder.

analysis illustrates a more nuanced type of co-operation, one that involves members of the community, civil society organisations and the local public sector as the primary actors working together to develop ideas, find resources and manage decision-making.

Most of the examples describe how members of the community band together to develop an idea, and as part of that process established an association, a co-operative, a social enterprise or a committee – depending on the national context and the setting. A multiplicity of legal forms are, therefore, observed in SI projects in the Nordic countries. The resources deployed vary among the examples. Some are completely based on voluntary work; some are dependent on public sector support; some source their income from consultancy (e.g. catering or other services), and some charge membership fees. Resources can also take the form of networks and social connections outside the community, which provide advice, funding and/or publicity.

The implications of the results of this study point towards the need to support the community's capacity to engage in collaborative processes. Social innovation in rural areas in the Nordic countries is initiated by relevant actors getting together to begin a cumulative process which produces a project to address a local challenge. The ideas from our SI examples are, to a large extent, developed by community members as a response to demographic change, such as an ageing and declining population, as well as service closures (or the threat of closure), local economic restructuring, and local authority mergers. As such, the examples illustrate how community-driven SI initiatives make a positive contribution to addressing specific challenges faced by rural areas across the Nordic countries.

Author declaration

We wish to confirm that there are no known conflicts of interest associated with this publication and there has been no significant financial support for this work that could have influenced the methods, theoretical framework, results and analysis, discussion or conclusion in the submitted article "Key actors in community-driven social innovation in rural areas in the Nordic countries".

We confirm that the manuscript has been read and approved by all named authors and that there are no other persons who satisfied the criteria for authorship but are not listed. We further confirm that the order of authors listed in the manuscript has been approved by all of us. We confirm that we have given due consideration to the protection of intellectual property associated with this work and that there are no impediments to publication, including the timing of publication, with respect to intellectual property. In so doing we confirm that we have followed the regulations of our institutions concerning intellectual property. We further confirm that any aspect of the work covered in this manuscript that has involved either experimental animals or human patients has been conducted with the ethical approval of all relevant bodies and that such approvals are acknowledged within the manuscript.

We understand that the Corresponding Author is the sole contact for the Editorial process (including Editorial Manager and direct communications with the office). He/she is responsible for communicating with the other authors about progress, submissions of revisions and final approval of proofs. We confirm that we have provided a current, correct email address which is accessible by the Corresponding Author and which has been configured to accept email from Leneisja.jungsberg@nordregio.org

Acknowledgement

This work was supported by the Nordic Working Group on Demography and Welfare, under the Nordic Council of Ministers' Committee of Senior Officials for Regional Policy; and also by the European Union's Horizon 2020 research and innovation programme (Nunataryuk project, grant agreement No. 773421).

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.jrurstud.2020.08.004>.

References

- Bærenholdt, Ole, Jørgen, 2002. Coping Strategies and Regional Policies - Social Capital in the Nordic Peripheries. Nordregio, Stockholm.
- Bernal, Avella, Leonor, 2019. Social Innovation Route: A Method to Innovate with the Territories. In: Ecosystem and Infrastructures for Social Innovation.
- Bock, Bettina, 2012. Social innovation and sustainability; how to disentangle the buzzword and its application in the field of agriculture and rural development. Stud. Agric. Econ. 114 (2), 57–63.
- Bock, Bettina B., 2016. Rural marginalisation and the role of social innovation: A turn towards nexogenous development and rural reconnection: rural marginalisation and the role of social innovation. Sociol. Rural. 56 (4), 552–573.
- Bosworth, Gary, 2010. Commercial counterurbanisation: an emerging force in rural economic development. Environ. Plann. A Econ. Space 42 (4), 966–981.
- Bosworth, Gary, Annibal, Ivan, Carroll, Terry, Price, Liz, Sellick, Jessica, Shepherd, John, 2016a. Empowering local action through neo-endogenous development; the case of LEADER in England: empowering local action. Sociologia Ruralis 56 (3), 427–449.
- Bosworth, Gary, Rizzo, Fulvio, Marquardt, Doris, Strijker, Dirk, Haartsen, Tialda, Thuesen, Annette Aagaard, 2016b. Identifying social innovations in European local rural development initiatives. Innovat. Eur. J. Soc. Sci. Res. 29 (4), 442–461.
- Cajaiba-Santana, Giovany, 2014. Social innovation: moving the field forward. A conceptual framework. Technol. Forecast. Soc. Change 82, 42–51.
- Caulier-Grice, Julien, Kahn, Lauren, Mulgan, Geoff, 2010. Study on Social Innovation. European Union, The Young Foundation, pp. 1–127.
- Cheshire, Lynda, Esparcia, Javier, Shucksmith, Mark, 2015. Community resilience, social capital and territorial governance. Ager 18, 7–38.
- Coffey, William J., Polese, Mario, 1984. The concept of local development: a stages model of endogenous regional growth. In: Twenty Third European Congress of the Regional Science Association, pp. 1–12.
- Copus, Andrew, Perjo, Liisa, Berlina, Anna, Jungsberg, Leneisja, Randall, Linda, Sigurjónsdóttir, Hjördís, 2017. Social Innovation in Local Development: Lessons from the Nordic Countries and Scotland. Nordregio, Stockholm.
- Crisan-mitra, Catalina, Borza, Anca, Razvan, Nistor, Bordean, O., 2011. Social entrepreneurs versus commercial entrepreneurs. In: Borza, A., Richter, C. (Eds.), Entrepreneurship in the Global Economy: Economics, Innovation, Competition and Social Change.
- Dubois, Alexandre, Kristensen, Iryna, Teräs, Jukka, 2017. Outsmarting geography: implementing territorial innovation strategies in sparsely populated regions. Eur. Plann. Stud. 25 (8), 1316–1333.
- Edwards-Schachter, Mónica, Tams, Svenja, 2013. How empowering is social innovation? Identifying barriers to participation in community-driven innovation.
- European Commission, Bureau of European Policy Advisors, 2011. Empowering People, Driving Change. Social Innovation in the European Union. Luxembourg Publication Office. European Commission.
- Fougère, Martin, Segercrantz, Beata, Seeck, Hannele, 2017. A critical reading of the European Union's social innovation policy discourse: (Re)legitimizing neoliberalism. Organization 24 (6), 819–843.
- Getimis, Panagiotis, 2012. Comparing spatial planning systems and planning cultures in Europe. The need for a multi-scalar approach. Plann. Pract. Res. 27 (1), 25–40.
- Grunfelder, Julien, Norlén, Gustaf, Randall, Linda, Gassen, Nora Sánchez, 2020. State of the Nordic region 2020. Nordic Council of Ministers.
- Harris, Michael, Albury, David, 2009. The Innovation Imperative - Why Radical Innovation is Needed to Reinvent Public Services for the Recession and Beyond. NESTA - National Endowment for Science, Technology and the Arts, pp. 1–32.
- Hörnström, Lisa, Perjo, Liisa, Johnsen, Ingrid HG., Karlsdóttir, Anna, 2015. *Adapting to, or mitigating demographic change?* Nordregio working paper.
- Howaldt, Jürgen, Kaletka, Christoph, Schröder, Antonius, Zirngiebl, Marthe, 2018. Atlas of social innovation. New practices for a better future. Eur. Commission Res. Innov. 1–245.
- Howaldt, Jürgen, Schwarz, Michael, 2017. Social innovation and human development—how the capabilities approach and social innovation theory mutually support each other. J. Hum. Develop. Capabil. 18 (2), 163–180.
- Knieling, Jörg, Othengrafen, Frank, 2009. Planning Cultures in Europe: Decoding Cultural Phenomena in Urban and Regional Planning/. Ashgate, Burlington, VT.
- Lang, Richard, Fink, Matthias, 2019. Rural social entrepreneurship: the role of social capital within and across institutional levels. J. Rural Stud. 70, 155–168.
- Lindberg, Malin, 2017. Promoting and sustaining rural social innovation. Eur. Publ. Soc. Innovat. Rev. (EPSIR) 2, 30–41.
- MacCallum, Diana, Haddock, Serena Vicari, 2016. In: Social Innovation and Territorial Development edited by F. Moulart. Routledge.
- Moulaert, Frank, Martinelli, Flavia, Swyngedouw, Erik, Gonzalez, Sara, 2005. Towards alternative model(s) of local innovation. Urban Stud. 42 (11), 1969–1990.
- Moulaert, Frank, Swyngedouw, Erik, Martinelli, Flavia, Gonzales, Sara, 2013. Can neighbourhoods save the city? Community development and social innovation. Int. J. Volunt. Nonprofit Org. 24 (1) <https://doi.org/10.1007/s11266-012-9297-6>.
- Mulgan, Geoff, 2007. Social Innovation, what it is, Why it Matters and How it Can Be Accelerated. Oxford, London.
- Neumeier, Stefan, 2012. Why do social innovations in rural development matter and should they be considered more seriously in rural development research? - proposal

- for a stronger focus on social innovations in rural development research. *Sociol. Rural.* 52 (1), 48–69.
- Neumeier, Stefan, 2017. Social innovation in rural development: identifying the key factors of success. *Geogr. J.* 183 (1), 34–46.
- Noack, Anika, Federwisch, Tobias, 2019. Social innovation in rural regions: urban impulses and cross-border constellations of actors: social innovation in rural regions. *Sociol. Rural.* 59 (1), 92–112.
- Nordic Council of Ministers, 2015. *Social Entrepreneurship and Social Innovation in the Nordic Countries: Initiatives to Promote Social Entrepreneurship and Social Innovation* (Copenhagen).
- Pestoff, Victor, 2012. *New Public Governance, Co-production & Third Sector Social Services*, 23.
- Ray, Christopher, 2006. Neo-Endogenous rural development in the EU. In: *The Handbook of Rural Studies*, pp. 278–291, 1 Oliver's Yard, 55 City Road, London EC1Y 1SP United Kingdom: SAGE Publications Ltd.
- Richter, Ralph, 2019. Rural social enterprises as embedded intermediaries: the innovative power of connecting rural communities with supra-regional networks. *J. Rural Stud.* 70, 179–187.
- Shucksmith, Mark, 2016. *Routledge International Handbook of Rural Studies*, first ed. Routledge, New York, NY : Routledge, [2016]:
- Shucksmith, Mark, David, L. Brown, 2016. *Routledge International Handbook of Rural Studies*, first ed. Routledge, New York, NY : Routledge, [2016]:
- Terstriep, Judith, Kleverbeck, Maria, Deserti, Alessandro, Rizzo, Francesca, Komatsu, Tamami, Pelka, Bastian, 2015. *Comparative report on social innovation across europe*, 215.
- Terstriep, Judith, Rehfeld, Dieter, 2014. *Social innovation biographies methodological guidelines*.
- Tietjen, Anne, 2017. Working with the backside of urban mobility: strategic design for rural decline. *Urban Mobil. Architect. Geograph. Soc. Space* 24, 45–68.
- Totterdill, Peter, Cressey, Peter, Exton, Rosemary, 2016. *SIMPACT SI POLICY TOOLBOX*.
- Totterdill, Peter, Cressey, Peter, Exton, Rosemary, Terstriep, Judith, 2017. *Stimulating, resourcing and sustaining social innovation*.
- Unceta, Alfonso, Castro-Spila, Javier, Fronti, Javier García, 2017. The three governances in social innovation. *Innovat. Eur. J. Soc. Sci. Res.* 30 (4), 406–420.
- Wilkinson, Charu, 2015. *A Map of social Enterprises and their eco-Systems in europe*. Luxembourg: European commission directorate-General for employment, social Affairs and inclusion.
- Wittorff Tanvig, Hanne, 2015. Når Lokalsamfund i yderområderne selv skal skabe mere udvikling - hvordan? Ministeriet for udlændinge, Integration og Boliger tidligere Ministeriet for by. Boliger og Landdistrikter 1–24.
- Ziegler, Rafael, 2017. Social innovation as a collaborative concept. *Innovat. Eur. J. Soc. Sci. Res.* 30 (4), 388–405.

Paper II

Title: *Local smart specialisation: An approach to increasing preparedness in rural communities with resource-based industries in the Northern Periphery*

Authors: *Leneisja Jungsberg, Lise Byskov Herlund, Kjell Nilsson, Karina Umander, Anna Kantola, Jukka Teräs, Ryan Weber*

Journal: *European Journal of Spatial Development*

Published: <http://norden.divaportal.org/smash/get/diva2:1499839/FULLTEXT01.pdf>

To cite this article: Jungsberg, L., Byskov Herslund, L., Nilsson, K., Umander, K., Kantola, A., Teräs, J., Weber, R. (2020). Local smart specialisation: an approach to increasing preparedness in rural communities with resource-based industries in the Northern Periphery, *European Journal of Spatial Development*, 71.
Available from: <http://doi.org/10.6027/EJSD2020:71.1650-9544>

Online publication date: November 2020

Local smart specialisation:

An approach to increasing preparedness in rural communities with resource-based industries in the Northern Periphery

Leneisja Jungsberg, Lise Byskov Herslund, Kjell Nilsson, Karina Umander, Anna Kantola, Jukka Teräs, Ryan Weber.

Abstract

A common challenge for Northern communities is how to retain local benefit from resource-based industries. This study assesses the process of developing a local smart specialisation strategy in two municipalities, Storuman and Sodankylä, both located in the Northern Periphery. The assessment framework applied is based on the concept of 'strategic dimensions' (Healey, 2009), along with a qualitative set of process and outcome criteria (Innes and Booher, 1999).

Our assessment of the strategic process indicates that all dimensions required for strategic planning were represented within it, but that they were mostly responsive rather than transformative in character. When comparing results from process criteria and outcome criteria, the process criteria score significantly higher. The strategic process engaged social networks and involved local stakeholders in discussion and joint prioritisation.

According to the participating stakeholders, the local smart specialisation strategies in Storuman and Sodankylä enhanced local preparedness. However, a significant limitation was a lack of long-term human and financial resources to address challenges in relation both to resource-based industries and local territorial development.

Keywords: *smart specialisation, local development, northern periphery, territorial challenges*

AUTHOR INFORMATION

Leneisja Jungsberg

Copenhagen University, Department of Geosciences and Natural Resource Management, Section for Landscape Architecture and Planning, Denmark; Nordregio, Stockholm, Sweden
Email: leneisja.jungsberg@nordregio.org

Lise Herslund Byskov

Copenhagen University, Department of Geosciences and Natural Resource Management, Section for Landscape Architecture and Planning, Denmark

Karina Umander

Project leader, Storuman municipality 2015-2018, Sweden

Anna Kantola

Project leader, Sodankylä municipality 2015-2018, Finland

Kjell Nilsson, Jukka Teräs, Ryan Weber

Nordregio, Stockholm, Sweden

1. Introduction

It is the abundance of natural resources in the Northern Periphery which attracts multinational companies engaged in resource extraction. Local economies are often dominated by large-scale industries extracting natural resources, which in turn influences opportunities for local territorial development (European Commission, 2016). Besides the lack of economic diversification, communities in sparsely populated areas of the Northern Periphery also face declining populations, land-use challenges, and a lack of adequate access to public services (Jungsberg et al., 2018; Knoblock and Pettersson, 2010).

The challenges of economic diversification, demographic change and conflicting interests around land-use have not been properly addressed before in the context of local smart specialisation (LS3). LS3s are concerned with smart specialisation as a bottom-up approach to regional innovation, and they are a cornerstone of the European Union's endeavour to guarantee territorial development opportunities for all regions (Garcilazo et al., 2010; Gill, 2010; Rönkkö and Aarrevaara, 2017). Developing smart specialisation strategies (S3) is also a core part of the European Union's policy with regard to regional growth and prosperity (European Commission, 2018).

A local smart specialisation strategy differs from a regional one by working closely with the local authority (i.e. the municipality) in order to engage community stakeholders in building preparedness to deal with, for example, resource-based industries that benefit from the abundance of natural resources in their area (Copus et al., 2016; Teräs et al., 2018). Preparedness is highlighted as a priority in the European Union's Northern Periphery and Arctic Programme (European Commission 2016). In this context, preparedness is defined as the ability to plan for local development in a way that addresses territorial challenges and adopts a strategic approach to retaining benefits from resource-based industries operating in the area (ibid). Regions in the Northern Periphery are vast in size, with municipalities encompassing both coastal and inland settlements, as well as mountainous settlements near to mining activities. Some municipalities even cover the size of a whole European country, which makes the 'local' aspect even more important. Within a regional perspective, it is harder to reach the same level of in-depth territorial analysis and collaborative engagement as it is when the focus is on a local setting.

However, there is insufficient research that concentrates on examining the theoretical application of smart specialisation in a local context. There have been some studies focussing on local strategies for tourism development (Olsen et al., 2016; Sisneros-Kidd et al., 2019), as well as reviews and recommendations regarding benefit-sharing agreements in relation to natural resource extraction (Suutarinen, 2015; Tysiachniouk et al., 2018), environmental and legal perspectives (Tolvanen et al., 2019), and social licenses for mining, including impact assessments of resource-based industries (Arruda Gisele M., 2017; Stammer and Ivanova, 2016; Tarras-Wahlberg, 2014). However, this has not included research focusing specifically on local strategic responses to territorial

challenges. The objective of this paper is to fill that gap by examining how Storuman Municipality (in Northern Sweden) and Sodankylä Municipality (in Northern Finland) worked on their local smart specialisation strategies (LS3s). Strategic plans for resource-based industries exist on a national and regional level in both Sweden and Finland (Jokelainen et al., 2013; Nurmi, 2011; Österberg et al., 2016; Regeringskansliet, 2015), but not on a local or community-based level.

The LS3 process in each area, which lasted for three years, was funded by the EU Interreg Northern Periphery and Arctic Programme. However, when external funding ended, Storuman and Sodankylä ceased their activities. One critical question concerns whether this process created any real local preparedness in a long-term perspective. Studies indicate there has been an increase in the number of strategies produced (Albrechts, 2001; Gunder et al., 2018, p. 15; Healey, 2009). However, it is unclear whether any of these strategies has resulted in a substantial impact – other than in ensuring formal compliance from EU and national government funding bodies in order to attract more finance, or to meet regulatory requirements (Healey, 2009). The risk of strategic plans becoming merely a matter of complying with a set of regulations to attract funds, rather than producing any real impact, has provided a key motivation for studying the outcome of the three-year strategic planning processes carried out in Storuman and Sodankylä. The objective is to assess both the development process and outcome of a local smart specialisation strategy (LS3). In particular, it is about understanding how, and to what extent, the LS3 can:

- strengthen local preparedness to manage resource-based industries.
- meet core challenges related to demographic change, land use and local economic development in the Northern Periphery.

2. Territorial challenges and strategic planning in the Northern Periphery

Since the 1980s, strategic planning in rural and peripheral areas has been used to protect and utilise natural resources, to balance conflicting land-use demands, and to improve conditions for individuals and companies engaged in local economic development activities. The wide range of issues involved, along with the scarcity of resources, demands a strategic approach (Cigler et al., 1993). One challenge for many rural and peripheral localities is the separation that exists between what is called ‘the space of flows’ and ‘the space of place’ (Castells, 2007). ‘The space of flows’ links people, companies and authorities in different places through interactive web-based and mobile economic networks. In the ‘space of place’, local activities and human interaction are central. Along with globalisation, the space of place has, in several instances, become disconnected from the space of flows. This can lead to manifest tensions, for example when a large-scale resource-based industry extracts value from a place without any recognisable economic gain returning to the local community.

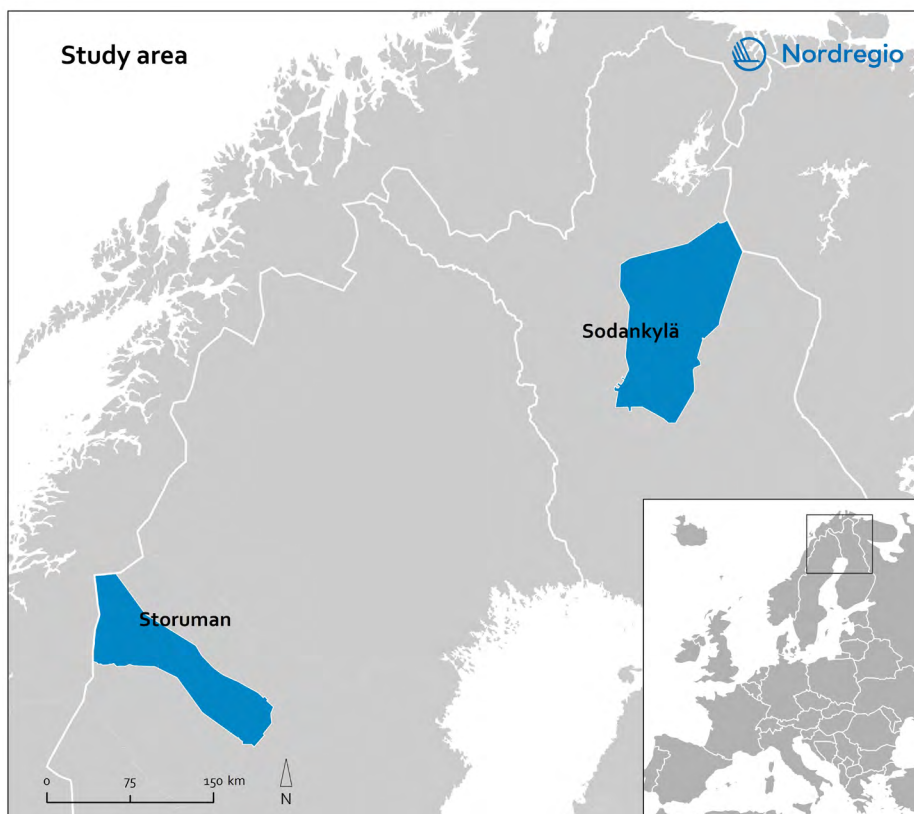
For rural and peripheral communities, development is dependent upon both endogenous (bottom-up) and exogenous (top-down) resources (Cheshire et al., 2015). This discovery has led to the development of the concept of neo-endogenous development, which combines local assets with external relationships and resources (Shucksmith and Brown, 2016). Effective external relationships with the public and private sectors can empower rural localities, decreasing the marginalisation of both rural and peripheral communities (Bock, 2016; Primdahl et al., 2018; Shucksmith and Brown, 2016).

Strategic planning must therefore deal with the ability of communities and regions to create neo-endogenous development by managing to operate within the space of flows, as well as through participating and cooperating in transnational (or even global) networks. This helps to ensure that the local community can profit from resources originating from the space of place (Castells, 2007). To manage these global changes and to include them in local planning, it has become common practice to launch a project tackling this specific issue, with the hope that prosperity can be created in rural and peripheral communities (Fred, 2018).

The word 'strategic' implies that certain decisions and actions are more important than others. A large part of 'the strategic process' involves making tough decisions. These are decisions about those actions which are most important for responding effectively to problems, challenges, aspirations, and diversity (Healey 2009). At the core of strategic planning is prioritisation, simply because it is impossible to do everything at once. In this paper, strategic planning is defined as the coordination of activities, practices and policies affecting spatial organisation in rural areas.

2.1 Study area

The study area consists of two municipalities – Storuman, in Sweden, and Sodankylä, in Finland (see Map 1). They are both located in the Northern Periphery and both face similar challenges concerning population change in recent decades – including the proportion of the population with higher educational experience, the gender ratio, and old-age dependency. This is the case in Storuman and Sodankylä, along with many of their neighbouring municipalities.



Map 1: Geographic location of Storuman Municipality in Sweden and Sodankylä Municipality in Finland.

2.2 Key indicators for Storuman and Sodankylä

Key demographic indicators for Storuman and Sodankylä (see Table 1) indicate that the two municipalities have experienced a decrease in population of 14.7 % and 14.9%, respectively, since 2001. Both municipalities are sparsely populated, with their dispersed populations living in villages or in the main town.

Employment rates are high, at 83.5% in Storuman and 74.6% in Sodankylä in 2018. Average disposable household income per annum was €28,456 in Storuman and €29,882 in Sodankylä in 2017. The gender ratio is skewed for Sodankylä, with 91 females per 100 males. For Storuman, on the other hand, it is slightly more balanced, with 94 women per 100 men.

Meanwhile, the old-age dependency ratio is 50% in Storuman and 43% in Sodankylä. This high old-age dependency ratio, along with a low proportion of the population possessing a higher education, is common among many of the municipalities in the Northern Periphery. That is a particular challenge which needs to be addressed when considering how to meet the needs of the local labour market. Future demographic development will therefore need to look at the question of how to achieve a balanced age profile, and also how to focus on becoming an attractive place to live and work – especially for young women. Both are necessary if the two municipalities are to achieve social sustainability.

Indicator	Definition	Storuman (SE)	Sodankylä (FI)
Total Population	Number of persons as of 31 st Dec 2018	5,912	8,444
Population density	Inhabitants per km ²	0.82	0.76
Population change 2001-2018	2018 as a % of 2001 (% change)	14.7% decrease	14.9% decrease
Employment	Registered employees 2018	83.5%	74.6%
Household income	(Disposable income one year, Euros, 2017)	28,456	29,882
Gender Ratio	Number of females per 100 males, 2018	94.2	90.9
Education equivalent MSc	Share of population with ISCED 5 or above, 2018	29.2%	23.8%
Old age dependency ratio 2018	Population aged 65 and more, as a proportion of the population aged 15-64 years	50%	43%

Table 1: Key socio-economic indicators for Storuman Municipality in Sweden and Sodankylä Municipality in Finland.

2.3 Storuman municipality

Storuman Municipality is located in Västerbotten county and covers an area of 8,234 km². This makes it one of the ten largest municipalities in Sweden. It is also among those with the lowest population density. There are eight hydroelectric power stations in Västerbotten, along with one windfarm, one working mine, and several other mining projects in the prospecting and remediation phase. In addition to large-scale, resource-based extractive industries, the main land use activities are agriculture, forestry, reindeer herding and fishing. The Sámi people also have a right to pasture, hunting and fishing in certain areas. While the western part of the municipality consists of mountainous landscape and mostly comprises small enterprises relying on tourism, the eastern part consists more of forests and agricultural landscape. Here companies are primarily involved in energy production, small scale engineering and the service sector. Forestry and the processing of forest products, as well as public services, is also important for the municipality.

2.4 Sodankylä Municipality

Sodankylä municipality is located in Finnish Lapland and covers a territory of 12,417 km², of which approximately 800 km² is water. The municipality has a population density of only 0.7 inhabitants per km². However, of the total municipal population of 8,000, approximately 5,000 live in the town Sodankylä. There are several mining projects in Sodankylä. Kevitsa Mine (nickel and copper) is operated by Boliden. It provides 400 jobs and is located 40 km north of the town. Pahtavaara Gold Mine is on standby at the moment. Finally, there is Sakatti, which has a copper-nickel-platinum deposit located under a Natura 2000 (a protected area within the EU). Approximately 35 employees work at Sakatti, and the mine is located 15 km north of Sodankylä. There are plans to expand this mine further, and to increase the number of

workers there. The military, science and research, the bio-economy (including agribusiness), tourism and reindeer herding all provide jobs in Sodankylä. The northern parts of the municipality belong to the Sámi homeland, and there are approximately 23,000 reindeer in this area.

2.5 Indigenous people in Sodankylä and Storuman

Sámi people live across the northern parts of Norway, Sweden and Finland, as well as the Kola Peninsula within the Murmansk Oblast, Russia. In the northern part of Sodankylä Municipality, the reindeer herding area is protected under section two of the Reindeer Husbandry Act. This act states that “land in this area may not be used in a manner which may significantly hinder reindeer herding” (Sodankylä Municipality, 2018). The official position of Sodankylä Municipality is that it takes note of what the law says about the Sámi homeland, and evaluates mining projects individually, utilising the corresponding perspectives of social, economic and environmental sustainability.

In the municipality of Storuman, the Sámi people’s right to land for reindeer herding is influenced by a system of parallel land use rights, through which forestry, mining activities and reindeer herding all occupy, and compete for, land allocation. However, it is difficult for either party to receive compensation in cases where there is a lack of access to land, and there are historically rooted tensions between using land for industrial activities and the needs of Sámi people for reindeer herding in the area (Storuman Municipality, 2018).

3. Framework: How to assess a strategic plan?

A strategic plan can be assessed by examining its different dimensions (see Figure 1). The strategic dimensions involved are interactive, rather than following a specific sequence. Each dimension represents important steps for implementing the strategic plan (Healey, 2009). Skilled practitioners know that strategic planning requires sensitivity to contingencies, rather than being a routine production that responds to external demands (Albrechts, 2006, 2001; Healey, 2009). Healey (2009) conceptualises the key difference as a responsive plan vis-à-vis a transformative strategic plan. While responsive strategy-making

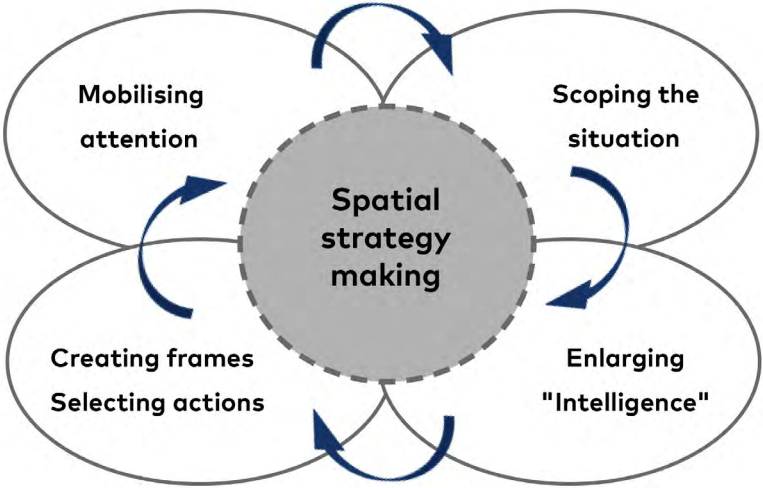


Figure 1: Dimensions of spatial strategy-making (Healey, 2009:442).

involves drawing on generalised approaches or accepted methodological protocols, a transformative strategy will build upon the specifics of local momentum (Healey, 2009). Each dimension of the plan can therefore have a transformative capacity, or else can be primarily responsive in character, or can combine the two features to some degree.

Mobilising attention is the dimension which focusses on communication about why and how strategic work should take place. It is important to raise motivation among different actors in order to get them involved. In responsive strategy-making, the focus is on aims, values, and directions; whereas transformative strategy-making requires flexibility in order to re-orientate attention towards those issues which could otherwise have been neglected.

The dimension known as scoping the situation focuses on the background to the strategy, namely what is at stake, and for whom. It is also focused on setting purposeful goals for the local area. In responsive strategy-making, this dimension identifies what goals the agency can achieve, whereas the transformative approach focusses on where the energy for change is, and the corresponding possibilities of building further coalitions to expand and develop this energy.

The next dimension, enlarging intelligence, brings fresh knowledge into the picture, in order to enrich strategy work and the resources available for it. In responsive strategy-making, this dimension summarises what is already known, while in transformative strategy-making it explores multiple knowledge sources, recasting agendas for particular problems, as well as potential actions and the stakeholders involved.

A final and key dimension is creating frames and selecting actions which are focused on making active priorities, with the purpose of generating the power needed to shape future direction. In responsive strategy-making, this part of the work involves finding a way to provide an expression of coherence for the benefit of other dimensions. For the purposes of transformative strategy-making, it articulates ideas on the basis of which specific issues can be prioritised for action.

All these dimensions are relevant when assessing the LS3s in Storuman and Sodankylä. However, to complement an assessment of strategic dimensions, this paper also brings in criteria for addressing both the process and outcome components of a strategic plan. What is involved in the process and outcome components is developed by Innes and Booher (1999), building on research in consensus-building, complexity science, and communicative rationality. There are, in total, seven process criteria and eight outcome criteria (Innes and Booher, 1999).

Figure 2 illustrates an interpretation of the connection between Healey's strategic dimensions and Innes and Booher's process and outcome criteria. The arrows illustrate the similarities between a criterion and a strategic dimension in terms of its content and focus. The process criteria focusing on 'shared purpose', and 'engage participants' resonate with activities in the strategic dimension for 'mobilising attention', because they focus on creating the kind of momentum

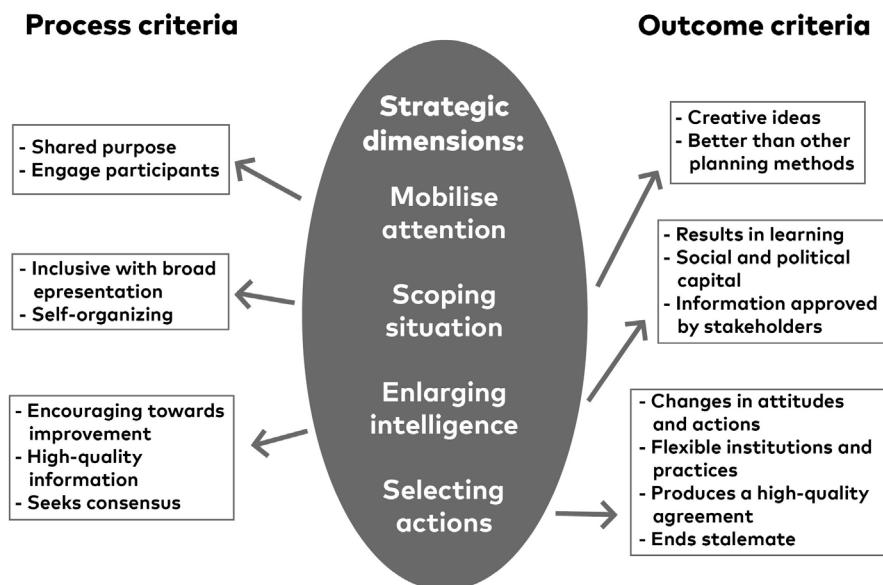


Figure 2: The author's interpretation of the connection between strategic dimensions (Healey), process criteria and outcome criteria (Innes and Booher).

which motivates people towards participation. The strategic dimension focussing on 'scoping the situation' corresponds with the process criteria for 'inclusive with broad representation' (with representatives of all relevant and significantly different interests) and 'self-organising', which allows 'participants to decide on ground rules, objectives and tasks'. This is because of the joint focus on representation and organisation (Innes and Booher, 1999). In terms of content, 'scoping the situation' is also connected to the outcome criteria for 'creative ideas' and 'better than other planning methods' – which means that the LS3 is measured according to whether it compares favourably in terms of a cost/benefit analysis.

Knowledge is a key part of strategy-making, and it is represented through the strategic dimension of 'enlarging intelligence'. There are three process criteria connected to this dimension. 'Encouraging towards improvement' means that the status quo is challenged; 'high-quality information' means incorporating good quality information of many types, and ensuring agreement over meaning. Finally, 'seeks consensus' focusses on exploring all issues and interests before finding and agreeing on the way forward (ibid).

The outcome criteria for 'enlarging intelligence' are focussed on knowledge-building. 'Results in learning' prioritises the need for learning to be happening even beyond the group. 'Social and political capital' emphasises the importance of creating a new shared understanding, and engendering trust in the process of collaboration. The criterion of 'information approved by stakeholders' brings us to the realisation that information needs to be approved, understood and accepted by stakeholders locally in order to be valid (ibid).

The final strategic dimension, 'selecting actions', is related to four outcome criteria. The first, 'changes in attitudes and actions', can be connected to new spinoff partnerships, along with new practices and/or new institutions. The second, 'flexible institutions and practices', entails understanding that institutional practices are connected to local networks, thereby permitting a joint response to change and conflict.

The third, 'produce high quality agreement', is oriented towards a way forward which actively induces change. The fourth, 'ends stalemate', is action-oriented, in terms of seeking to change a deeper-rooted conflict.

The strategic dimensions of 'scoping the situation' and 'enlarging intelligence' both relate to some process criteria and some outcome criteria. While these strategic dimensions provide a picture of both the important focus areas and the content of strategic planning, the criteria (divided into process and outcome) bring additional nuances to the two dimensions.

In this paper, both the criteria and the dimensions are used to assess the quality of LS3 activities carried out in Storuman and Sodankylä. A strategic plan is not only about producing an agreement. It is also an exercise in experimentation, learning, willingness to change, and consensus-building. Applying the process and outcome criteria together with the strategic dimensions for our assessment of LS3s in Storuman and Sodankylä also reflects and emphasises the fact that both process and outcome have value.

4. Materials and methods

'Materials' consists of those activities carried out during the LS3 process (Table 2). The table presents these activities organised as part of the six steps involved in carrying out the LS3. Different participants were involved for each activity. In the first step, 'assessing the current situation', the local project leader and research partners carried out a documentary analysis of existing strategies. Step two, 'opportunities, challenges, and a vision', engaged participants from the public, private and third sectors in bringing a variety of perspectives to bear on the most important priorities for local development. In step three, 'foresight analysis', researchers collaborated with a local project leader and community members in order to conduct an analysis of population projections and the potential impact of new mining projects. As part of step four, 'planning and monitoring', a survey was carried out so as to gather community members' perceptions about the local impact of extractive industries. For Geographic Information System (GIS) activities, it was municipal employees working with land-use planning who took part. In 'local benefit retention', it was entrepreneurs and small and medium enterprise (SME) representatives who participated in the development of priorities for the business community. For the final step, 'policy options', meetings and dialogues were organised with municipal management. In Sodankylä, the local steering committee reviewed results from those elements of the strategy process concerned with priorities and policy options.

The methods applied in relation to activities involved in the LS3 process included desktop studies, qualitative information, and quantitative data gathering. The qualitative component consisted of workshops with community members, semi-structured interviews, and informal conversations. The quantitative element involved processing population data and material from questionnaires answered by more than 400 people Storuman and Sodankylä.

Table 2: Activities carried out through LS3 in Storuman and Sodankylä.

LS3 step by step	Storuman		Sodankylä	
	Activities	Participants	Activities	Participants
Curent situation	Document analysis of existing strategies	Local project leader and researchers	Document analysis of existing strategies	Local project leader and researchers
Opportunities, challenges and a vision	Community workshop discussing opportunities, challenges, and a local vision	Approx. 20 participants incl. representatives from public, private and third sector, local people from associations etc.	Three community workshops discussing local impacts, and outline of mining programme	Approx. 30 participants representing, mining companies' local representatives, local people, local associations, local public sector etc.
Foresight analysis	Demographic analysis and forecast model for opening a new mine and qualitative interviews	Local project leader, community members and researchers	Demographic analysis and forecast model on impact of opening a new mine	Local project leader, local planners and researchers
Planning and monitoring	GIS analysis, Harava planning, questionnaire on social impacts	Local project leader, questionnaire with 217 community members	GIS analysis, Questionnaire on social impacts	Local project leader, 200 community members, researchers
Local benefit retention	Local Benefit Retention Analysis and stakeholder workshop	Local project leader, 16 representatives from private sector	Local Benefit Retention Analysis and stakeholder workshop	Local project leader, senior researcher and 10 entrepreneurs/ industry representatives, and 5 from municipal development projects
Policy options	Dialogue and 2 meetings on recommendations and implementation	Municipal management, local project leader	2 meetings concerning key findings and recommendations	REGINA Local Steering Committee, municipal management team, municipal board, municipal council

The authors participated in developing the workshop format, the questionnaires, the interview guides, and policy guidance. This guidance provided the foundation for collecting all the materials required. Participants in community workshops were carefully selected to represent the municipality in terms of age, gender and occupation. There was also an attempt to ensure that particular representative groups – such as community members, local school representatives, Non-Governmental Organisations (NGOs), indigenous people, business representatives, public employees, the unemployed and elderly people – were all included (Nordregio et al., 2017).

The information on ‘activities and participants’ in Table 2 is the primary material used to assess the LS3. In addition, two interviews were conducted with the two municipal managers, both before

and after the LS3 process. The focus of these interviews was on demographic challenges, stakeholder involvement, land-use planning, and managing the risks involved in new investments in resource-based industries. Altogether, the information from interviews and ‘activities and participants’ were used as to assess the strategic dimensions, the process and the outcome of the LS3. This approach to assessment builds on Healey’s four strategic dimensions, followed by Innes and Booher’s process and outcome criteria.

The focus of assessment is on the activities carried out and the participants joining in as part of the LS3. While the two supplementary interviews are of great value in understanding local perceptions, the activities analysis provides information about specific actions taken locally. With this combined approach, the LS3 can be assessed in terms of its local impact in increasing preparedness and can be measured by activities carried out as part of the six steps.

5. Results: LS3 in Storuman and Sodankylä

The LS3 was developed as part of a €1.2 million research project. The participants in the project were municipalities, regional authorities and research partners from Scotland, Norway, Greenland, Sweden and Finland. The researchers were specialists in the areas of regional development, land use, planning and demography.

5.1 Assessment of the strategic dimensions of LS3

Our assessment is based on the material presented in Table 2 – but in a more elaborated format, structured according to each strategic dimension.

Mobilising attention focusses on communication about why and how strategic work is carried out (Healey, 2009). In LS3, the ‘why?’ is about enhancing preparedness in dealing with local territorial challenges and resource-based industries. This ‘why?’ was established by the two municipalities deciding to participate in a project consortium and applying for funding from the Northern Periphery and Arctic Programme. The main reasons for applying set out by the two municipalities were that they had both been facing demographic challenges (with shrinking and ageing populations), as well as facing existing and potential land-use tensions between the mining industry, reindeer herding and outdoor recreation. The ‘how?’ is essentially framed by the six-step process in the LS3 (see Table 2). There has been a continuous process of sharing ‘why?’ and ‘how?’ questions as part of the municipalities’ communication to their citizens, via their websites.

In Sodankylä, communication was focussed on engaging stakeholders. They became involved through receiving an official invitation to participate in step two, ‘opportunities, challenges and a vision’, from the municipality. The project leader also followed up with personal phone calls, underlining the importance and benefits of participation to invited stakeholders. There were also articles in local newspapers, and cooperation with the municipality’s communications department. Factsheets, working papers and information about the activities in step four, the

social impact questionnaire, were shared on the municipal website.

In Storuman, their outreach activities were conducted through the local newspaper and via social media. The local questionnaire looking at the social impact of mining attracted a good deal of attention, in particular, with many comments being made about it on Facebook. A significant number of people were concerned that the municipality was using the survey to legitimise further mining projects. Many of those who expressed their views hoped that the municipality would listen to local people and recognise their concerns about opening new mines (Umander et al., 2017).

Both municipalities communicated about the aims, values and direction of their strategic work. They ran multiple outreach activities and were flexible in terms of their willingness to re-orient aspects of the process appropriately. One example comes from the period when the social impact questionnaire began gaining a considerable amount of attention in Storuman. In that context, the municipality made a real effort to reply to local concerns and to address them through their communications channels.

Despite those elements of flexibility in the interaction with the local population, and an orientation towards issues that could otherwise have been neglected, most of the activities involved in mobilising attention for Storuman and Sodankylä proved both responsive and transformative during the LS3 process. However, when the project ended, no specific resources were allocated to encouraging attention towards policy recommendations which should be a prioritised in future.

Scoping the situation focussed on the background to the strategy, and what is at stake, for whom (Healey, 2009). The activity in step one of the LS3 was to conduct a document analysis of existing strategies, in order to position their contribution in relation to the LS3 as a whole. Local project leaders collaborated with researchers in summarising local governance and planning practices, demographic situations and current trends, land-use patterns, and the structure of overall economic activity in both municipalities (Sodankylä Municipality, 2018; Storuman Municipality, 2018). The document analysis provided a thorough description of the current situation, ensuring that the LS3 process was coordinated with, and offered support to, existing strategies for both Storuman and Sodankylä.

The activity in step two was a community workshop involving approximately 20 participants from the public and private sectors, as well as from civil society. The focus of the workshop was on securing input into the LS3 strategy process by discussing opportunities, challenges, and local visions. After thorough discussion, participants voted on the three most important opportunities and challenges. The results are listed in Table 3.

The activities in steps one and two provided information for the strategic dimension of 'scoping the situation'. Input comprised a review of existing strategies and a community workshop to understand what is at stake, and for whom. All the opportunities and challenges agreed upon were used as input for the next steps. In Storuman, the most important

	Storuman Municipality	Sodankylä Municipality
Opportunities	<ul style="list-style-type: none"> - Use of natural resources - Training and education - Local cooperation 	<ul style="list-style-type: none"> - New jobs - More work for small businesses and service providers - Vocational education
Challenges	<ul style="list-style-type: none"> - Outmigration - Poor infrastructure - Lack of skills and competences 	<ul style="list-style-type: none"> - Environmental risks - Lack of information - Impact on reindeer herding - To attract people to move there

Table 3: Opportunities and challenges identified in Storuman and Sodankylä.

opportunities were seen to be utilising locally available natural resources better, developing local training and educational opportunities, and improving local cooperation among stakeholders across the municipality. The most important (multi-pronged) challenge identified was the fear that outmigration would lead to depopulation, poor infrastructure, and a lack of requisite skills and competences. For Sodankylä, the most important opportunities agreed upon were jobs for young people and newcomers, more work for small businesses and local service providers, and the development of vocational education services throughout the municipality. The most important challenges were various environmental risks, including the need to secure readily understandable information about the impact on significant water reserves (e.g. Kitinen River), the effect on reindeer herding and the meat produced from it, and how to attract people to the municipality. Following the community workshop, the energy for change (that is for achieving the agreed opportunities, and for mitigating the principal challenges) was mainly driven by the local project leader rather than by community members themselves. This implies that a transformational focus was not used to build the kind of coalitions which could expand and develop beyond the workshop itself.

Enlarging intelligence was about bringing in new knowledge through cooperation between the local project leaders, researchers, local people, and planners. Knowledge was generated in three focus areas. These corresponded to the three territorial challenges – demographic change, land-use planning, and local economic development.

Population decline has been a particular concern among stakeholders in both Storuman and Sodankylä (see Table 1 and Table 3). This provided the motivation for an analysis of future population projections, and the potential impact on population growth of establishing new resource-based industries in the area (Copus, 2017). That, in turn, led to a foresight analysis, focussing on demographic projections. The results indicated a decline in population towards 2040, and the potential impact on population growth of an ‘employment shock’ (in the form of a sharply increased demand for labour) if the establishment of new resource-based industries was limited in both municipalities (Jungsberg et al., 2018; Nordregio, 2018). Analysis indicated that a new mine would not, in itself, change a negative population trend. For that reason, it is therefore important to work on a variety of measures to address outmigration, too.

The **planning and monitoring** component of the LS3 focussed on approaches to resolving land-use tensions brought about by industrial development. It included a questionnaire for the public about the social impact of resource-based industries (Suopajärvi and Kantola, 2019; Weber et al., 2017). The results of this survey showed that resource-based industries are widely accepted in Sodankylä (85%), while in Storuman, fewer than one-third (30%) of residents favoured such activities (Suopajärvi et al., 2019). In Sodankylä, the majority of respondents said that resource-based industries had improved local services, as well as education, work, and career opportunities for local people (Suopajärvi and Kuisma, 2017). In Storuman, on the other hand, many local residents were concerned about environmental degradation – such as losing the opportunity to hunt, fish and pick berries. A previous environmental disaster involving a mine in Svärträsk/Blaiken might have contributed towards a greater reluctance about, or negative attitude towards, resource-based industries (Umander et al., 2017). In addition to questionnaires, local planners in Storuman and Sodankylä worked with the GIS (Geographic Information System). The planners also tested Harava¹, an online map-based survey tool allowing local residents to voice their opinions about different areas within the municipality. This tool makes it possible for planners to engage with local stakeholders earlier in the planning process, rather than through traditional public consultation at a later point. Despite an interest in testing Harava and GIS, regular procedures for land-use planning were not changed either in Storuman or in Sodankylä in the end. Since it is an institutional decision to alter such practices, it would have required municipal managers to agree upon this change in procedure.

The knowledge gathered to address territorial challenges concerned with diversification of the local economy was derived from a Local Benefit Retention Analysis. This is a set of guidelines supporting local business development and entrepreneurship (University of Highlands and Islands and Nordregio, 2018). In Storuman, representatives from small and medium-sized enterprises (SMEs), entrepreneurs and private sector employees worked with the guidelines toolbox. Through this work they identified the need for more investment in both the eastern Storuman and western Tärnaby areas. In the Storuman area, analysis indicated that the municipality's experience with large-scale projects (and increasing global demand for raw materials) meant that the recommended investment priority should be in large-scale raw material extraction. In the Tärnaby area, analysis showed that investment was needed in transport links and infrastructure, with a principal focus on the ferry-line between Vasa and Umeå and the airport in Mo I Rana (Storuman Municipality, 2018).

In Sodankylä, results from the Local Benefit Retention Analysis concentrated on the importance of developing the municipality's attractiveness as a brand, on furthering local cooperation, and on harvesting synergies between local companies and the mining industry. Private sector representatives emphasised that the strengths of the area included infrastructure, and the competence and know-how arising from local

Arctic conditions. Finally, particular emphasis was given to the importance of ensuring that the actors involved in local development are active and collaborative (Sodankylä Municipality, 2018).

For the strategic dimension of Enlarging Intelligence, responsive strategy-making mostly summarises what is already known, whereas transformative strategy-making explores multiple knowledge sources to recast agendas around particular problems. In Storuman and Sodankylä, the Enlarging Intelligence components were mostly transformative in character. The activities in steps three, four and five analysed multiple knowledge sources and brought new insights into play in order to mitigate the three territorial challenges of demographic change, land-use planning, and local economic development.

Creating frames and selecting actions was, and is, about the mobilisation and enrichment of resources which can shape future directions and actions (Healey, 2009). In Sodankylä, the Municipal Board decided to use the mining programme, which was developed as part of the LS3, to guide future direction. The mining programme is a policy instrument which sets guidelines and goals for local development in relation to specific mining projects. It is the result of a stakeholder process enacted jointly by the municipality, mining companies and other stakeholders, with the aim of establishing common objectives. The Local Steering Committee was constantly involved in helping to guide this work, and it provided immediate feedback on results from the workshops. The guidance was also supported by an ongoing dialogue between the municipal management team (department heads) and the municipal board. The mining programme now serves as a foundational instrument for negotiating future agreements on mining activities (Sodankylä Municipality, 2018).

In Storuman, the local project leader communicated regularly with municipal management, and facilitated several meetings as part of step six, policy options. The final recommendations guiding decisions about future direction emphasised the importance of education – both in terms of local upskilling, but also in relation to attracting qualified labour and investment in the direction of new, resource-based industrial projects. Also mentioned as being important was regular use of a participatory land-use planning tool to improve citizens' and other local actors' opportunities to influence the planning process. Work on ensuring adequate preparation can now proceed, with the focus on the municipal organisation as a means of achieving an understanding of the different interests involved in resource-based industries, and how to navigate these differences both within the organisation and among citizens living in the municipality (Storuman Municipality, 2018).

When comparing Sodankylä and Storuman, there is a clear difference between their respective approaches to shaping future direction. In Sodankylä, the municipal board decided, at an early stage in the LS3, to develop a mining programme to support local preparedness. This mining programme continued to guide cooperation between private companies, the local public sector and civil society after the LS3 process had ended. In Storuman, on the other hand, the management team

found it adequate simply to follow the step-by-step process and to create frames and priorities as part of step six, policy options. However, the recommendations developed in the LS3 were not included in Storuman Municipality’s strategic plan for 2020-2023 (Storumans Kommun, 2019). The lack of coherence and transferrable actions is the result of this non-inclusion of the LS3 process in the strategic plan. It indicates a weak transformative dimension in creating frames, selecting actions for Storuman. By contrast, Sodankylä is now in a stronger position in making its LS3 transformative, because its mining programme continues to guide collaboration between the municipality, mining companies, and civil society.

5.2 Assessment of the LS3 process in Storuman and Sodankylä

This section focusses on the quality of the activities carried out as part of the LS3 process. Table 4 summarises the results for Storuman and Sodankylä in relation to each process criteria, based on Innes and Booher’s framework for evaluating collaborative planning (Innes and Booher, 1999).

Process Criteria	Storuman	Sodankylä
‘Includes representatives of all relevant and significantly different interests’	Yes	Yes
‘Is driven by a purpose and task that is real, practical, and shared by the group’	Yes	Yes
‘Is self-organising, allowing participants to decide on ground rules, objectives, tasks, working groups, and discussion topics’	Partly	Partly
‘Engages participants, keeping them at the table, interested, and learning through in-depth discussion, drama, humour, and informal interaction’	Yes	Yes
‘Encourages challenges to the status quo and fosters creative thinking’	Partly	Partly
‘Incorporates high-quality information of many types and assures agreement on its meaning’	Yes	Yes
‘Seeks consensus only after discussions have fully explored the issues and interests and significant effort has been made to find creative responses to differences’	Yes	Yes

Table 4: Achievements from the local smart specialisation strategies (LS3) process in Storuman and Sodankylä.

Storuman and Sodankylä achieved similar results for all the process criteria. Four criteria were fulfilled, and two were partially fulfilled. The criteria involving ‘relevant representatives’, ‘engage the participants’, and ‘seek consensus based on fully explored issues and interests’ are connected to the careful selection of, and interaction with, stakeholders joining the process. Participation was broad, and all relevant stakeholders were represented in the discussions. Together with research partners, the local project leaders carefully incorporated all perspectives within the scope of the stakeholder dialogue, as part of the second LS3 step, ‘opportunities and challenges’. In this dialogue, conflicting interests expressed by representatives of the Sámi people and the mining industry were raised. In Storuman, three Sámi representatives joined the discussion, but two of them only participated for part of the day (Storuman

Municipality, 2018). In Sodankylä, the Sámi Parliament (Sámediggi), the self-governing body of indigenous Sámi people in Finland, was invited to join the process. They sent a letter saying that they were not prepared to accept mining in their area. The rights of the Sámi people were recognised, and there was a commitment from the municipality to following what the legislation in Finland and Sweden says about Sámi land. During the discussions in Storuman and Sodankylä, several comments were made about the Sámi people's special rights regarding land use (Sodankylä Municipality, 2018; Storuman Municipality, 2018).

For the criteria about 'having strategy process driven by a purpose' and to 'incorporate high-quality information of many types', the connection is with the strategic dimension of the 'why?' question, along with local territorial challenges faced by Storuman and Sodankylä. In the first LS3 step, a review of existing local and regional strategies was carried out and complemented by an overview of key indicators for the two municipalities (Sodankylä Municipality, 2018; Storuman Municipality, 2018). Material from this review was also used for presentations at community workshops. Throughout these community workshops, everyone involved was encouraged to provide input. All proposals were then discussed – before a vote took place to identify the issues that needed to be prioritised.

The two criteria of 'self-organising, allowing participants to decide on ground rules, objectives, tasks, working groups, and discussion topics' and 'encourage challenges to the status quo and fosters creative thinking' were achieved to some extent. Elements of self-organisation existed, but it was, for the most part, representatives from the local authorities and research partners who assumed leadership within the strategy process. On the topic of challenging the status quo, there have been discussions about how to change certain conditions concerning outmigration, land-use tensions, and the need for improving the matching of skills to the needs of the local labour market. There was a strong emphasis on the importance of communicating clearly that the municipality can provide an attractive community within which young families can settle. This helps to mitigate outmigration, as well as supporting processes for recruiting and retaining skilled labour.

5.3 Assessment of the outcome in Storuman and Sodankylä

Significant outcomes from the process may also include new collaborations and fresh networks (Emerson et al., 2012; Innes and Booher, 1999). In this respect, one important outcome of LS3 activities was enhanced dialogue between representatives from different sectors, including mining companies, the local authorities, and community representatives. The outcome of the LS3 is summarised in Table 5, based on the framework for collaborative planning (ibid).

Neither Storuman nor Sodankylä fulfilled the outcome criterion 'ends stalemate situation', which refers to existing land-use tensions. Both municipalities were interested in the question of how to balance economic activities for resource-based industries alongside reindeer herding activities, which implies a willingness to continue working with

a situation in stalemate. However, it needs to be recognised that this involves a long-term, historical conflict between industrial activities and reindeer herding, and it is beyond reasonable expectation that such deeply-rooted contrapositions can be resolved within a three-year strategic process.

Outcome criteria	Storuman	Sodankylä
'Ends stalemate situation'	No	No
'Compares favourably with other planning methods in terms of costs and benefits'	N/A	Partly
'Produces creative ideas'	Yes	Yes
'Results in learning and change in and beyond the group'	Yes	Yes
'Creates social and political capital'	Partly	Partly
'Produces information that stakeholders understand and accept'	Yes	Yes
'Sets in motion a cascade of changes in attitudes, behaviours and actions, spinoff partnerships, and new practices or institutions'	Partly	Partly
'Results in institutions and practices that are flexible and networked, permitting the community to be more creatively responsive to change and conflict'	Yes	Yes

Table 5: Achievements from local smart specialisation strategies (LS3) outcomes in Storuman and Sodankylä.

Concerning the LS3 process being 'favourable to other planning methods in terms of cost and benefit', this was not applicable in Storuman, since there have not been any similar strategic planning methods focussed on retaining the benefits of resource-based industries with which to compare. It could be relevant to integrate some of the findings and conclusions from the LS3 process into the municipal strategic plan (Storumans Kommun, 2019). However, the 2020-2023 local strategic plan for Storuman mentions neither the LS3 nor any other ongoing projects in the municipality (Storumans Kommun, 2019). It may take some time for local planners and politicians to decide on a system for transferring knowledge from local projects into the strategic plan.

In Sodankylä, an extended series of community workshops established a collaborative process which resulted in the mining programme. Both the inclusive stakeholder approach and collaboration with the municipal board made this process favourable in comparison with other planning methods. However, it also demanded significant time and resources.

The results in both Storuman and Sodankylä certainly represent 'the production of creative ideas'. Among the creative ideas developed within the process was the notion of four typologies for those migrating into rural communities. These comprise: 1) the ideal recruit, who will stay forever; 2) the active inward migrant who also has attachments to other areas, and does not stay; 3) the inward migrant with a high level of skill, who nevertheless stays only temporarily for work; and 4) the inward migrant who stays, but prefers a life of solitude and does not engage in local development activities (Vuin et al., 2018). These typologies are

useful when considering, in detail, how to attract people to mitigate out-migration from rural communities.

For the criterion to do with ‘production of information that stakeholders understand and accept’, it was evident that new knowledge served as a key foundation. In total, 24 publications were produced during and beyond the LS3 process. These include factsheets, policy briefs, working papers, reports, and peer-reviewed academic articles. Four videos were produced to communicate strategic insights from the process on social media in a readily understandable format. At various community and project meetings, stakeholders both expressed their interest in, and affirmed the value of, the information which had been produced for them.

Regarding ‘institutions and practices that are flexible and networked, permitting the community to be more creative and responsive to change and conflict’, one outcome in both Storuman and Sodankylä was organising community meetings and other stakeholder interactions. This resulted in a strategic awareness about the need to plan for inclusive local development. In terms of ‘learning and change in and beyond the group’, what proved important was inspiration from other countries, and further networking with other (foreign) municipalities in the Northern Periphery. This criterion was also fulfilled through the interest shown by neighbouring municipalities. Several people from neighbouring areas attended the final conference, which was hosted in Sodankylä. One municipality, Jokkmokk, in northern Sweden, also organised a seminar to learn from the LS3 process, and to increase its own awareness and capacity-building capability (Jokkmokk Kommun, 2019).

The two criteria ‘creates social and political capital’ and ‘sets in motion a cascade of changes in attitudes, behaviours and actions, spinoff partnerships, and new practices or institutions’ were partly achieved. The interaction between the local project leader, municipal staff and other local stakeholders created valuable new networks. These networks enabled the creation of both social and political capital. However, because the process of building social and political capital was not continued, this can only be seen as a partial outcome. It also explains why a change in attitudes was only partly achieved. Nurturing the new contacts that have been established, and continuing to interact through new networks – both these are crucial for achieving long-term impact and for changing attitudes.

6. Discussion: Did the LS3 improve local preparedness?

Assessment of the strategic dimensions of the LS3, as well as the process and outcome criteria, demonstrated a high level of engagement from the local authorities, the mining industry and local groups, both in Storuman and in Sodankylä. However, did these activities improve local preparedness? That is a rather more involved question.

6.1 Preparedness for whom?

Despite a broad range of community members being invited, not everyone could participate – even though the meeting was announced well in advance. For example, the representation of Sámi people was limited in Storuman, and in Sodankylä representation was based on written correspondence with the Sámi Parliament. The LS3 process itself underlines the importance of broad representation, to take all interests into account properly. Although it is beyond the scope of the LS3 process to end a historic stalemate between the Sámi people and the authorities, more effort could have been made to achieve better representation and participation, in order to attempt to build greater consensus for future projects.

In Sodankylä, some local inhabitants see mining projects as opportunities for growth, jobs, tax and revenue, while others see them as a threat to other natural resource-based operations, such as fishing, tourism, reindeer herding, and so on. An important aspect of building preparedness, therefore, is to create local consensus in relation to the development of a resource industry. The mining programme developed through the LS3 addresses the issues involved by facilitating dialogue and consensus around safeguarding the recreational use of nature, reconciling mining with other livelihoods, and mitigating potentially negative environmental impacts (Suopajarvi et al., 2017).

In Storuman, the LS3 process was acknowledged by the municipal management team as helpful in weighing different industries against one another, and in supporting decision-making about priorities for business development. The aim of the municipality in this area is to be able effectively to balance activities for reindeer herding, windfarms, tourism, and resource-based industries. The LS3 was perceived as improving local preparedness by highlighting key opportunities and challenges, by providing a picture of the demographic impact of establishing new resource-based industries, and by working on improving local attractiveness. Overall, the LS3 therefore helped the municipal management and other key personnel to think pro-actively about what kind of society they wished to create, rather than just being reactive – that is, merely dealing with problems as they occurred.

While the main recommendations from the LS3 were not included in Storuman Municipality's strategic plan for 2020-2023, the mining programme in Sodankylä continues to guide collaboration between the municipality, mining companies and civil society. This indicates that the transformative effect was higher in Sodankylä than in Storuman. For both municipalities, community meetings and the production of new knowledge had transformative impacts throughout the LS3 process. Extended contact with international mining companies operating in the area supported a stronger link between those actors engaged in 'the space of flows' and those actors engaged in 'the space of place'. In addition to improving dialogue with mining companies, interaction and collaboration between stakeholders from the private sector (including entrepreneurs and SMEs), the public authorities and civil society was also improved.

6.2 A place-based process and outcome?

In the qualitative evaluation, both Storuman and Sodankylä achieved lower scores for outcome criteria than for process criteria. Even so, the LS3 process was still considered valuable, according to key stakeholders, because it supported the generation of new knowledge and drew more attention to practical ways of increasing local preparedness for community-based environmental management.

In a rural development perspective, the LS3 process builds on the neo-endogenous approach by bringing in external funding to activate local stakeholders and to stimulate local economic benefit retention. However, the combination of both internal resources (the local authorities) and external resources (programme funding and international partners) is also an important prerequisite for understanding the potential long-term effects of the LS3 process. Notably, when the external funding ended, work on enhancing preparedness slowed down in Sodankylä, and finished in Storuman. So they remain vulnerable, as a result both of limited human capacity and a lack of committed competence for attracting new external resources – even though a number of competences have been enhanced by working with the three territorial challenges (demographic change, land-use conflicts, and local economic benefits). Because the LS3 was developed over a limited period, many activities ceased when project funding ended. This included the employment of the two project managers, who were responsible for carrying out each of the steps in the LS3 process, as well as for coordinating activities, mediating input from the researchers, and finalising the reporting.

7. Conclusions

The objective of this paper has been to assess both the process and the outcome of local smart specialisation strategies (LS3s) in two municipalities in the Northern Periphery, Storuman (Sweden) and Sodankylä (Finland). It has also aimed to understand how, and to what extent, LS3s can enhance local preparedness in meeting core challenges related to demographic change, land-use conflicts, and local economic development. All strategic dimensions were present in the LS3 process. Overall, they were more responsive than transformative in character. Even so, the assessment showed positive impacts from transformative traits throughout the process. The community workshops ensured a bottom-up approach by bringing in perspectives from different stakeholder groups with regard to the opportunities and challenges of local territorial development.

A key outcome has been increased knowledge about population change, including the creation of scenarios for demographic development in the process of establishing new resource-based industries, as well as input on the perceived impact of such industries in the area, and Local Benefit-Retention Analysis. These LS3 activities supported local preparedness in both municipalities. In Sodankylä, the LS3 resulted in a mining programme for 2018-2021. This created preparedness through dialogue between local stakeholders about the future development of resource-based industries in the area. In Storuman, the LS3 contributed

knowledge about demographic challenges, land-use planning and local benefit retention. All this led to better knowledge-based preparedness among both planners and the municipality's management group.

However, shortcomings were also noted. These were primarily related to a lack of continuity, and correspondingly to limited potential for making a long-term impact. Despite active stakeholder interaction and collaboration, implementation of several of the resulting ideas was never realised, due to lack of human and financial resources being committed to them. The ability to continue strategic work depends upon the priorities of local, regional and national decision-makers. One way to improve LS3s, therefore, would be to incorporate plans for continuation from the outset, so that resources are allocated to implement some of the ideas generated by the LS3 process.

8. Acknowledgements

This paper received support from the Nunataryuk project, funded by the European Union's Horizon 2020 Research and Innovation Programme, under grant agreement No. 773421. All empirical material is based on research carried out in the REGINA project (Regional Innovation in the Nordic Arctic), funded by the EU Interreg Northern Periphery and Arctic Programme. We would also like to thank all participants in the REGINA project, especially our former colleague, Andrew Copus. Finally, we would like to acknowledge the helpful and constructive feedback from the reviewers in the blind peer-review process.

Endnotes

- ¹ <https://cityplanneronline.com/site/index.php/3d-visualisation-for-urban-planning/>

References

- Albrechts, L., 2006. *Bridge the Gap: From Spatial Planning to Strategic Projects*. Eur. Plan. Stud. 14, 1487–1500. <https://doi.org/10.1080/09654310600852464>
- Albrechts, L., 2001. *In Pursuit of New Approaches to Strategic Spatial Planning. A European Perspective* 19. <https://doi.org/10.1080/13563470120026514>
- Arruda Gisele M., 2017. *Social impacts of climate change and resource development in the Arctic*. J. Enterprising Communities People Places Glob. Econ. 11, 277–288. <https://doi.org/10.1108/JEC-08-2015-0040>
- Bock, B.B., 2016. *Rural Marginalisation and the Role of Social Innovation; A Turn Towards Nexogenous Development and Rural Reconnection*. Sociol. Rural. 56, 552–573. <https://doi.org/10.1111/soru.12119>
- Castells, M., 2007. Space of flows, space of places: Materials for a theory of urbanism in the information age, in: *Rethinking Technology: A Reader in Architectural Theory*. Routledge, p. 20.
- Cheshire, L., Esparcia, J., Shucksmith, M., 2015. *Community resilience, social capital and territorial governance*. Ager Rev. Estud. Sobre Despoblación Desarro. Rural 7–38. <https://doi.org/10.4422/ager.2015.08>
- Cigler, B.A., Reed, B.J., Blair, R., 1993. *Economic Development in Rural Communities: Can Strategic Planning Make a Difference?* Public Adm. Rev. 53, 88–92. <https://doi.org/10.2307/977285>
- Copus, A., 2017. *How to make population projections for sparsely populated municipalities: A User Manual for the Demographic Foresight Model 23*.

- Copus, A., Jungsberg, L., Weber, R., 2016. *The 6-Step Model for Local Smart Specialisation Strategies*.
- Emerson, K., Nabatchi, T., Balogh, S., 2012. *An Integrative Framework for Collaborative Governance*. J. Public Adm. Res. Theory 22, 1–29. <https://doi.org/10.1093/jopart/muro11>
- European Commission, N.P. and A. programme, 2016. *Northern Periphery and Arctic Cooperation programme 2014-2020*.
- European Commission, R. and U.P., 2018. *Strengthening Innovation in Europe's Regions*. European Commission Smart Specialisation Platform.
- Fred, M., 2018. *Projectification: The Trojan horse* (Ph.D. dissertation). Lund University.
- Garcilazo, J.E., Martins, J.O., Tompson, W., 2010. *Why policies may need to be place-based in order to be people-centred*. OECD Publishing.
- Gill, I., 2010. *Regional development policies: Place-based or people-centred?*
- Gunder, M., Madanipour, A., Watson, V. (Eds.), 2018. *The Routledge handbook of planning theory*, Routledge handbooks. Routledge, Taylor & Francis Group, New York London.
- Healey, P., 2009. *In search of the "strategic" in spatial strategy making 1*. Plan. Theory Pract. 10, 439–457. <https://doi.org/10.1080/14649350903417191>
- Innes, J.E., Booher, D.E., 1999. *Consensus Building and Complex Adaptive Systems: A Framework for Evaluating Collaborative Planning*. J. Am. Plann. Assoc. 65, 412–423. <https://doi.org/10.1080/01944369908976071>
- Jokelainen, K., Mäcklin, K., Teräs, J., Kostander, K., 2013. *Region of Lapland, Finland: Towards a RIS3 strategy of Northernmost Europe*.
- Jokkmokk Kommun, 2019. *Jokkmokk Inbjudan Smart specialisering 14 maj 2019*.
- Jungsberg, L., Copus, A., Nilsson, K., Weber, R., 2018. *Demographic change and labour market challenges in regions with large-scale resource-based industries in the Northern Periphery and Arctic*.
- Knoblock, E.A., Pettersson, Ö., 2010. *Restructuring and risk-reduction in mining: employment implications for northern Sweden*. Fenn. - Int. J. Geogr. 188, 61–75.
- Nordregio, Environment Research Institute, University of Lapland, Nordland Research Institute, 2017. *REGINA_LS3_Guidelines_Step_1_and_2.pdf*.
- Nordregio, F., 2018. *Demographic Foresight Modelling as a strategic planning tool for local authorities*.
- Nurmi, P.A., 2011. *Finland's Minerals Strategy*.
- Olsen, L.S., Berlina, A., Jungsberg, L., Mikkola, N., Roto, J., Rasmussen, R.O., Karlsdotir, A., 2016. *Sustainable Business Development in the Nordic Arctic*. Nordregio.
- Österberg, S.-E., Ögren, K., Bergqvist, E., Lövgren, L., Andersson, M., Höglund, E., 2016. *Innovativ och hållbar utveckling av mineralsektorn i Norrbottens och Västerbottens län - 2025*.
- Primdahl, J., Kristensen, L.S., Arler, F., Angelstam, P., Christensen, A.A., 2018. *Rural landscape governance and expertise: on landscape agents and democracy*, in: *Defining Landscape Democracy. A Path to Spatial Justice*. Edward Elgar Publishing, p. 12.
- Regeringskansliet, 2015. *Sveriges mineralstrategi*.
- Rönkkö, E., Aarvevaara, E., 2017. *Towards Strengths-Based Planning Strategies for Rural Localities in Finland*. Eur. Countrys. 9, 397–415. <https://doi.org/10.1515/euco-2017-0024>
- Shucksmith, M., Brown, David.L., 2016. *Routledge International Handbook of Rural Studies, 1st ed*. Routledge, Abingdon, Oxon ; New York, NY : Routledge, [2016]. <https://doi.org/10.4324/9781315753041>
- Sisneros-Kidd, A.M., Monz, C., Hausner, V., Schmidt, J., Clark, D., 2019. *Nature-based tourism, resource dependence, and resilience of Arctic communities: framing complex issues in a changing environment*. J. Sustain. Tour. 27, 1259–1276. <https://doi.org/10.1080/09669582.2019.1612905>
- Sodankylä Municipality, 2018. *Sodankylä Municipality's mining programme 2018 - 2021*. Kaivos Finland.
- Stammler, F., Ivanova, A., 2016. *Resources, Rights and Communities: Extractive Mega-Projects and Local People in the Russian Arctic*. Eur.-Asia Stud. 68, 1220–1244. <https://doi.org/10.1080/09668136.2016.1222605>
- Storuman Municipality, 2018. *Local Smart Specialisation in Storuman*.
- Storumans Kommun, 2019. *Strategisk plan 2020-2023*.

- Suopajarvi, L., Kantola, A., 2019. *The social impact management plan as a tool for local planning*. Land Use Policy 104046. <https://doi.org/10.1016/j.landusepol.2019.104046>
- Suopajarvi, L., Kantola, A., Weber, R., 2017. *Local smart specialisation: a step-by-step guide to social impact management in remote communities with resource-based economies 22*.
- Suopajarvi, L., Umander, K., Jungsborg, L., 2019. *Social license to operate in the frame of social capital exploring local acceptance of mining in two rural municipalities in the European North*. Resour. Policy 64, 101498. <https://doi.org/10.1016/j.resourpol.2019.101498>
- Suopajarvi, L., Kuisma, M., 2017. *Social Impacts of Mining in Sodankylä*.
- Suutarinen, T., 2015. *Local natural resource curse and sustainable socio-economic development in a Russian mining community of Kovdor*. Fenn. – Int. J. Geogr. <https://doi.org/10.11143/45316>
- Tarras-Wahlberg, N.H., 2014. *Social license to mine in Sweden: do companies go the extra mile to gain community acceptance?* Miner. Econ. 27, 143–147. <https://doi.org/10.1007/s13563-014-0053-9>
- Teräs, J., Salenius, V., Fagerlund, L., Stanionyte, L., Europäische Kommission, Gemeinsame Forschungsstelle, 2018. *Smart specialisation in sparsely populated European Arctic regions*.
- Tolvanen, A., Eilu, P., Juutinen, A., Kangas, K., Kivinen, M., Markovaara-Koivisto, M., Naskali, A., Salokannel, V., Tuulentie, S., Similä, J., 2019. *Mining in the Arctic environment – A review from ecological, socioeconomic and legal perspectives*. J. Environ. Manage. 233, 832–844. <https://doi.org/10.1016/j.jenvman.2018.11.124>
- Tysiachniouk, M., Henry, L.A., Lamers, M., van Tatenhove, J.P.M., 2018. *Oil and indigenous people in sub-Arctic Russia: Rethinking equity and governance in benefit sharing agreements*. Energy Res. Soc. Sci. 37, 140–152. <https://doi.org/10.1016/j.erss.2017.09.004>
- Umander, K., Norlén, G., Jungsborg, L., 2017. *Social Impacts of Mining in Storuman Municipality: Results of a survey to local residents*. Storuman municipality & Nordregio.
- University of Highlands and Islands, E.R.I., Nordregio, 2018. *REGINA Local Smart Specialisation Strategy: Local Benefit Analysis Toolbox (LBAT)*.
- Vuin, A., Berggren, P., Carson, D., 2018. *The Unicorn Model - Four Types of Migrants*. Presented at the Three minute thesis, Darwin NT, Australia.
- Weber, R., Eilertsen, S.M., Suopajarvi, L., 2017. *Local land use planning: Guidance on spatial data, geographic information systems and foresight in the Arctic 44*.

Paper III

Title: Social license to operate in the frame of social capital exploring local acceptance of mining in two rural municipalities in the European North

Authors: Leena Suopajärvi, Karina Umander, Leneisja Jungsberg

Journal: Resources Policy, Vol 64.

Published: <https://doi.org/10.1016/j.resourpol.2019.101498>



Social license to operate in the frame of social capital exploring local acceptance of mining in two rural municipalities in the European North

Suopajarvi Leena^{a,*}, Umander Karina^b, Leneisja Jungsberg^{c,d}

^a University of Lapland, Postbox 122, 96101, Rovaniemi, Finland

^b Storuman Municipality, Blå vägen 242, 923 81, Storuman, Sweden

^c Copenhagen University, Institute for Geosciences and Natural Resource Management, Department for Architecture, and Planning, Rolighedsvej 23, 1958, Frederiksberg C, Copenhagen, Denmark

^d Nordregio, Box 1658, SE-111 86, Stockholm, Sweden

1. Introduction

The social license to operate (SLO) is discussed by practitioners and scholars of the mining industry around the globe, especially in the Australian, Canadian, and U.S. contexts (Karakaya and Nuur, 2018; Mercer-Mapstone et al., 2018). In short, the social license to operate refers to local communities' and other stakeholders' acceptance of extractive industry, for example mining. It concerns the daily operations of companies in their localities – especially in terms of having fair, open, and reciprocal relationships with the local stakeholders (e.g. Boutilier and Thomson, 2011; Thomson and Boutilier, 2011; Prno, 2013; Moffat and Zhang, 2014; Mercer-Mapstone et al., 2018)).

The SLO is gained through a company's performance, but what does the term 'social' actually refer to? Is it more than just working dialogue between companies and communities (See Lempinen 2019, pp. 43–61.)? The answer seems to be yes, because a growing body of literature indicates that distributional justice, including local benefit provision (e.g. Prno, 2013; Jijelava and Vanclay, 2017), is just as important as procedural fairness (e.g. Moffat and Zhang, 2014; Mercer-Mapstone et al., 2018). And, as often stated in the SLO literature, all mining projects and their diverse operating environs are unique and hence “the context plays a key role in shaping SLO outcomes” (Prno, 2013, pp. 584).

The aim of this article is to discuss the meaning of 'social' in SLO. To accomplish this, we link the SLO concept to the social capital approach, a subject that started to develop in the end of the 20th century, by discussing the effects of industrialization and modernization on social life (Putnam and Goss, 2002). The social capital approach offers applicable insights into the SLO, as it not only discusses the importance of good social relations and trust – which are needed in gaining a social license to operate – but also deepens the community perspective. Robert D. Putnam (1993; Putnam and Goss, 2002), one of the leading theorists in the field, links the economic prosperity of a community – certainly one of the goals of all host

communities – to the development of social capital. His main argument is that dense networks of interaction foster general reciprocity and trust that can produce both private and public good. Further, his classical study on Italian North and South stresses the importance of historical paths that manifest themselves in the institutions of a community, in a broad sense defining “the rules of the game in society” (Putnam, 1993, p. 179). To apply these ideas to our practical research questions, we discuss the mining-related history in the localities, the social composition of the communities, the various relations within the communities, and the relations between the communities and the operating companies.

The relevant questions in this context are as follows: What is the social composition of a given locality and how will a mining company operating therein change the local community? Furthermore, all communities are unique social contexts. For example, if a community has a history that involves mining in the locality, the members' experiences of the industry may vary a great deal. All these themes are relevant in gaining a social license to operate, as they deal with people's perceptions of mining.

In this article, we aim to discuss local acceptance of mining within the frame of social capital through two case studies, one involving Storuman Municipality in Västerbotten County in Sweden and the other involving Sodankylä Municipality in Lapland, the northernmost province of Finland.

The next section addresses the cases, data, and method. Section 3 focuses on social relations, section 4 on local context, section 5 on trust, and section 6 on local benefits. The article ends with a discussion and conclusions concerning the reasons why mining has a strong social license to operate in Sodankylä and a weak one in Storuman.

2. Surveys in two rural communities: Storuman and Sodankylä

Sodankylä in Finland and Storuman in Sweden were partners in the Regina project,¹ aimed at improving the planning capacity of remote municipalities whose economies are dependent on large-scale

* Corresponding author.

E-mail address: leena.suopajarvi@ulapland.fi (S. Leena).

¹ REGINA stands for Regional Innovation in the Nordic Arctic and Scotland, with a special focus on regions with resource-based industries. The project, funded by Northern Periphery and Arctic Programme, ran from 2015 to 2018 and it was led by Nordregio, a research institute funded by the Nordic Council of Ministers that consists of Denmark, Norway, Sweden, Finland, and Iceland, as well as the Faroe Islands, Greenland, and Åland.

industries. Surveys on mining developments were conducted in both municipalities during the project. The respondents were to evaluate the impacts of mining on the local community, to express their perceptions related to mining, and to assess the environmental impacts and local acceptance of mining.

Sodankylä is a municipality situated in the middle of Lapland, the northernmost province of Finland. It is sparsely populated, with approximately 8,600 inhabitants in an area of 12,440 square kilometres. For decades, the population growth rate in the region has been negative, but after 2010, the share of working-age people has risen owing to developments in the mining sector. Also, the unemployment rate at the end of July 2018 was lower (11%) than in Lapland in general (13%) (Association of Finnish Local and Regional Authorities, 2018). With the Boliden Kevitsa mine employing around 450 people, of whom 70% are permanent residents (Koskela, 2018), mining was the largest private-sector business in the municipality in 2018.

There have been several mining projects in their various phases in Sodankylä. First Quantum Minerals started operations at the Kevitsa mine (nickel, copper) in 2012, which have been continued by Boliden since 2016. Anglo American Sakatti Mining was prospecting a mine (copper-nickel-platinum group elements) and carrying out the environmental impact assessment process in 2018. A special circumstance in the Sakatti project is that it is located by the Viiankiaapa mire, which is protected by the EU-wide Natura 2000 nature conservation programme (Metsähallitus Parks & Wildlife in Finland, 2018). The Pahtavaara gold mine started in 1996, but it has been weighed down by several bankruptcies and ownership changes. In 2018, the mine was owned by Rupert Resources, which is conducting further mineral exploration in the area. In addition to these established projects, a large number of exploration projects and activities are under way in Sodankylä.

A web survey on the experienced impacts of mining was carried out in the municipality in February 2018. The questionnaire was also discussed in five village meetings near the existing or planned mine areas. Altogether 160 responses were received, 106 of which through the web survey. Among the respondents, the share of pensioners was lower (23%) than their share actually is in the municipality (32%). In addition, the share of unemployed people was less than three percent and the share of respondents under the age of 30 was less than one percent. More than one-third of the respondents were employed or had a household companion who was employed by a mining company. In Sodankylä, most of the respondents were employed people living in the villages near the mine or mineral exploration sites. Only one respondent identified herself with Sámi culture. This is probably because none of the mining projects is located in the Sami Home Area that covers the northern parts of Sodankylä Municipality.

Storuman, located in Västerbotten County in Sweden, is another sparsely populated and large northern municipality. It has 5,900 inhabitants, of whom 28% are over 65 years of age, in an area of 8,234 square kilometres. The population growth rate has been negative for a long time, with a very small increase in the last couple of years thanks to immigration and possibly also investments in the industrial and tourism sectors. The unemployment rate of the municipality is 7,5%. In the western part of the municipality near the Norwegian border, tourism plays a major role in the region's economy. In the eastern part, livelihoods are based on energy production, forestry, small-scale engineering industries, and public services.

In 2018, the role of mining was not significant in terms of employment, but there were ongoing mineral exploration activities, a plan for a new mine, and mines that had already been closed. In Pauträsk, Dragon Mining had run a gold mine during 2005–2015, and there was a processing plant operating by the time of the survey in spring 2017. The Svartliden Plant in Pauträsk processed gold concentrates, also those coming from the company's Finnish operations. Dragon Mining had also had exploration tenure in the area, and it has a new project going on in the neighbouring Lycksele Municipality (Dragon Mining, 2015). In

Barsele, Agnico Eagle has explored minerals through a variety of methods since mid-2015 (Agnico Eagle, 2018). In Högländ, Tertiary Minerals had a plan for a fluorite mine. Its construction and operation would have lasted around 25 years and it would have employed approximately 90 people in the production phase. Västerbotten County stopped the planning in September 2018, because the mine would have threatened reindeer herding in the area (SVT Nyheter, 2016, 2018). People in Storuman Municipality have negative experiences of mining, because two local mines have been closed owing to toxic leaks.

The Storuman survey was carried out between January and June 2017 in the eastern part of the municipality. This area was selected because it is the location of ongoing mining or mineral exploration projects in their various phases. Additionally, Luleå University of Technology and Umeå University conducted a study in the western part that ended in May 2016 (Beland-Lindahl et al., 2016). The questionnaire was posted to 571 residents living in the villages of Pauträsk, Barsele, and Högländ. The recipients were also able to answer the questionnaire via the municipality's website using a personal password given to everyone. Altogether 217 responses were received, of which 175 arrived by mail. Almost half of the respondents were retirees (45%) and slightly more than one-third were employed workers (36%). The share of unemployed people was two percent and some were self-employed (6%). Nine respondents (4%) or someone else in their household worked in a mine. Only three of the respondents stated that they belong to an ethnic minority. The majority of the local Sámi people live in the western part of the municipality, which explains the low response rate.

The data from both questionnaires was uploaded to the Statistical Package for the Social Sciences (SPSS) programme. Background questions (age, education, occupation, the respondent's or household member's employment in mining) were asked to capture demographic and socio-economic data needed in interpreting the survey answers using frequency distributions. Web-based surveys are open to anyone and hence the group of respondents is always biased in one way or another. Further, since answering is voluntary in both web-based and posted surveys, responses are received mainly from people who are interested in the topic (See Saariemi, 2018; Umander et al., 2018).

3. Social relations – a cornerstone of the SLO

According to the social capital approach, good social networks and reciprocity create value as well as other capital, such as money (Putnam, 1993; Putnam and Goss, 2002). Also in the SLO literature, a company's investment in good host community relations is regarded as an important component of local acceptance, which, in turn, is essential for the smooth running of business operations. As Prno notes, “a social licence to operate is built on relationships” (2013, 585). Boutilier and Thomson (2011), for their part, address interactional trust and state that companies and their management should listen, respond, keep their promises, engage in mutual dialogue, and exercise reciprocity in their interactions. According to two surveys conducted by Moffat and Zhang (2014), the quality of contacts and a positive and pleasant engagement with a company enhance trust – an idea that further supports the social capital approach.

In the questionnaires, the respondents in Storuman and Sodankylä were asked to evaluate the performance of the operating mining companies in terms of their engagement in developing the community, the sufficiency and reliability of their information, and the possibilities offered for local residents to participate in mining-related decision making in the municipality.

In Sodankylä, the respondents were to evaluate the performance of Anglo American (Sakatti project), Boliden (Kevitsa mine), and Rupert Resources (Pahtavaara mine). The chosen rating scale was 4–10, because it has traditionally been used in Finnish schools and the respondents could be expected to be familiar with it.

Of the three companies, the weakest performer was Rupert Resources, which at the time of the survey in the beginning of 2018 was

holding the Pahtavaara mine on standby. The mean rating was fair (6). At the time of the survey, Anglo American was conducting its environmental impact assessment for the Sakatti project, involving local people in the process. The company was assigned a good grade (8) in reliability and sufficiency of information, activeness and timeliness of communication, and cooperation and interaction with the local residents.

Boliden, running the Kevitsa mine, received a satisfactory (7) grade in cooperation and interaction with the local residents, reliability and sufficiency of information, and activeness and timeliness of communication. When compared to an earlier survey done in the municipality in summer 2016 (Kuisma and Suopajärvi, 2017), the performance of all the companies was judged better and, accordingly, the acceptance of mining had strengthened. In 2016, around 80% accepted mining in the municipality and in 2018, the figure was 85%. As all the companies, especially Anglo American, have operated actively with local stakeholders, our Sodankylä case supports the results of Moffat and Zhang (2014) in that dense interaction and a well-functioning company–community relationship are important in gaining a social license to operate.

The most striking issue in the Storuman case was that when the respondents were to evaluate the three mining cases, a very high percentage chose not to respond to questions concerning company performance. In the Pauträsk case, with Dragon Mining's mine and processing plant, the share of respondents who evaded the questions related to company performance (for example the residents' opportunities to participate in decision making, the reliability and the sufficiency of information) was 46–52%. In the Barsele case, with Agnico Eagle engaged in mineral exploration, the no-answer rate was 35–39%, and in the Högländ case, with Tertiary Mineral planning to establish a mine, more than half of the respondents left no reply (54–60%). These rates are noticeably high in comparison to the generic questions on mining and its impacts, where the share of those who did not reply was only a few percent. That said, it seems that the companies operating in the area had failed to build a relationship of trust with the local residents. In addition, the majority of those who responded to the questionnaire argued that the companies' engagement in developing the municipality was weak. Finally, the reliability and sufficiency of information was deemed weak in all the cases, although communication should be an integral part of building social capital and gaining a social license to operate (e.g. Boutillier and Thomson, 2011; Moffat and Zhang, 2014; Prno, 2013). One of the reasons why the companies have not been able to build a relationship of trust with the local residents might be the fact that the mines employed only few people. Only nine respondents (4%) responded that they or someone else in their household worked in a mine. A quarter of the respondents stated that they or someone else in their household owned property in the area of an existing or planned mine (24%).

In general, the social acceptance of mining was high in Sodankylä and the performance of the mining companies was considered relatively good. In Storuman, the respondents were not able to evaluate the performance of the mining companies. If mining companies do not interact with their local communities, they are not likely to gain a social license to operate.

4. Local context matters – different situations and perceptions on mining developments

The social capital approach opens up a topic related to social networks that is perhaps equally important as company–community relations, namely, the altering effect of mining-based industrial development on the host community itself (Putnam and Goss, 2002, 13). This theme may also be important in gaining local acceptance of mining.

In Sodankylä, more than half of the respondents (54%) were between 40 and 59 years of age, and roughly two-thirds (68%) were employed. Around 80% of the respondents reported that they had a

good social network in the locality and that they felt comfortable living there. Mining's effect on the social life of Sodankylä had been positive, as the majority of the respondents (60%) said that it had increased their opportunities to establish new and meaningful relationships. More than 60% also stated that mining had contributed to the cosiness of the place. In general, mining was perceived to have had a positive impact on the atmosphere of the locality. Sodankylä Municipality is on its way to becoming a mining community, as 39% of the respondents reported that they or someone in their household had a job connected to mining. More than 70% also stated that mining had improved the municipality's image.

Nevertheless, the residents had not yet reached the state of identifying themselves as a mining community (Boutillier and Thomson, 2011). A majority (70%) of the in-migrated employees at the Boliden Kevitsa mine had settled in Sodankylä, but they had not yet been accepted as locals – for example, they were sometimes referred to as “miners” to make a difference between the “old” community and newcomers (Suopajärvi, 2017). The local residents and the mine-workers live side by side, but they do not form a coherent mining community. Further, a local movement against the Sakatti project was launched in January 2017. The movement is against mining in nature reserves such as the Viiankiaapa mire, which is part of the European-wide Natura 2000 protection programme. The respondents in Sodankylä were therefore asked whether mining had split the residents into two camps. One-third (32%) had not recognized such development, but 44% agreed that mining divided opinions and had weakened the atmosphere of the community. Hence, there may be mining-related issues that cause conflicts of interests regardless of the general acceptance of mining, as “residents are rarely an homogenous group” (Vanclay et al., 2015).

The situation was very different in Storuman, where mining had gained no foothold in the community. Most of the respondents were aged, as 60% of them were in their sixties or older. Slightly more than half (52%) had lived in the area for more than 30 years. More than 80% stated that they had a good social network consisting of friends and relatives in the village and 91% responded that the village was a pleasant place to live in. In the small villages of Storuman Municipality, people seem to have *bonding ties*, which means strong ties between people who are alike. *Bridging ties*, on the other hand, develop between people and groups who are different and whose ties are not that dense, close, and strong (Granovetter, 1973; Putnam and Goss, 2002). Based on the questionnaire, the villages in Storuman were considered safe havens, in other words familiar and cosy places to live in. The mining companies were regarded as intruders, representing the outside world that is becoming increasingly globalized, uncertain, and unpredictable (Beck, 1994). This conclusion builds on the fact that a quarter of the respondents (26%) considered mining to have had an adverse effect on the atmosphere of the village and almost an equal number (30%) said that the atmosphere had actually become worse. Overall, 43% stated that mining operations are not acceptable, while slightly fewer than 30% accepted mining in the region (See also Beland-Lindahl et al., 2018.).

Social capital is typically portrayed in positive terms, but it may also happen that it does not bring common good to the local community. If strong ties, defined by frequency of contact and proximity, only exist between a company and community leaders, it may give rise to suspicions among other residents (see Granovetter, 1973; Putnam and Goss, 2002). Even if the municipality negotiates with the mining company about building infrastructure, roads, and services with an attempt to vouch for the common good, it may be interpreted as pro-mining cabinet politics. This may well be a prevailing perception, because municipal leaders in remote regions struggling with unemployment and out-migration tend to be more positive towards mining than the local residents are (Suopajärvi et al., 2016). These doubts became evident in Storuman.

When the survey was launched in January 2017, people with a

critical attitude toward mining wrote a number of comments against it on social media, arguing that the municipality would use the survey to legitimize mining. Although this was not the municipality's intention, the criticism pointed out that people were not satisfied with the municipality's effort to listen to its residents and their concerns about mining activities (Umander et al., 2018). Apparently, the negative stance originated from the opponents of mining in the western part of the municipality, where the Rönneback mine had stirred up criticism (Beland-Lindahl et al., 2016). In the eastern part of the municipality, the respondents reported that the ties between the municipality and the mining companies were not very strong. Only 18% reported that the linkages between the two are too strong, which indicates that the criticism in social media did not come from the eastern research area.

In both surveys, the respondents noted that it is not easy to take part in the decision-making processes related to mining. In Storuman, less than one-tenth (9%) and in Sodankylä less than one-fifth (19%) thought that this participation is easy. Almost half of the respondents in Storuman (45%) and in Sodankylä (46%) stated that the mining-related decision-making processes are not comprehensible. The results support the earlier study conducted in Storuman, where respondents believed that the processes are not democratic, open, equal, or inclusive (Beland-Lindahl et al., 2016).

To sum up, the respondents in Sodankylä thought that mining had had a positive effect on local life. In Storuman, the respondents reported that mining had deteriorated the social climate. In both cases, the decision-making processes related to mining were considered difficult, even non-democratic.

5. Trust – generalized and earned through the formation of social capital

According to Thomson and Boutilier (2011), interactional trust refers to the idea that a company engages in mutual and respectful dialogue with the local community. When the relations have been established and there is an enduring regard for each other's interests, institutionalized trust comes into play (also e.g. Jijelava and Vanclay, 2017). On the other hand, some scholars argue that general trust towards authorities and environmental legislation is as important as a company's performance in reaching the acceptance of mining (Jartti et al., 2017; Litmanen et al., 2015).

The social capital approach aims to distinguish between trust earned through social relations and generalized trust in a system or organization. For example, Putnam (1993) defines generalized trust as trust in authorities, the state, and so on. Trust is needed in the complex relations of modern society, as there are many situations where you simply have to trust that the authorities follow the law and that fellow citizens behave according to norms (Putnam, 1993). Luhmann (1979) refers to confidence instead of trust when addressing social order and social systems. According to him, anyone who trusts a system places the trust in the functioning of the system, not individual persons. In fact, generalized trust or confidence is invested in organizations and systems despite the fact that they are composed of individuals who make human decisions.

The questionnaires addressed generalized trust in authorities, law, and statutory decisions because they form the general frame within which mining companies implement their projects. Despite the strong acceptance of mining in Sodankylä, almost half of the respondents (44%) thought that environmental permits are given to projects on meagre grounds, and two-fifths (40%) did not trust the authorities' assessment of the environmental impacts of mining. Similar findings have been made for example in the Academy of Finland's programme *Mineral Resources and Material Substitution*, according to which nearly half of the Finns (45%) do not trust the authorities in charge of mining-related environmental decisions (Jartti et al., 2017). The results of the Storuman case do not stray far from the above. Two-fifths (41%) of the respondents thought that the environmental authorities are not

trustworthy in monitoring the impacts of mining, and two-thirds (67%) reported that mining-related legislation should be tightened even if it decreased foreign investments. The results are interesting, as people in Finland and Sweden typically think that state authorities follow the law and act in a trustworthy manner (Rothstein, 2002; van Oorschot et al., 2006). On the other hand, although people in general trust the authorities in both countries, they are more pessimistic about environmental decision making and less likely to place their trust in it (Jartti et al., 2017; Saariniemi, 2018). The reasons for this difference are yet unknown, but they may have something to do with the problems that the respondents have faced in taking part in mining-related decision-making processes.

In the Sodankylä survey, trust in the local operators also played a noteworthy role. Trust in Anglo American and Boliden was rated good (8) and in Rupert Resources fair (6). Actually, the highest ratings were given to trust (or credibility, as in Finnish they are synonymous) in the companies, not in their performance, as shown by the following figure (Fig. 1).

It may come somewhat as a surprise that people rate trust higher than actual co-operation with the companies. This unexpected behaviour may be explained through the concept of trust itself: trust is always about probability and uncertainty (Luhmann, 1979; Putnam, 1993; Sztompka, 1999). Consequently, if one can be sure that, for example, a company does what it says, there is *no need* for trust. Trust is needed in situations of probability, where the actions of others are unpredictable and uncontrollable (Sztompka, 1999). The relatively strong trust in Boliden and Anglo American may result from the fact that more than one-third of the respondents or their household members were working for the companies. On the other hand, Boliden may be seen locally as a saviour of the Kevitsa mine, which was on the brink of insolvency under the ownership of First Quantum Minerals (YLE, 2016). After buying the mine, the company has developed its production and reported of large investments in it (YLE, 2018), which probably strengthened the respondents' trust in continued operation. Further, Anglo American has made it clear that prospecting the mineral deposit in Sakatti is one of the company's leading projects (Jokela, 2018). Both companies have worked in Sodankylä for more than a decade, and it seems that they have earned the trust of the local residents in doing so.

6. Local expectations and benefits – the most important aspect of the SLO?

Local acceptance is a result of expectations and the actual outcomes at the local level (Moffat and Zhang, 2014). High expectations followed by poor results may lead to dissatisfaction that eventually ruins the foundations of a social license to operate.

In Sodankylä, the respondents reported that mining had increased their opportunities to establish new and meaningful relationships (60%), improved the atmosphere in the community (78%), and contributed to the amenity of the locality (70%). Hence, mining had affected positively the residents' perceptions of Sodankylä's social life. In addition, the respondents saw that mining had improved municipal and private services (57% and 62%), increased educational possibilities (68%) and opened up work and career opportunities (87%). In addition, a large majority stated that mining had benefitted the local economy (86%) and over a half said that it had not impaired other livelihoods (56%). In general, the respondents considered mining important for the vitality of the municipality (84%).

In Storuman, the general message was that mining had not affected local life. The majority of the respondents reported that mining had not had an impact on the public services (59%) and half (50%) said that there were no effects on private services either. Compared with Sodankylä, the number of people reporting positive developments was smaller and the opinions were divided. Less than half of the respondents (44%) thought that educational, work, and career opportunities had

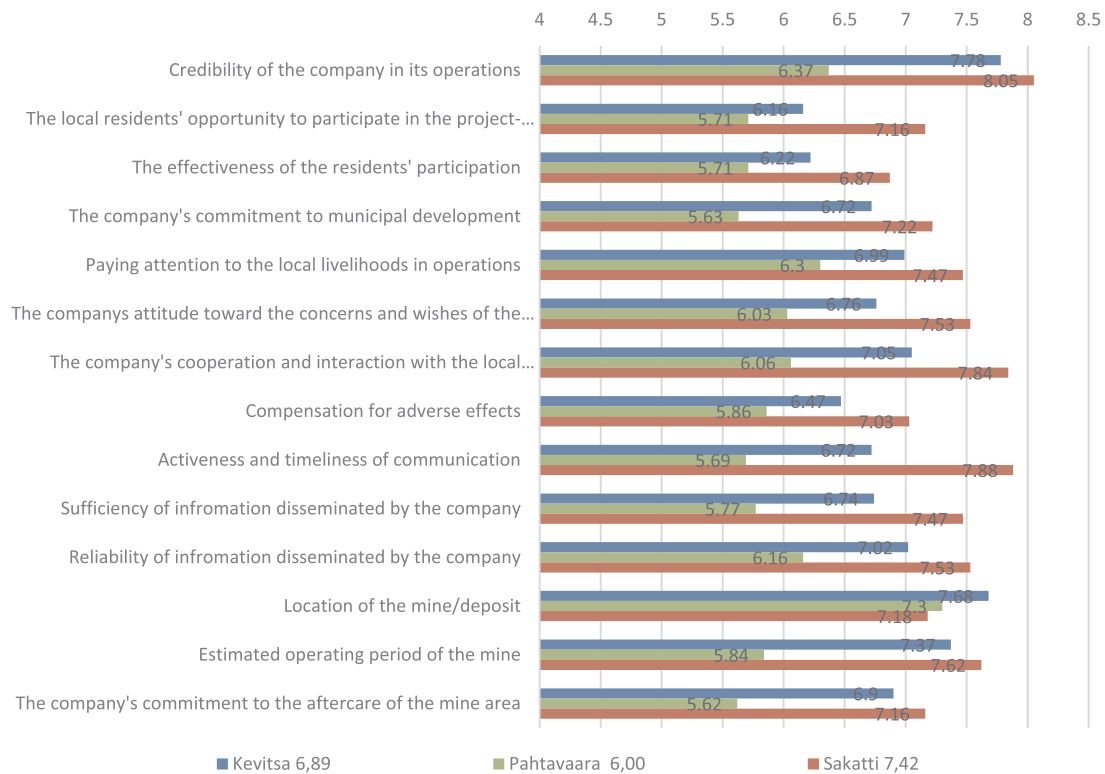


Fig. 1. Project-specific assessment in the mining cases of Sodankylä.

improved, while two-fifths (41%) thought that mining had had no impact whatsoever. The local benefits of mining were also assessed in a variety of ways: roughly one-fourth (28%) thought that the local economy had benefitted from the industry, but an equal proportion (30%) estimated that there were no such benefits. The rest of the respondents were unaware of the benefits or gave a neutral reply. Overall, half of the respondents (49%) thought that mining was not essential to the vitality of the municipality. In an open-ended question about the positive impacts of mining on the respondents' own lives and future possibilities, more than one-third (35%) replied that there were none.

Another message from the Storuman survey was that there was a great deal of concern about environmental degradation and its consequences, such as losing the possibility to hunt, fish, pick berries, and so on. A large majority of the respondents (73%) thought that mining had harmed the environment in the municipality and an even larger majority (86%) regarded mining as a threat to the landscape. The respondents also thought that animals and plants (83%) as well as water systems (83%) had been compromised. In an open-ended question on the negative impacts of mining and its threat to human life, environmental concern was expressed in many ways. The respondents were worried about polluted water, polluted air, and reduced possibilities to pursue outdoor activities. The villagers in Storuman valued the environment very much. Nearly all of the respondents (92%) were very satisfied about their opportunities to engage in outdoor activities. The importance of clean nature was emphasised and mining was characterised as a threat.

In Sodankylä, environmental concern was not as great as in Storuman, but also there, people appreciated the environment because of its recreational value (93%). Half of the respondents (49%) thought that mining had impaired the state of the environment and nature in the municipality. On the other hand, one-fourth (27%) replied that mining had not changed the environment. The most significant causes of concern were changes in the landscape (19%) and impacts on water (15%).

Nevertheless, the majority of the respondents (58%) replied that regardless of the environmental threats, the expansion of mining in Sodankylä is acceptable.

In sum, the respondents in Sodankylä felt that mining activities had improved the local economy and the social atmosphere. In Storuman, opinions were divided and only a minority of the respondents thought that mining had had positive impacts on local life. This indicates that fulfilling residents' expectations for positive impacts, mainly on the local economy, is important in gaining the SLO (see also Jartti et al., 2017; Litmanen et al., 2015; cf. Moffat and Zhang, 2014).

7. Discussion

In line with the concept of social capital (Putnam, 1993) and SLO literature (e.g. Boutilier and Thomson, 2011; Thomson and Boutilier, 2011; Prno, 2013; Moffat and Zhang, 2014; Mercer-Mapstone et al., 2018), a company can gain a social license to operate by creating reciprocal relations with the host community, which will eventually consolidate the trust of the local residents and lead to cumulative positive effects on wellbeing in the community. However, our study indicates that this line of reasoning is somewhat simplistic. In addition to good company performance and interaction with the local community, there are other factors contributing to local acceptance.

This is not to say that company performance does not matter. As strongly pointed out in the SLO literature, a company's continued efforts to engage in open dialogue with the community is important in gaining local acceptance (e.g. Moffat and Zhang, 2014; Prno, 2013; Thomson and Boutilier, 2011). Our case studies also show that the presence of a company in the local community is important. For example, the respondents in Storuman were not able to evaluate the performance of the local mining companies, because they did not know what the companies were doing. Partly because of this, local acceptance of mining was clearly lower in Storuman (43%) than in Sodankylä

(85%). The difference may also be attributed to the phases of the mining operations in both communities. Instead of actual mining operations, Storuman had various projects in the prospecting or planning phase. Several companies have operated in the area, but apparently no long-term interaction has occurred between the industry and the local residents. In fact, the local people did not know exactly what companies were operating in their neighbourhood. In Sodankylä, the Kevitsa mine has been operative since 2012 and Anglo American has been prospecting and developing the Sakatti project since 2011 (Koskela, 2018; Jokela, 2018). Thus, mining and mineral prospecting have been visible in the local and regional media and part of the local life for a decade or so, which is why people know about the developments in both projects.

According to the SLO research literature, trust is important in gaining local acceptance, but opinions vary on whether it is a *condition* of good relations between a company and its host community (Boutilier and Thomson, 2011) or a *result* of good relations (Moffat and Zhang, 2014). Boutilier and Thomson (2011, pp. 4) make a difference between legitimacy and trust. According to the authors, trust requires that a company exhibit reciprocity in its interactions and that the relations between the company and the community are “based on an enduring regard for each other’s interests”. Moffat and Zhang (2014, pp. 68), for their part, argue that trust results from contact quality and procedural fairness – from a feeling that people are heard and listened to and that the company acts on their concerns. Hence, trust emanates from shared experiences and social relations and is, essentially, a prerequisite for the SLO. But perhaps trust could be something more?

Sztompka (1999, 25) argues that “trust is a bet about future contingent actions of others”. Consequently, trust is based on expectations in a situation where there is no certainty of how others will act and what the results will be. It means “committing ourselves to action with at least partly uncertain and uncontrollable consequences” (ibid, 26). According to this definition, trust in fact entails more than a company’s perceived reciprocal and responsive action. In the Sodankylä project assessments, “trust in the company” was indeed rated higher than “company performance” in connection with information sharing and participation opportunities. Putnam (1993) argues that trust is a *moral resource* for co-operation and that it is fostered by norms and networks. Hence, trust may arise not only from previous experiences of interaction with a company, but also from its reputation and stories spreading by word of mouth.

One facet of the issue of trust is that the local benefits of mining and their fair distribution also influence the trustworthiness of the industry (e.g. Jartti et al., 2017; Prno, 2013). The reported positive impacts of mining in Sodankylä – the vitality of the municipality, better public and private services, educational opportunities, and work and career opportunities – have contributed to the overall local acceptance of mining. In Storuman, on the other hand, the majority of the respondents failed to see any impacts of mining on their locality and everyday life. Instead, mining was mainly regarded as a risk for the environment and recreational life, which were highly valued by the residents.

Mining also changes communities. In roughly a decade, mining has become Sodankylä’s largest private-sector industry. New people have moved in, and hence the atmosphere in the community has started to change. Nevertheless, Sodankylä is not yet identified as a mining community and the ties between the local residents and newcomers are not very strong (Suopajarvi, 2017). From the perspective of social cohesion, stronger bridging ties between locals and “miners” would be important, as they enable diverse groups to meet and get to know one another (Putnam and Goss, 2002; van Oorschot et al., 2006). In Storuman, most of the respondents were elderly people who had lived in the area most of their lives. Mining may be seen there as an intruder, threatening the small and cosy villages that are regarded as safe havens far away from the outside world. Based on the survey, relatives and friends in Storuman have bonding ties that by definition are quite strong, close, and protective (Putnam, 1993; Putnam and Goss, 2002; van Oorschot et al., 2006).

A social license to operate is not gained in a vacuum. Socio-political legitimacy (Boutilier and Thomson, 2011) or legitimacy in general (see Jijelava and Vanclay, 2017), including trust in environmental legislation and authorities (Litmanen et al., 2015), are needed for reaching generalized trust (Luhmann, 1979; Putnam, 1993; Sztompka, 1999). In Scandinavian countries such as Finland and Sweden, generic trust is strong, even when compared with other European countries. This can be explained by the countries’ wealth and dominant Protestant culture (van Oorschot et al., 2006). However, based on the surveys of this study, there are serious doubts concerning environmental legislation and authorities in both countries. Almost half of the respondents in both countries reported that the environmental authorities were not monitoring environmental impacts effectively enough and that mining-related legislation and decision making should be enhanced. The imbalance between generalized trust in the state and mistrust in the environmental authorities is an issue where further research is needed.

8. Conclusions

This article aims to broaden the prevailing discourses on the social license to operate and local acceptance of industrial operations, especially mining. Our study comprised two surveys: one made in Storuman Municipality (Sweden) and the other in Sodankylä Municipality (Finland). Several mining and mineral exploration companies have been operating in both municipalities and there are mines in various phases of operation. In Sodankylä, mining was widely accepted (85%), whereas in Storuman, less than one-third (30%) of the residents favoured it. Based on our findings, company performance does matter, but it is far from being the only condition of the social license to operate. For example, trust plays an important part in gaining the license, but it does not arise solely from sufficiency of information and participatory possibilities. In the Sodankylä case, trust in the companies was graded higher than company performance. This may be due to the reputation of the companies, their contribution to the economic development of the region, and the positive impacts of mining on local life. The majority of the respondents in Sodankylä said that mining had improved municipal and private services as well as the residents’ educational, work, and career opportunities. In addition, it had also benefitted the local economy and contributed to the vitality of the municipality. In Storuman, the situation was quite the opposite, as roughly half of the respondents stated that mining had not affected the public and private services or the vitality of the municipality at all. Furthermore, almost one-third of the respondents reported that the local community had not benefitted from mining and that people instead were very concerned about the environment.

Our study shows that further research is needed to understand the process of advancing local acceptance of mining. Moreover, the social capital approach may provide useful insights into understanding the different facets of the SLO. Besides company–community relations, there are other, equally important factors that contribute to local residents’ attitudes. The social fabric of the community, the history and current phase of mining in the locality, the reputation of the operating companies, generalized trust in the regulatory framework, and distributional justice are all building blocks of the social license to operate.

Acknowledgements

The authors wish to thank the *Northern Periphery and Arctic* programme for making this article possible by funding our projects addressing the SLO. The research and the first draft of the article were funded by the REGINA (Regional Innovation in the Nordic Arctic and Scotland with special focus on regions with large-scale projects) project (2015–2018). The article was finalized through funding from the BuSK (Building shared knowledge capital to support natural resource governance in the Northern periphery) project (2016–2019). Finally, we are also grateful to researcher Johanna Saariniemi, research assistant

Sanna Pettersson, and our anonymous reviewers for their valuable comments on the earlier versions of the text.

References

- Agnico Eagle, 2018. Barsele. <https://www.agnicoeagle.com/English/exploration/exploration-projects/barsele/default.aspx>, Accessed date: 22 September 2018.
- Association of Finnish Local and Regional Authorities, 2018. Population. <https://www.kuntaliitto.fi/tilastot-ja-julkaisut/kuntakuvaajat/vaesto>, Accessed date: 22 September 2018.
- Beck, U., 1994. The reinvention of politics: towards a theory of reflexive modernization. In: Beck, U., Giddens, A., Lash, S. (Eds.), *Reflexive Modernization. Politics, Tradition and Aesthetics in the Modern Social Order*. Polity Press, Cambridge.
- Beland-Lindahl, K., Zachrisson, A., Viklund, R., Matti, S., Fjellborg, D., 2016. Fjällnära Gruvdrift? Konfliktier Om Vägar till Hållbarhet. Delrapport September 2016. Luleå technological university, Luleå.
- Beland-Lindahl, K., Johansson, A., Zachrisson, A., Viklund, R., 2018. Competing pathways to sustainability? Exploring conflicts over mine establishments in the Swedish mountain region. *J. Environ. Manag.* 218, 402–415.
- Boutilier, R.G., Thomson, I., 2011. Modelling and Measuring the Social License to Operate: Fruits of a Dialogue between Theory and Practice. https://www.researchgate.net/profile/Emmanuel_Raufflet/publication/276333081_De_l'acceptabilite_sociale_au_developpement_local_resilient/links/56000d6b08aeba1d9f8493ff.pdf, Accessed date: 12 October 2018.
- Dragon Mining, 2015. Svartliden Production Centre. <http://www.dragonmining.com/svartliden>, Accessed date: 22 September 2018.
- Granovetter, M.S., 1973. The strength of weak ties. *Am. J. Sociol.* 78 (6), 1360–1380.
- Jartti, T., Litmanen, T., Lacey, J., Moffat, K., 2017. Finnish Attitudes toward Mining. Citizen Survey – 2016 Results. University of Jyväskylä and Commonwealth Scientific & Industrial Research Organisation, Australia. <https://jyx.jyu.fi/handle/123456789/56561>, Accessed date: 12 October 2018.
- Jijelava, D., Vanclay, F., 2017. Legitimacy, credibility and trust as the key components of a social license to operate: an analysis of BP's projects in Georgia. *J. Clean. Prod.* 140, 1077–1086.
- Jokela, J., 2018. Running large-scale business in remote regions – challenges for industry. In: A Presentation in Regina Flagship Conference in Rovaniemi, 11th of September 2018.
- Karakaya, E., Nuur, C., 2018. Social sciences and the mining sector: some insights into recent research trend. *Resour. Policy* 58, 257–267.
- Koskela, J., 2018. Boliden Kevitsa mine. In: Presentation in the Mining Forum in Sodankylä 24.9.2018.
- Kuisma, M., Suopajärvi, L., 2017. Social Impacts of Mining in Sodankylä. University of Lapland. <http://lauda.ulapland.fi/handle/10024/62768>, Accessed date: 12 October 2018.
- Lempiäinen, H., 2019. Arctic Energy and Social Sustainability. Springer, Cham.
- Litmanen, T., Jartti, T., Rantala, E., 2015. Refining the preconditions of a social license to operate (SLO): reflections on citizens' attitudes towards mining in two Finnish regions. *Extr. Ind. Soc.* 3, 782–792.
- Luhmann, N., 1979. *Trust and Power*. John Wiley, Chichester.
- Mercer-Mapstone, L., Rifkin, W., Louis, Winnifred R., Moffat, K., 2018. Company-community dialogue builds relationships, fairness, and trust leading to social acceptance of Australian mining developments. *J. Clean. Prod.* 184, 671–677.
- Metsähallitus Parks & Wildlife in Finland, 2018. Viiankiaapa. <http://www.nationalparks.fi/viiankiaapa>, Accessed date: 12 October 2018.
- Moffat, K., Zhang, A., 2014. The paths to social license to operate: an integrative model explaining community acceptance of mining. *Resour. Policy* 39, 61–70.
- Prno, J., 2013. An analysis of factors leading to establishment of a social license to operate in the mining industry. *Resour. Policy* 38, 577–590.
- Putnam, R.D., 1993. *Making Democracy Work. Civic Traditions in Modern Italy*. Princeton University Press, Princeton.
- Putnam, R.D., Goss, K.A., 2002. Introduction. In: Putnam, R.D. (Ed.), *Democracies in Flux: the Evolution of Social Capital in Contemporary Society*. Oxford University Press, Oxford, pp. 3–19.
- Rothstein, B., 2002. Sweden. Social capital in the social democratic state. In: Putnam, R.D. (Ed.), *Democracies in Flux: the Evolution of Social Capital in Contemporary Society*. Oxford University Press, Oxford, pp. 289–332.
- Saariniemi, J., 2018. Experienced Impacts of Mining in Sodankylä: Follow-Up Study. University of Lapland. <http://lauda.ulapland.fi/handle/10024/63422>, Accessed date: 12 October 2018.
- Sztompka, P., 1999. *Trust : a Sociological Theory*. Cambridge University Press, Cambridge.
- Suopajärvi, Leena, Poelzer Gregory, A., Thomas, Ejdemo, Elena, Klyuchnikova, Elena, Korhach, Vigdis, Nygaard, 2016. Social sustainability in northern mining communities. A study of the European North and Northwest Russia. *Resour. Policy* 47, 61–68.
- Suopajärvi, L., 2017. Asettuaoko Pysyvästi Sodankylään? Kaivosalan Työntekijöiden Paikkakokemukset. [English Abstract: to Settle in Sodankylä? Place Experiences of Employees in the Mining Sector] *Acta Lapponica Fenniae*, vol 27. Lapin tutkimusseura, Rovaniemi, pp. 28–39.
- SVT Nyheter, 2016. Grönt Ljus till Gruva – 250 Jobb På Gang. [Green Light to the Mine – 250 Workplaces in the Offing]. <https://www.svt.se/nyheter/lokalt/vasterbotten/gront-ljus-till-gruva-over-50-jobb-pa-gang>, Accessed date: 22 September 2018.
- SVT Nyheter, 2018. Nej till en gruva vid Kyrkberget: “Blir svårigheter för rennäring”. [No the mine in Kyrkberget: “Problems to the reindeer herding”.] <https://www.svt.se/nyheter/lokalt/vasterbotten/landshovdingen-om-kyrkberget-det-blir-svarigheter-for-rennaringen>, Accessed date: 22 September 2018.
- Thomson, I., Boutilier, R.G., 2011. Social licence to operate. In: Darling, P. (Ed.), *SME Mining Engineering Handbook. Society for Mining, Metallurgy and Exploration*, Littleton, CO, pp. 1779–1796.
- Umander, K., Norlén, G., Jungsberg, L., 2018. Social Impacts of Mining in Storuman Municipality: Results of a Survey to Local Residents. Storuman Municipality and Nordregio. https://static1.squarespace.com/static/5649b47fe4b0b9e2752c60c9/t/5a856391e2c4835ce8f4efd1/1518691223470/Social+Impacts+of+Mining+in+Storuman_Survey+Results_Final.pdf, Accessed date: 12 October 2018.
- Vanclay, F., Esteves, A.M., Aucamp, I., Franks, D.M., 2015. *Social Impact Assessment: Guidance for Assessing and Managing the Social Impacts of Projects*. International Association for Impact Assessment. International Association for Impact Assessment, pp. 98.
- van Oorschot, W., Arts, W., Gelissen, J., 2006. Social capital in Europe. Measurement and social and regional distribution of a multifaceted phenomenon. *Acta Sociol.* 49 (2), 149–167.
- YLE, 2016. Kevitsan Kaivoksen Emoyhtiön Tulos Romahti. <https://yle.fi/uutiset/3-8684545>, Accessed date: 15 October 2018.
- YLE, 2018. Kevitsan Kaivokselle Suurinvestointi Sodankylässä – Laajennusurakka Tuo Jopa Satoja Työpaikkoja. <https://yle.fi/uutiset/3-10075406>, Accessed date: 15 October 2018.

Paper IV

Title: Population living on Permafrost

Authors: Justine Ramage, Leneisja Jungsberg, Shinan Wang, Sebastian Westermann, Hugues Lantuit, Timothy Heleniak.

Journal: Population and Environment, Vol. 43, P. 22–38

Published: <https://link.springer.com/article/10.1007/s11111-020-00370-6>



Population living on permafrost in the Arctic

Justine Ramage¹ · Leneisja Jungsberg^{1,2} · Shinan Wang¹ · Sebastian Westermann³ · Hugues Lantuit^{4,5} · Timothy Heleniak¹

Accepted: 25 November 2020/Published online: 06 January 2021
© The Author(s) 2021

Abstract

Permafrost thaw is a challenge in many Arctic regions, one that modifies ecosystems and affects infrastructure and livelihoods. To date, there have been no demographic studies of the population on permafrost. We present the first estimates of the number of inhabitants on permafrost in the Arctic Circumpolar Permafrost Region (ACPR) and project changes as a result of permafrost thaw. We combine current and projected populations at settlement level with permafrost extent. Key findings indicate that there are 1162 permafrost settlements in the ACPR, accommodating 5 million inhabitants, of whom 1 million live along a coast. Climate-driven permafrost projections suggest that by 2050, 42% of the permafrost settlements will become permafrost-free due to thawing. Among the settlements remaining on permafrost, 42% are in high hazard zones, where the consequences of permafrost thaw will be most severe. In total, 3.3 million people in the ACPR live currently in settlements where permafrost will degrade and ultimately disappear by 2050.

Keywords Arctic circumpolar permafrost region · Arctic settlements · Arctic population · Permafrost thaw · Arctic infrastructure · Risk

Introduction

The unprecedented rise in air surface temperature observed in the Arctic causes dramatic changes on the components of the cryosphere, including permafrost.

✉ Justine Ramage
justine.ramage@nordregio.org

¹ Nordregio, Stockholm, Sweden

² Institute for Natural Resources and Geosciences, Copenhagen University, Copenhagen, Denmark

³ Department of Geosciences, University of Oslo, Oslo, Norway

⁴ Alfred Wegener Institute Helmholtz Centre for Polar and Marine Research, Potsdam, Germany

⁵ Department for Earth Sciences, University of Potsdam, Potsdam, Germany

Permafrost is ground (soil, sediment, or rock) that remains at or below 0 °C for at least two consecutive years (Van Everdingen 2005). The permafrost region covers about 24% of the Earth's land surface in the Northern Hemisphere, including large areas of the Arctic (Gruber 2012). Over the last two decades, Arctic surface air temperature has increased by more than double the global average. Near-surface permafrost in the Arctic has warmed by more than 0.5 °C between 2009 and 2017 (Biskaborn et al. 2019), triggering permafrost thaw. This thaw causes changes in the ecosystems on which Arctic inhabitants are directly dependent. The impacts of permafrost thaw in the Arctic are becoming more visible, leading to increased scientific, economic, and political attention. The impacts on communities (Allard et al. 2012; Ford and Pearce 2010) include, e.g., destabilization of infrastructure (O'Garra 2017; Streletskiy et al. 2019), reduction in country food accessibility (Berkes and Jolly 2000; Wesche and Chan 2010), and declining health conditions (Sharma 2010). While people in the Arctic are adaptable to climatic variability, financial, institutional, and knowledge constraints are limiting their adaptive capacity (Ford et al. 2010).

As permafrost thaw accelerates in the Arctic, the need for studies looking at the impact of permafrost thaw on permafrost societies and economies increases. Seventy percent of the pan-Arctic residential, transportation, and industrial infrastructure is in areas with high potential for near-surface permafrost thaw by 2060 (Hjort et al. 2018). The changing environmental conditions not only affect people by damaging infrastructure but also impact the livelihoods and cultural activities of the populations living on permafrost (Ford and Pearce 2010). Arctic communities have a strong relationship with the land and the sea, and traditional activities such as hunting and fishing continue to be important for much of the population (Duhaime et al. 2004).

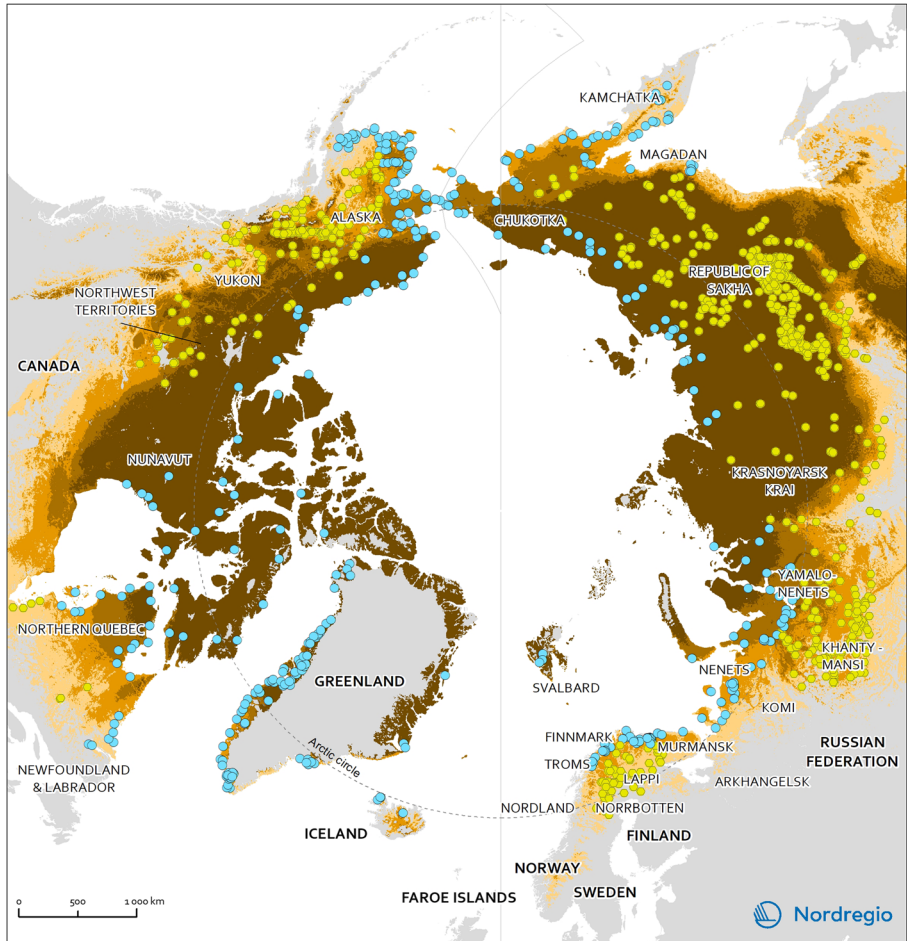
To understand the magnitude of the forthcoming challenges related to permafrost thaw in the Arctic, it is crucial to estimate the number of people who will be impacted. While most literature suggests that approximately 4 million people live in the commonly defined administrative Arctic region (NSIDC 2019; Nymand Larsen 2014), there is yet no estimate of the number of people living on permafrost in the Arctic. To address this, we define the Arctic Circumpolar Permafrost Region (ACPR) and contribute data on the number of people residing on permafrost in the Arctic. We combine administrative boundaries with current permafrost extent to define permafrost settlements and calculate the population living on permafrost. To fully grasp the risk of the anticipated change in permafrost in the ACPR, we combine a model projecting permafrost extent to 2060 with population projections from regional and national statistical institutes. The outcome forecasts the possible impact of permafrost loss on the population in the ACPR by 2050.

Study area

Our study area comprises the ACPR (Fig. 1). In defining this region, we developed a strategy for converging demographic and northern circumpolar permafrost extent datasets. We used the definition of the Arctic from the Arctic Human Development Report (AHDR, Einarsson et al. 2004) and adapted it to the scope of this study, to (1) reflect current Arctic geopolitical divisions; and (2) focus on the northern circumpolar permafrost region. As a result, a few regions comprising large areas underlain by

permafrost were added to the definition of the Arctic from the AHDR in order to conform to this paper’s focus on permafrost—the entire regions of Kamchatka, Magadan, Khanty-Mansi, the Sakha Republic, and Krasnoyarsk (Russian Federation).

The regions and countries included in the definition of the ACPR are Alaska (USA); Yukon, the Northwest Territories, Nunavut, Newfoundland and Labrador, Northern



Permafrost zones

- Continuous
- Discontinuous
- Sporadic
- Isolated

Permafrost settlements

- Inland
- Coastal

Included in the Arctic Circumpolar Permafrost Region:

- US - Alaska;
- CA - Yukon, Northwest Territories, Nunavut, Newfoundland & Labrador, Northern Quebec;
- GL - all;
- IS - all;
- NO - Nordland, Troms, Finnmark, Svalbard;
- SE - Norrbotten;
- FI - Lappi;
- RU - Komi, Arkhangelsk, Nenets, Khanty-Mansi, Yamalo-Nenets, Krasnoyarsk Krai, Republic of Sakha, Kamchatka, Magadan, Chukotka.

Fig. 1 Study area: permafrost settlements in the Arctic circumpolar permafrost region

Quebec (Canada); Nordland, Troms, Finnmark, Svalbard (Norway); Norrbotten (Sweden); Lapland (Finland); Komi, Arkhangelsk, Khanty-Mansi, Yamalo-Nenets, Krasnoyarsk, Sakha Republic, Kamchatka, Magadan, Chukotka (Russian Federation); as well as Greenland and Iceland. We further refer to regions from the Russian Federation as the Russian Arctic, and regions from Sweden, Norway, and Finland as the Fennoscandian Arctic.

Materials and methods

Settlements and permafrost extent

Settlements in this study are defined according to the Arctic countries' National Statistical Institutes (NSI). We defined permafrost settlements as settlements located within the permafrost extent, as modeled by Obu et al. (2019). The permafrost extent is based on the modeled temperature at the top of the permafrost (TTOP model) for the period 2000–2016. The permafrost extent is available at the circum-Arctic scale, with a resolution of 1 km². The permafrost zones are as follows: continuous (90–100% area coverage), discontinuous (50–90% area coverage), and sporadic (0–50% area coverage). In the definition of permafrost settlements, we used a socio-ecological system approach, which takes into account the fact that inhabitants strongly rely on services provided by ecosystems and are culturally deeply rooted in their local environment. Therefore, settlements within the sporadic permafrost zone are considered as permafrost settlements even if they are not directly built on permafrost.

To estimate the future of permafrost settlements, we used projected permafrost extents modeled by Hjort et al. (2018) using Representative Concentration Pathways (RCPs) 2.6, 4.5, and 8.5 for the period 2041–2060 (hereafter 2050). The model is binary and uses 30 arc-second grid cells (1 km²) to determine if permafrost is present or absent. We used the consensus index (I_c), which classifies future permafrost extent into hazard zones (1, low; 2, medium; and 3, high hazard zones). When defining hazard zones, the consensus index considers the relative increase of the active layer thickness, ground ice content, ground temperature, permafrost thaw potential, surface properties (sediment/bedrock), fine-grained sediment content, frost susceptibility of ground material, and slope gradient.

We further classified permafrost settlements as coastal or inland. There is no strict definition of the Arctic coastal zone. We defined coastal zones as regions where interactions of sea and land processes occur, from both physical and human geography perspectives. To define permafrost coastal settlements, we used a raster of the Arctic coastal zone defined in the Arctic Circumpolar Vegetation Map (Raynolds et al. 2019), which we overlapped with the permafrost extent.

Current and projected population

The two main sources of demographic data in this study are population censuses and administrative and register data, at settlement level. The study uses the latest available population data from 2016 or 2017 (Table 1).

The number of people and settlements impacted by permafrost thaw by mid-century in the ACPR is a function of two factors: projected permafrost extent and demography.

Table 1 List of demographic data sources used in this study

Name	Data year	Projection year	Data sources
Alaska	2017	2015–2045	Alaska Department of Labor and Workforce Development (http://www.labor.state.ak.us/) U.S. Census Bureau (https://www.census.gov/en.html)
Canada	2016	2016–2035	Yukon Bureau of Statistics (http://www.eco.gov.yk.ca/stats/ybs.html) NWT Bureau of Statistics (http://www.statsnwt.ca/) Nunavut Bureau of Statistics (https://www.gov.nu.ca/cia/information/nunavut-bureau-statistics) Newfoundland & Labrador Statistics Agency (https://www.stats.gov.nl.ca/) Statistics Canada (http://www.statcan.gc.ca/eng/start)
Greenland	2017	2017–2040	Statistics Greenland (http://www.stat.gl/)
Iceland	2017	2016–2066	Statistics Iceland (http://www.statice.is/)
Faroe Islands	2017	2016–2040	Statistics Faroe Islands (http://www.hagstova.fo/en)
Norway	2017	2017–2040	Statistics Norway (http://www.ssb.no/en/)
Sweden	2016	2017–2040	Statistics Sweden (http://www.scb.se/en/)
Finland	2016	2017–2040	Statistics Finland (http://www.stat.fi/index_en.html)
Russian Federation	2017	2019–2036	Federal States Statistics Service (http://www.gks.ru/)

The methodologies for projecting population and permafrost are quite separate, and do not take trends in the other into account. We used the population projections provided by the national and regional statistical offices and synthesized by Heliak (2019), and extrapolated the annual rate of change to the year 2050. The standard practice used by the national and regional statistical offices for projecting population change is the cohort-component method. The components of population change—fertility, mortality, and migration—are applied to the cohorts, or the age-sex structure of the population. Population projections at the settlement level are scarce, thus we applied the projected regional rates of change to the settlement level, assuming that all permafrost settlements within a region will change at the same rate over the projection period.

Limitations of the study

We used two models of permafrost extent to estimate the number of permafrost settlements. While the model resolutions are the same (1 km²), the models include different parameters to measure the probabilities of permafrost to occur in one place. This might impact our results when comparing ground conditions for current and projected permafrost settlements.

Additionally, projecting future demographic trends in the Arctic is difficult because of their small population sizes and their economies based on natural resources, which are subject to boom-and-bust cycles. To overcome this, we used regional population projections when available. On the one hand, it provides more

detail and nuance than the national projections. However, it also increases errors by combining different projection models. Models mainly differ in the amount of detail involved in the projected population and the length of the projection period (Heleniak 2019). Moreover, the demographic variability observed at the regional level in Arctic societies (Hamilton et al. 2018) confirms that the use of regional rates to project population at the settlement level might lead to over- or underestimation of the future population. However, with exception of Canada, there are no population projections available at the settlement level.

Results

Population on permafrost

In 2017, there were 4,942,685 inhabitants in the ACPR, residing in 1162 permafrost settlements (Table 2). Most of the population in the ACPR was concentrated in a few large permafrost settlements. A majority of the permafrost inhabitants lived in 511 settlements located in zones of sporadic permafrost (Table 2). However, most of the permafrost settlements were in zones of continuous permafrost, where 18.6% of the permafrost inhabitants lived. A few settlements were in zones of discontinuous permafrost. There were large regional differences in the distribution of permafrost settlements. The majority of the settlements in the Russian Arctic were located on continuous permafrost, while most of the permafrost settlements in the Fennoscandian Arctic were located in zones of sporadic permafrost (Appendix Table 5).

Of all permafrost settlements, 32.6% were coastal, where 1,099,186 inhabitants resided (Table 2). The majority of the coastal inhabitants were living in zones of sporadic permafrost, whereas 10% were living in zones of continuous permafrost. In Greenland, all settlements were coastal. In Canada and Alaska, almost half of the permafrost settlements were along the coastline, all located on continuous permafrost. In the Russian Arctic, permafrost settlements were mostly situated inland on continuous permafrost, except for the Nenets region, where all permafrost settlements were coastal, in zones of sporadic permafrost.

Table 2 Number of permafrost settlements and inhabitants by permafrost type in the Arctic Circumpolar Permafrost Region in 2017. Coastal settlements and population are included in the numbers of permafrost settlements and population

	Settlements on permafrost	Population on permafrost	Coastal settlements on permafrost	Coastal population on permafrost
Sporadic	511	3,286,723	205	876,896
Discontinuous	162	733,485	79	108,896
Continuous	489	922,477	95	113,394
Total	1162	4,942,685	379	1,099,186

Population impacted by the loss of permafrost

The number of people living on permafrost in the ACPR is expected to decrease, from 4.9 million in 2017 to 1.7 million in 2050. This means that 3.3 million people in the ACPR live in settlements where permafrost will degrade and ultimately disappear by 2050 (Table 3). The area with the largest population on permafrost by 2050 will remain the Russian Arctic (Khanty-Mansi, Sakha Republic, Murmansk, and Yamalo-Nenets).

In 2050, 1.7 million people will live in 628 permafrost settlements (Table 3). Although there were only few settlements located in areas with permafrost in Sweden, Finland, and Iceland, by 2050 there will no longer be any permafrost settlements in these countries (Fig. 2, Appendix Table 6).

Damage caused by permafrost thaw in permafrost settlements will differ depending on the permafrost's vulnerability to thawing, as summarized by the hazard zones. Among the settlements remaining on permafrost in 2050, 41.7% (RCP 4.5) will be in high hazard zones, where the consequences of permafrost thaw will be most severe (Table 3). This will mainly affect settlements in the Russian Arctic and in Alaska (Fig. 2, Appendix Table 7). By contrast, 20.9% (RCP 4.5) of the settlements remaining on permafrost in 2050 will be least impacted by permafrost thaw, mainly in Greenland and Canada. While 43.0% (RCP 4.5) of the permafrost inhabitants will live in low hazard zones, 32.0% will be in high hazard zones, where permafrost is likely to be extremely degraded. In comparison to inland settlements, a larger proportion of coastal settlements will become permafrost-free by 2050, although fewer of these coastal settlements will be in high hazard zones (Table 3). By 2050, 323,362 people will live in a coastal permafrost settlement, 42.7% of them in a high hazard zone (Table 3).

Almost all the population currently living in areas of sporadic permafrost in the ACPR will be living in permafrost-free areas (Table 4). More than half of the population currently living in areas of discontinuous or continuous permafrost will be living in medium and high hazard zones (Table 4).

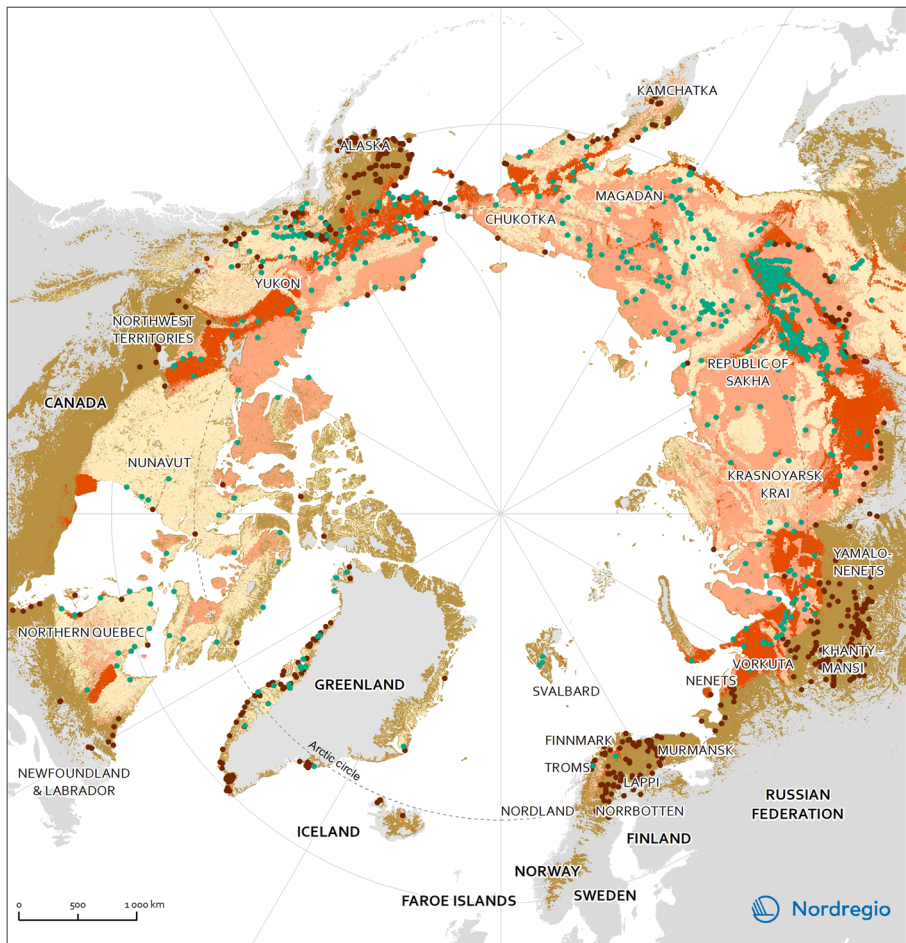
Largest settlements impacted by the loss of permafrost

Most of the permafrost settlements in the ACPR were small, with a median size of 622 inhabitants. However, there were 123 permafrost settlements with more than 5000 inhabitants in 2017. These large settlements had a median population of 12,696 (min = 5024, max = 360,590), and a total of 4 million inhabitants. Eighty-five percent of the large permafrost settlements were in the Russian Arctic. The population in the large settlements is projected to increase by 3.5% by 2050. In total, 65.8% of these large settlements were in zones of sporadic permafrost, while 34.1% were in zones of discontinuous and continuous permafrost.

Surgut, Yakutsk, Murmansk, Nizhnevartovsk, and Norilsk are the five largest settlements in the Russian Arctic that will have to adapt to the loss of permafrost. In 2017, 1.4 million people lived in these five settlements, where the population is projected to increase by 3.9%. Surgut, Murmansk, and Nizhnevartovsk are in the sporadic and discontinuous permafrost zones. While it is not possible to determine from the permafrost maps utilized in this study to what extent the settled areas are currently underlain by permafrost, the regions around the settlements will become permafrost-free by 2050. Yakutsk and Norilsk are located on continuous permafrost

Table 3 Projected number of permafrost settlements and population by 2050 using three Representative Concentration Pathways (RCPs 2.6; 4.5; and 8.5) and hazard zone scenarios. Coastal settlements and population are included in the numbers of permafrost settlements and population

	Permafrost settlements			Population on permafrost			Coastal permafrost settlements			Coastal population on permafrost		
	RCP 2.6	RCP 4.5	RCP 8.5	RCP 2.6	RCP 4.5	RCP 8.5	RCP 2.6	RCP 4.5	RCP 8.5	RCP 2.6	RCP 4.5	RCP 8.5
Low hazard zone	144	131	106	730,048	711,333	481,123	59	56	44	119,438	108,835	70,101
Medium Hazard zone	245	235	239	408,550	414,219	617,118	56	56	59	67,638	76,498	100,483
High Hazard zone	239	262	283	516,692	529,738	557,049	39	42	51	136,286	138,029	152,778
Total	628			1,655,290			154			323,362		



Permafrost extent
Current:
 Permafrost extent 2016

Future: hazard zones (2060, RCP 4.5)
 Low
 Medium
 High

Permafrost settlements
 Permafrost settlements by 2060
 Permafrost settlements in 2017

Fig. 2 Settlements at risk due to permafrost thaw by 2060

and will be more affected by permafrost thaw, although they will be in low hazard zones. Yellowknife in Canada is the largest settlement on permafrost in the Canadian Arctic. Its population of 19,596 in 2017 is expected to grow by 20.5% by 2050. Yellowknife is located on discontinuous permafrost, and will be in a high hazard zone by 2050.

Due to permafrost thaw, 65.0% of the large settlements of the ACPR will become permafrost-free by 2050 (RCP 4.5), and their 3 million inhabitants will have to contend with changes related to the loss of permafrost. Among the 43 large settlements that will remain on permafrost by 2050, 20 are in high hazard zones, where the consequences of

Table 4 Proportion of the population within type of permafrost area that will be affected by permafrost thaw by 2050 (RCP 4.5)

Permafrost type 2017	Population 2017	Proportion of the population affected by permafrost thaw by 2050 (%)			
		Permafrost-free zone	Low hazard zone	Medium hazard zone	High hazard zone
Sporadic	3,286,723	95,6	0,7	0,3	3,5
Discontinuous	733,485	12,8	38,9	24,8	23,5
Continuous	922,477	3,3	43,9	25,2	27,7

permafrost thaw will be the most profound. Of these 20 settlements, 19 are in the Russian Arctic and one is in Canada.

Variability in the impacts depending on the climate trajectory

The results we describe consider a mitigation emission scenario (RCP 4.5), suggesting a stabilization of atmospheric concentrations near 2060 to 4.5 W/m² (or 650 ppm CO₂ equivalent). Following a “business as usual” scenario (RCP 8.5), the consequences of permafrost thaw on permafrost settlements and population will be worse. In such a scenario, the number of permafrost settlements that will be in high hazard zones by 2050 will be 8% higher and the permafrost population 5% higher (Table 3). The consequences for coastal settlements will be more severe, with a 21% increase in the number of permafrost settlements in high hazard zones and an 11% increase in permafrost population in these zones. The consequences of permafrost thaw on permafrost settlements and population will be reduced if greenhouse gases emissions are low and atmospheric concentrations stabilize earlier (RCP 2.6). The number of permafrost settlements located in high hazard zones will be 10% lower, and the permafrost population will fall by 3% (Table 3).

Discussion

Adaptation to permafrost-free environment

We show that close to 3.3 million people living in the ACPR will be affected by the thawing—and eventual loss—of permafrost. Three percent of the settlements that are currently located on continuous permafrost will become permafrost-free, meaning that the settlements will have to face the costs of rebuilding and renovating public and private infrastructure damaged by permafrost thaw. The majority of permafrost inhabitants (3.1 million) live in zones of sporadic permafrost. While almost all of the people living in zones of sporadic permafrost will live in a permafrost-free area in 2050, the costs related to permafrost thaw in these settlements might not be as high if they are not directly located on permafrost. However, people living on sporadic permafrost will be impacted by the changes affecting the permafrost ecosystems surrounding their settlements, which will trigger transitions in socio-ecological systems (Schuur and Mack

2018). By contrast, settlements in discontinuous or continuous permafrost zones that will be in high hazard zones in 2050 will face significant costs associated with adapting to permafrost thaw. Damage to infrastructure due to permafrost thaw is caused by both ground subsidence and a decrease in the ground's bearing capacity, leading to cracks, deformations, and the collapse of built structures (Streletskiy et al. 2012, 2019). This impacts the useful life of infrastructure, reducing it by 0.2% in sporadic permafrost and by 0.9% in continuous permafrost per °C increase (Larsen et al. 2008). In the Russian Arctic, the most significant reduction in bearing capacity is expected in the discontinuous and southern fringes of continuous permafrost zones (Shiklomanov et al. 2017a), in which we calculate that 472 settlements and 1.5 million people are located.

Adaptation in settlements remaining on permafrost

For the settlements remaining on permafrost, the consequences of permafrost thaw will vary depending on the hazard zone on which they are located. In 2050, half a million inhabitants on permafrost will live in high hazard zones, where the consequences of permafrost thaw will be most severe, mainly in the Russian Arctic and in Alaska. These areas are in thaw-unstable zones characterized by relatively high ground-ice content and thick deposits of frost-susceptible sediments (Hjort et al. 2018). By contrast, permafrost thaw will be a minor concern for slightly more than 700,000 permafrost inhabitants who will live in low hazard zones, mostly in Greenland and in Canada, where a large number of people currently live in settlements built on bedrock.

Adaptation in coastal permafrost settlements

We show that coastal settlements are proportionally more exposed to permafrost thaw than inland settlements. Flooding and coastal erosion are major risks for many of these settlements, threatening the viability of some settlements, damaging important cultural heritage sites, and compromising municipal infrastructure and water supply (Nelson et al. 2001; Shiklomanov et al. 2017b; Warren et al. 2005). Coastal settlements will suffer from both ground subsidence and coastal erosion. While ground subsidence is a parameter included in the permafrost projection model (Hjort et al. 2018), coastal erosion is not. Along the Arctic coast, coastal erosion rates average 0.5 m a^{-1} , with high geographic variability (Lantuit et al. 2012). Coastal erosion is a real threat for the 379 coastal settlements on permafrost and their 1 million inhabitants. Several communities have already been forced to relocate, while others have just left vulnerable settlements (Bronen 2010; Hamilton et al. 2016). However, the settlements most threatened by erosion in Alaska do not yet show any evidence of increased outmigration (Hamilton et al. 2018).

Adaptation capacity

Settlements in the ACPR differ considerably in terms of both population size and physical ground conditions. Despite their differences in terms of population size, infrastructure, and economy (Hamilton et al. 2018), Arctic settlements face similar challenges related to the loss of permafrost. The impacts mainly relate to damage to infrastructure and changes in the livelihoods of people living on permafrost. These impacts might have significant consequences on the future economic and social development of the Arctic (Streletskiy et al.

2012). Adaptation capacity to permafrost-free environments will vary depending on the type of permafrost and potential hazard zone on which the settlements are currently located, as well as the settlements' size and economic situation. Larger settlements located in high hazard zones related to permafrost thaw are mostly located in the Russian Arctic, and in some ACPR regions with the strongest economies (as measured by the Growth Regional Product (GRP)). The economic situation in these regions may help to offset some mitigation costs (Suter et al. 2019). However, some regions with large settlements and weaker economies located in high hazard zones will incur high annual costs to address damages related to permafrost thaw. This is the case for the Northwest Territories in Canada, where the annual costs might be as high as 1.5% of GRP (Suter et al. 2019).

Conclusion

This is the first demographic study assessing the population living on permafrost and the impact of permafrost thaw on the population living in the Arctic Circumpolar Permafrost Region. In 2017, close to five million inhabitants lived in 1162 permafrost settlements in the ACPR. As a result of permafrost thaw, many of these inhabitants will live in permafrost-free areas by 2050. The total number of inhabitants on permafrost is projected to decrease by 61.2%—from 4.9 million to 1.7 million by 2050. Permafrost will degrade and ultimately disappear in 534 permafrost settlements, impacting the life of 3.3 million inhabitants. Settlements remaining on permafrost by 2050 will also have to adapt to permafrost thaw, as 42% of them will be located in high hazard zones. The impacts will vary depending on the future climate trajectory, the permafrost type and hazard zones in which settlements are located, and the extent to which settlements can adapt in the remaining time before the permafrost thaws.

Data

The data used is listed in the references, tables, supporting information, and the ZENODO repository <https://doi.org/10.5281/ZENODO.4266017> (Wang and Ramage 2020).

Appendix 1

Table 5 Number of settlements within each permafrost extent zone per country in 2017

	Alaska	Canada	Finland	Greenland	Iceland	Norway	Russia	Sweden
Sporadic	123	45	21	34	4	20	241	23
Discontinuous	50	19	0	22	0	0	71	0
Continuous	19	44	0	23	0	2	401	0

Appendix 2

Table 6 Number of settlements and people in the permafrost zone of the ACPR per region in 2017 and by 2050

Country	Region	Settlements 2017	Population 2017	Settlements 2050	Population 2050
Alaska	All ACPR regions	192	169,481	77	29,173
	Bethel	32	17,985	0	0
	Bristol Bay	1	309	0	0
	Denali	4	1574	2	182
	Dillingham	9	3982	0	0
	Fairbanks North Star	17	96,665	2	3182
	Haines	1	265	0	0
	Kusilvak CA (Wade Hampton)	13	8180	0	0
	Lake and Peninsula	2	146	0	0
	Matanuska-Susitna	3	307	2	525
	Nome	20	10,798	10	8743
	North Slope	8	8745	6	2534
	Northwest Arctic	11	7374	11	9118
	Southeast Fairbanks	19	6520	14	2495
	Valdez-Cordova	15	1557	7	258
	Yukon-Koyukuk	37	5074	23	2136
	Canada	All ACPR regions	108	155,714	59
Newfoundland and Labrador		9	21,432	0	0
Northwest Territories		33	41,425	19	34,051
Nunavut		24	34,944	17	44,746
Quebec		22	26,607	13	18,693
Yukon		20	31,306	10	5235
Finland	All ACPR regions	21	76,536	0	0
	Lappi	21	76,536	0	0
Greenland	All ACPR regions	79	54,257	17	12,554
	Aasiaat	1	3112	0	0
	Ammasalik	6	2930	1	184
	Illoqqortoormiut	2	380	1	5
	Ilulissat	5	4908	2	4179
	Ivittuut	1	1	0	0
	Kangaatsiaq	5	1182	1	242
	Maniitsoq	4	3143	0	0
	Nanortalik	6	283	0	0
	Narsaq	6	1674	0	0
	Nuuk	4	17,851	1	3
	Paamiut	2	1530	0	0
	Qaanaaq	4	755	2	621

Table 6 (continued)

Country	Region	Settlements 2017	Population 2017	Settlements 2050	Population 2050
	Qaqortoq	4	3273	0	0
	Qasigianguit	2	1183	0	0
	Qeqertarsuaq	2	876	0	0
	Sisimiut	4	6096	2	5356
	Uden for Kommunal Inddel	2	96	1	82
	Upernavik	11	2748	2	393
	Uummannaq	8	2236	4	1489
Iceland	All ACPR regions	4	1570	0	0
	Iceland	4	1570	0	0
Norway	All ACPR regions	23	43,973	5	7138
	Finmark	15	38,637	1	2013
	Svalbard (incl. Barentsburg)	3	3044	3	4818
	Troms	5	2292	1	307
Russian Federation	All ACPR regions	712	4,390,905	470	1,503,700
	Arhangelskaja oblast	1	2405	1	1985
	Autonomous Nenets	20	43,937	5	3088
	Chukotsk	28	47,038	20	55,631
	Hanty-Mancijskij (Jugra)	96	1,638,880	0	0
	Kamchatskij Kraj	5	13,203	0	0
	Komi	6	79,593	6	61,825
	Koryak Okrug	22	13,447	8	3076
	Krasnoyarsk	29	207,945	16	176,162
	Magadan Oblast	22	139,308	20	33,783
	Murmansk	33	701,683	0	0
	Saha (Jakutija)	398	937,160	364	846,800
	Sakha (Yakutia)	1	1089	1	1078
	Taymur	4	30,717	3	27,631
	Yamalo-Nenets	47	534,500	26	292,641
Sweden	All ACPR regions	23	50,249	0	0
	Norrbotten	23	50,249	0	0

Appendix 3

Table 7 Projected number of settlements within each permafrost hazard zones per country by 2050. The projections follow the RCP 4.5 scenario

	Alaska	Canada	Finland	Greenland	Iceland	Norway	Russia	Sweden
Low hazard	20	32	0	15	0	0	64	0
Medium hazard	28	16	0	2	0	3	186	0
High hazard	29	11	0	0	0	1	221	0

Open Access This article is licensed under a Creative Commons Attribution 4.0 International License, which permits use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons licence, and indicate if changes were made. The images or other third party material in this article are included in the article's Creative Commons licence, unless indicated otherwise in a credit line to the material. If material is not included in the article's Creative Commons licence and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder. To view a copy of this licence, visit <http://creativecommons.org/licenses/by/4.0/>.

References

- Allard, M., Lemay, M., Barrette, C., L'Hérault, E., Sarrazin, D., Bell, T., & Doré, G. (2012). Permafrost and climate change in Nunavik and Nunatsiavut: Importance for municipal and transportation infrastructures (Nunavik and Nunatsiavut: From science to policy. An integrated regional impact study (IRIS) of climate change and modernization, p. 27).
- Berkes, F., & Jolly, D. (2000). Adapting to climate change: Social-ecological resilience in a Canadian Western Arctic community. *Ecology and Society*. <https://doi.org/10.5751/ES-00342-050218>.
- Biskaborn, B. K., Smith, S. L., Noetzi, J., Matthes, H., Vieira, G., Streletskiy, D. A., Schoeneich, P., Romanovsky, V. E., Lewkowicz, A. G., Abramov, A., Allard, M., Boike, J., Cable, W. L., Christiansen, H. H., Delaloye, R., Diekmann, B., Drozdov, D., Etzelmüller, B., Grosse, G., et al. (2019). Permafrost is warming at a global scale. *Nature Communications*, 10(1), 264. <https://doi.org/10.1038/s41467-018-08240-4>.
- Bronen, R. (2010). Forced migration of Alaskan indigenous communities due to climate change. In *Environment, forced migration and social vulnerability* (pp. 87–98). Berlin: Springer.
- Duhaime, G., Chabot, M., Fréchette, P., Robichaud, V., & Proulx, S. (2004). The impact of dietary changes among the inuit of Nunavik (Canada): A socioeconomic assessment of possible public health recommendations dealing with food contamination. *Risk Analysis*, 24(4), 1007–1018. <https://doi.org/10.1111/j.0272-4332.2004.00503.x>.
- Einarsson, N., Nymand Larsen, J., Nilsson, A. and Young, O.R., 2004. Arctic human development report. Stefansson Arctic Institute.
- Ford, J. D., & Pearce, T. (2010). What we know, do not know, and need to know about climate change vulnerability in the western Canadian Arctic: A systematic literature review. *Environmental Research Letters*, 5(1), 14008.
- Ford, J. D., Pearce, T., Duerden, F., Furgal, C., & Smit, B. (2010). Climate change policy responses for Canada's Inuit population: The importance of and opportunities for adaptation. *Global Environmental Change*, 20(1), 177–191.
- Gruber, S. (2012). The cryosphere derivation and analysis of a high-resolution estimate of global permafrost zonation. *Cryosphere*, 6, 221–233. <https://doi.org/10.5194/tc-6-221-2012>.
- Hamilton, L. C., Saito, K., Loring, P. A., Lammers, R. B., & Huntington, H. P. (2016). Climigration? Population and climate change in Arctic Alaska. *Population and Environment*, 38(2), 115–133.

- Hamilton, L. C., Wirsing, J., & Saito, K. (2018). Demographic variation and change in the Inuit Arctic. *Environmental Research Letters*, 13(11) IOP Publishing, 115007. <https://doi.org/10.1088/1748-9326/aae7ef>.
- Heleniak, T. (2019). The future of the Arctic populations. *Polar Geography*. <https://doi.org/10.1080/1088937X.2019.1707316>.
- Hjort, J., Karjalainen, O., Aalto, J., Westermann, S., Romanovsky, V. E., Nelson, F. E., Etzelmüller, B., & Luoto, M. (2018). Degrading permafrost puts Arctic infrastructure at risk by mid-century. *Nature Communications*, 9(1), 5147. <https://doi.org/10.1038/s41467-018-07557-4>.
- Lantuit, H., Overduin, P. P., Couture, N., Wetterich, S., Aré, F., Atkinson, D., Brown, J., Cherkashov, G., Drozdov, D., Forbes, D. L., & Graves-Gaylord, A. (2012). The Arctic coastal dynamics database: A new classification scheme and statistics on Arctic permafrost coastlines. *Estuaries and Coasts*, 35(2), 383–400.
- Larsen, P. H., Goldsmith, S., Smith, O., Wilson, M., Strzepek, K., Chinowsky, P., & Saylor, B. (2008). Estimating future costs for Alaska public infrastructure at risk from climate change. *Global Environmental Change*, 18(3), 442–457. <https://doi.org/10.1016/j.gloenvcha.2008.03.005>.
- Nelson, F. E., Anisimov, O. A., & Shiklomanov, N. I. (2001). Subsidence risk from thawing permafrost. *Nature*, 410(6831), 889. <https://doi.org/10.1038/35073746>.
- NSIDC (2019). Arctic people | National Snow and ice data center. The National Snow and Ice Data Center. <https://nsidc.org/cryosphere/arctic-meteorology/arctic-people.html>.
- Nymand Larsen, J. (Ed.). (2014). Arctic human development report: Regional processes and global linkages. Nordic Council of Ministers.
- O'Garra, T. (2017). Economic value of ecosystem services, minerals and oil in a melting Arctic: A preliminary assessment. *Ecosystem Services*, 24, 180–186. <https://doi.org/10.1016/j.ecoser.2017.02.024>.
- Obu, J., Westermann, S., Bartsch, A., Berdnikov, N., Christiansen, H. H., Dashtseren, A., Delaloye, R., Elberling, B., Etzelmüller, B., Kholodov, A., Khomutov, A., Kääb, A., Leibman, M. O., Lewkowicz, A. G., Panda, S. K., Romanovsky, V., Way, R. G., Westergaard-Nielsen, A., Wu, T., et al. (2019). Northern hemisphere permafrost map based on TTOP modelling for 2000–2016 at 1 km² scale. *Earth-Science Reviews*, 193, 299–316. <https://doi.org/10.1016/j.earscirev.2019.04.023>.
- Raynolds, M. K., Walker, D. A., Balsler, A., Bay, C., Campbell, M., Cherosov, M. M., Daniëls, F. J., Eidesen, P. B., Ermokhina, K. A., Frost, G. V., & Jedrzejek, B. (2019). A raster version of the circumpolar Arctic vegetation map (CAVM). *Remote Sensing of Environment*, 232, 111297. <https://doi.org/10.1016/j.rse.2019.111297>.
- Schuur, E. A. G., & Mack, M. C. (2018). Ecological response to permafrost thaw and consequences for local and global ecosystem services. *Annual Review of Ecology, Evolution, and Systematics*, 49(1), 279–301. <https://doi.org/10.1146/annurev-ecolsys-121415-032349>.
- Sharma, S. (2010). Assessing diet and lifestyle in the Canadian Arctic Inuit and Inuvialuit to inform a nutrition and physical activity intervention programme: Nutrition transition in Arctic Canada. *Journal of Human Nutrition and Dietetics*, 23, 5–17. <https://doi.org/10.1111/j.1365-277X.2010.01093.x>.
- Shiklomanov, N. I., Streletskiy, D. A., Swales, T. B., & Kokorev, V. A. (2017a). Climate change and stability of urban infrastructure in Russian permafrost regions: Prognostic assessment based on GCM climate projections. *Geographical Review*, 107(1), 125–142. <https://doi.org/10.1111/gere.12214>.
- Shiklomanov, N. I., Streletskiy, D. A., Grebenets, V. I., & Suter, L. (2017b). Conquering the permafrost: Urban infrastructure development in Norilsk, Russia. *Polar Geography*, 40(4), 273–290. <https://doi.org/10.1080/1088937X.2017.1329237>.
- Streletskiy, D. A., Shiklomanov, N. I., & Nelson, F. E. (2012). Permafrost, infrastructure, and climate change: A GIS-based landscape approach to geotechnical modeling. *Arctic, Antarctic, and Alpine Research*, 44(3), 368–380. <https://doi.org/10.1657/1938-4246-44.3.368>.
- Streletskiy, D. A., Suter, L. J., Shiklomanov, N. I., Porfiriev, B. N., & Eliseev, D. O. (2019). Assessment of climate change impacts on buildings, structures and infrastructure in the Russian regions on permafrost. *Environmental Research Letters*, 14(2), 025003. <https://doi.org/10.1088/1748-9326/aa15e6>.
- Suter, L. J., Streletskiy, D. A., & Shiklomanov, N. I. (2019). Assessment of the cost of climate change impacts on critical infrastructure in the circumpolar Arctic. *Polar Geography*. <https://doi.org/10.1080/1088937X.2019.1686082>.
- Van Everdingen, R. O. (2005). Multi-language glossary of permafrost and related ground-ice. International Permafrost Association, Terminology Working Group.
- Wang, S., & Ramage, J. (2020). Population in the Arctic circumpolar permafrost region at settlement level. *Zenodo*. <https://doi.org/10.5281/ZENODO.4266017>.
- Warren, J. A., Berner, J. E., & Curtis, T. (2005). Climate change and human health: Infrastructure impacts to small remote communities in the north. *International Journal of Circumpolar Health*, 64(5), 487–497. <https://doi.org/10.3402/ijch.v64i5.18030>.

Wesche, S. D., & Chan, H. M. (2010). Adapting to the impacts of climate change on food security among Inuit in the Western Canadian Arctic. *EcoHealth*, 7(3), 361–373. <https://doi.org/10.1007/s10393-010-0344-8>.

Publisher's note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

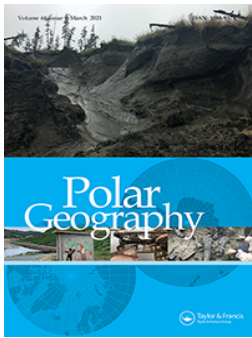
Paper V:

***Title:** Adaptive capacity to manage permafrost degradation in Northwest Greenland*

***Authors:** Leneisja Jungsberg, Lise Byskov Herslund, Kjell Nilsson, Shinan Wang, Soňa Tomaškovičová, Karl Madsen, Johanna Scheer, Thomas Ingeman- Nielsen.*

***Journal:** Polar Geography*

***Published:** <https://www.tandfonline.com/doi/full/10.1080/1088937X.2021.1995067>*



Adaptive capacity to manage permafrost degradation in Northwest Greenland

Leneisja Jungsberg, Lise Byskov Herslund, Kjell Nilsson, Shinan Wang, Soňa Tomaškovičová, Karl Madsen, Johanna Scheer & Thomas Ingeman-Nielsen

To cite this article: Leneisja Jungsberg, Lise Byskov Herslund, Kjell Nilsson, Shinan Wang, Soňa Tomaškovičová, Karl Madsen, Johanna Scheer & Thomas Ingeman-Nielsen (2021): Adaptive capacity to manage permafrost degradation in Northwest Greenland, Polar Geography, DOI: [10.1080/1088937X.2021.1995067](https://doi.org/10.1080/1088937X.2021.1995067)

To link to this article: <https://doi.org/10.1080/1088937X.2021.1995067>



© 2021 The Author(s). Published by Informa UK Limited, trading as Taylor & Francis Group



Published online: 26 Oct 2021.



Submit your article to this journal [↗](#)





View related articles [↗](#)



View Crossmark data [↗](#)

Adaptive capacity to manage permafrost degradation in Northwest Greenland

Leneisja Jungsberg ^{a*}, Lise Byskov Herslund ^a, Kjell Nilsson^b, Shinan Wang^c, Soňa Tomašková^d, Karl Madsen^e, Johanna Scheer^d and Thomas Ingeman-Nielsen^d

^aInstitute for Geosciences and Natural Resource Management, Københavns Universitet, København, Denmark;

^bNilsson Landscape, Hjarup, Sweden; ^cNordregio, Stockholm, Sweden; ^dDepartment of Civil Engineering, Danmarks Tekniske Universitet, Lyngby, Denmark; ^eAvannaata Kommunia, Ilulissat, Greenland

ABSTRACT

Global warming has reduced the extent of permafrost, increased permafrost temperatures, and deepened the active layer across the Arctic. Permafrost degradation has detrimental effects on infrastructure and negative impacts on ecosystem services for many Arctic communities. This study examines the adaptive capacity for managing permafrost degradation in Northwest Greenland. The methods are based on questionnaire and interview data from fieldwork, frozen ground temperature records and published data forecasting the deepening of the active layer. Results illustrate the impact of permafrost degradation on the physical environment, hunting and harvesting, housing, and the economy in Northwest Greenland. House owners are mending damage caused by ground movement, and local institutions are concerned with the maintenance of roads and other public infrastructure impacted by permafrost. The scientific knowledge needed to inform decision-making is useful for identifying overall changes, but existing data sources are scarce, and more detailed permafrost maps are needed for long-term town planning. The study concludes that many individuals and institutions engage in autonomous adaptation on an ad hoc basis, rather than pursuing an overall strategy to increase the adaptive capacity in advance of future permafrost degradation in Northwest Greenland.

ARTICLE HISTORY

Received 2 June 2021

Accepted 14 October 2021

KEYWORDS

Adaptive capacity; permafrost degradation; community action; long-term planning; Northwest Greenland

Introduction

In past generations, permafrost conditions were not a cause of concern. Communities and lifeways were built with little consideration for the subsurface, or else on the assumption that permafrost would continue in perpetuity. However, global warming has reduced the extent of permafrost, increased the temperature of the permafrost and deepened the active layer in numerous locations across the Arctic (Aalto et al., 2018; Biskaborn et al., 2019; Doré et al., 2016; Streletskiy et al., 2012). Some of the common societal effects include coastal erosion, archaeological and cultural heritage sites eroding into the sea,

CONTACT Leneisja Jungsberg  leneisja.jungsberg@nordregio.org  Institute for Geosciences and Natural Resource Management, Københavns Universitet, København, Denmark

*Present address: Nordregio, Stockholm, Sweden

© 2021 The Author(s). Published with license by Taylor and Francis Group, LLC

This is an Open Access article distributed under the terms of the Creative Commons Attribution-NonCommercial-NoDerivatives License (<http://creativecommons.org/licenses/by-nc-nd/4.0/>), which permits non-commercial re-use, distribution, and reproduction in any medium, provided the original work is properly cited, and is not altered, transformed, or built upon in any way.

collapsing fill around the pilings supporting public infrastructure, the destabilization of roads, and ice cellars thawing and flooding (Doloisio & Vanderlinden, 2020; Doré et al., 2016; Instanes & Anisimov, 2008; Larsen et al., 2021; Shiklomanov et al., 2017).

Climate scenarios for the coming decades predict the permafrost thaw will continue to have negative effects on engineered constructions, socio-economic activities and natural ecosystems (AMAP, 2018; Hjort et al., 2018; Vincent et al., 2013). The detrimental effects on infrastructure and various negative ecosystem impacts require long-term adaptation planning. Studies of the social impact of permafrost illustrate that more effort is needed to increase the geographic coverage of observations, to improve local-level projections and to reduce uncertainty (Allard et al., 2012; AMAP, 2018; Doré et al., 2016). To prepare for future changes, the Arctic Council has recommended expanding the documentation of adaptation responses by Arctic communities (Arctic Council, 2017). Several communities in Canada and Alaska have already developed strategic plans on adaptation planning for permafrost (Allard et al., 2012; Hong et al., 2014; Jeff Birchall & Bonnett, 2020).

Findings from research in Northwest Greenland estimate 200 areas face a risk of permafrost thaw leading to rock slope stability issues. Of these, 18 are in the vicinity of human settlements and infrastructure, and therefore expose these communities to the risk of rock-slides induced by permafrost degradation (GEUS, 2018; Schultz-Nielsen, 2019). While several researchers have studied adaptation in the context of climate change in Greenland (Hastrup, 2018; Naalakkersuisut, 2012, 2017), gaps remain in our understanding of adaptation practices to cope with permafrost degradation and, even more importantly, for assessing the adaptive capacity needed to manage the impact in the future (Ramage et al., 2021). The ability to cope with manage permafrost change is also influenced by community capacity and local perceptions of the impact (McNamara & Buggy, 2017; Piggott-McKellar et al., 2019).

In this article, we will examine the adaptive capacity to cope with permafrost changes in Northwest Greenland. Our analysis builds on a theoretical framework encompassing three dimensions, each informed by the adaptive capacity studies. In the first dimension, we assess *community awareness of permafrost change*. In the second, we assess the *institutional organization of adaptation measures for permafrost*, and in the third, we assess the *scientific knowledge needed to inform decision-making about permafrost*.

Theoretical framework: adaptive capacity

Adaptive capacity has its roots in organizational theory and has attracted considerable attention through work published by the Intergovernmental Panel on Climate Change (IPCC). The IPCC defines adaptive capacity as the ability of a system to cope with both the risk and the opportunities related to change (Engle, 2011; Smit & Wandel, 2006). Adaptive capacity is closely linked to other commonly used concepts, including vulnerability, resilience, coping ability, management and response capacity, stability and robustness (Berrang-Ford et al., 2011; Engle, 2011; Siders, 2019; Smit & Wandel, 2006). Adaptive capacity dynamics inform research and help us better understand vulnerability in a local context. A low adaptive capacity assessment means that a community is highly vulnerable (Engle, 2011).

The level of adaptive capacity is influenced by a range of different factors. Much of the research on adaptive capacity characterizes the important factors relevant in specific case study areas (Engle, 2011; Siders, 2019). Different factors, dimensions and determinants

impact the adaptive capacity and these all depend on local conditions. On an aggregated level, however, we can observe that these factors revolve around the community, the institutions and the access to knowledge (Engle, 2011; Ford & King, 2015; Gupta, 2010; Koop et al., 2017; Siders, 2019; Smit & Wandel, 2006). In a community context, the focus is on the impact experienced locally, the sense of connectedness, networking and social agency, and the ability to solve problems (ibid). The role of relevant institutions in responding to environmental change can stimulate or prevent the development of adaptive capacity (Bronen & Chapin, 2013; Ford & King, 2015; Gupta, 2010). Institutions enhance their adaptive capacity through informed decision-making and action on adaptation planning. Informed decisions are dependent on knowledge about the ongoing change process. Monitoring ongoing environmental change is therefore highly relevant for ensuring institutional adaptive capacity (Bronen & Chapin, 2013; Siders, 2019).

In this paper, we combine several dimensions which illustrate adaptive capacity as observed in the relevant literature (Arctic Council, 2017; Baker et al., 2012; Berman et al., 2020; Engle, 2011; Ford & King, 2015; Koop et al., 2017; Siders, 2019; Smit & Wandel, 2006). We also ensure that these dimensions are informed by empirical data. The outcome of this work enables us to use the concept of adaptive capacity as an assessment tool (Engle, 2011). We have identified three crucial dimensions to assess adaptive capacity for permafrost degradation in Northwest Greenland.

The first dimension focuses on *community awareness* as an important factor in assessing the capacity of a community to manage change. In this context, we define *community* as people living in the same settlement in a specific area. Information about *community awareness* illustrates what type of adaptation practices, local networks and problem-solving abilities exist among community members. This dimension is crucial to understanding local experiences and the perceived level of urgency involved (Ford & King, 2015; Koop et al., 2017).

The second dimension focuses on the *institutional organization of adaptation measures* (Ford & King, 2015). Institutions and governance processes provide the kind of political and administrative structure that can either enable or restrict adaptation (Ford & King, 2015). This dimension looks at how municipal judgments shape local interventions (Healey, 2009). The focus is on permafrost in relation to strategy-making and spatial planning, the coordination between various actors involved, and institutional action related to adaptation measures (Healey, 2009; Smith et al., 2005).

Table 1: Analytical framework dimensions for assessing adaptive capacity in the event of permafrost change.

Dimensions	Definition	Empirical data
<i>Community awareness of permafrost</i>	Extent to which community members possess relevant knowledge about the challenges. Perceived impacts and assessment of ability to cope.	Questionnaire data on local observations about changes in landscape and the impact on infrastructure. Questionnaire on community members' experiences and judgments concerning permafrost thaw.
<i>Institutional organization in relation to permafrost</i>	Institutional capacity to address permafrost and other climate change challenges.	Review of the municipal planning strategies, and interviews with municipal representatives on current challenges related to climate and permafrost.
<i>Scientific knowledge to inform decision-making on permafrost</i>	Research showing measurements of permafrost change.	Frozen ground/permafrost (active layer) temperature data. Settlement data shown on maps illustrating active layer projections for 2050.

The third dimension focuses on the *scientific knowledge needed to inform decision-making* (Ford & King, 2015; Koop et al., 2017). This dimension assesses the usability of available knowledge on the thermal state of permafrost and the capacity of the relevant local authorities to make future predictions. This information is relevant for the institutional organization since they will naturally base their adaptation measures on available knowledge. For permafrost, this knowledge can be based on monitoring datasets, e.g. of active layer thickness or ground temperature, and on modeled projections. Such knowledge is vitally important as a strategic dimension and a key part of any strategy to enhance the available intelligence (Healey, 2009).

Adaptive capacity can be either enabled or restricted through all three dimensions in our analytical framework. Adaptation literature distinguishes between two types of adaptation: autonomous adaptation and planned adaptation (Forsyth & Evans, 2013; Gupta, 2010; Mersha & van Laerhoven, 2018). While the autonomous kind is characterized by independent and ad hoc adaptation solutions, planned adaptation refers to adaptation for which preparations are made well in advance – by institutions, for example. These two types of adaptation are also connected to what can be considered short-term responses, including the ability to cope with pressing changes as well as the long-term adjustments to enhance sustainability (Smit & Wandel, 2006).

Material and methods

The materials and methods section follows the three dimensions presented in the theoretical framework (see Table 1) to structure and present the empirical data. *Community awareness of permafrost change* comprises material from qualitative interviews and a community questionnaire. For the qualitative interviews, 22 participants were selected, based on snowball sampling and local contacts through our field assistant. Eight of the participants were engaged full-time in hunting and fishing; ten of them were employed in the public or private sectors, and only engaged in hunting and fishing as a leisure activity; one was enrolled in youth education, and three were entrepreneurs working with local trade and handicrafts. Not all participants were familiar with the specific term ‘permafrost’. We therefore broadened the focus in some cases, involving more general observations and a broader conversation about nature. Through this, new insights emerged concerning our participants’ experiences of changes involving frozen ground. The participants shared about their involvement in seasonal livelihood activities, perceptions of important issues right now and over the next 10–20 years, the biggest risks involved and the most important opportunities and challenges facing community development.

Two different questionnaires were applied – one in Qeqertarsuaq in Disko Bay, and one in Qaanaaq, the northernmost town. These questionnaires were translated into Greenlandic and distributed by two local field assistants in a face-to-face setting. One of the assistants used a printed paper version, while the other used an electronic tablet to register answers. The local field assistants were hired through a network at the University of Copenhagen Arctic Research Station. The field assistants informed all participants about the project, how the data would be used, and made it clear that participation was voluntary. All this was done before participants answered the questionnaire. The sampling strategy utilized (or benefitted from) local field assistants’ knowledge of people living in the two communities. This enabled them to ensure a balanced representation of age, gender, and occupation. Those involved in construction work, hunting and fishing activities, along

with municipal planning, were particularly interesting, because the people involved in these have an occupational interaction with nature and the landscape.

In Qaanaaq, 10% of all adults answered the questionnaire. The population is 646 (as of 2019) of whom 450 are above the age of 18. The number of respondents ($n = 45$) therefore represents 10% of all adults in total. The questions focused on changes observed locally, the family situation, households and other physical assets, membership of organizations, income and livelihood activities, and coping mechanisms for dealing with local environmental change. The questionnaire was conducted between February and June 2020.

In Qeqertarsuaq, 15% of all adults answered the questionnaire. The population is 854 (as of 2019), of whom 653 are above the age of 18. The number of respondents ($n = 100$) represents 15% of the total adult population. The questions focused on their use of the natural environment, changes observed in relation to the permafrost thaw, subsistence activities and adaptation measures to cope with permafrost thaw. Participants responded to the questionnaire between February and the end of April 2019.

Institutional organization of adaptation measures to cope with permafrost consists of a review of the municipalities' planning strategies for examining existing adaptation measures. One of the municipal tools for long-term planning is the municipal planning strategy. Such strategies comprise the most important tools for focusing on municipal development. For the review, we examined how permafrost challenges are articulated, and the action points listed to address these. To complement the strategy review, we also conducted a set of 10 semi-structured qualitative interviews with public sector employees, municipal planners and representatives from the construction, energy and water sectors.

All materials for building community awareness of permafrost and strengthening institutional organization on adaptation measures for permafrost thaw were collected over a two-year period. This included a 12-day fieldwork visit in February 2019 and a 24-day visit in February–March 2020. Winter and the early spring months proved beneficial, since many local people had time to meet and talk about the changes, they had experienced. Some interviews were conducted in Danish, while others were in Greenlandic with a local translator.

Scientific knowledge to inform decision-making about permafrost assesses the availability of relevant scientific knowledge. Permafrost is defined as rock or soil that remains below 0 degrees for two or more consecutive years (Ingeman-Nielsen et al., 2018). The extent and temperature of permafrost, its active layers of thickness (the maximum thaw depth at the end of summer), its subsurface geological composition and its ice contents all provide important parameters for evaluating the risk associated with thawing. Such information can be obtained from boreholes, where soil or rock samples are collected during drilling for laboratory analysis. A datalogger with temperature sensors is installed in the borehole to monitor temperatures and provide this information.

Northwest Greenland is characterized by the presence of continuous permafrost (90–100% of land underlain by permafrost), with some other areas of discontinuous permafrost (50–90% of land underlain by permafrost) (Obu et al., 2019). Active layer thickness (ALT) is a key indicator of permafrost change. We produced maps comparing the current and projected active layer thicknesses, based on statistical modeling forecasts (Aalto et al., 2018). The time period from 2000 to 2014 is referred to as the baseline scenario, and the time period from 2041 to 2060 is referred to as the future scenario by 2050. The future climate scenario is based on the representative concentration pathway (RCP) 4.5. The

spatial resolution of the active layer thickness modeling the product data is 30 arc seconds (approximately 1 km). We focused on Northwest Greenland, which is the Nordic region most affected by permafrost. It is where the most pronounced changes are expected to take place. Settlements with population data from 2020 have been added as an interpretative layer on the map showing the ALT.

Study area

Greenland is one of the autonomous, self-governing areas in the Nordic Region. In 1971, Greenland was granted home rule, and in 2009 full self-government. The Danish government provides a block grant, supplying around 60% of the government revenue and 40% of Greenland's GDP (Nordic Council of Ministers, 2018). The main industry is fishing, but Greenland also has potential for further development in the tourism and mineral industry sectors. In 2009, a program of municipal reform cut the 18 municipalities to four. However, the inhabitants in Qaasuitsup municipality in Northwest Greenland expressed dissatisfaction with this. They experienced a democratic distance from governance, and increased detachment between the settlements (Hansen, 2015; Løvschall-Wedel, 2016; Turnowsky, 2016). Qaasuitsup was the largest of the merged municipalities, and continuing dissatisfaction led to the decision to split Qaasuitsup into two municipalities in 2018. These are Avannaata and Qeqertalik. The largest settlement in Avannaata is Ilulissat, with a population of 4670. In Qeqertalik it is Aasiaat, population of 3069 (Greenland Statistics, 2020).

All settlements in Avannaata and Qeqertalik are accessible by helicopter or airplane, and during the ice-free season (in the summer months) by boat or ferry, too. The main municipal planning departments are located in Aasiaat (Qeqertalik) and Ilulissat (Avannaata). There is also a municipal office with a few employees working on the environment, citizen's services and administration in the larger towns, which includes Qeqertarsuaq (Qeqertalik municipality) and Qaanaaq (Avannaata). Qeqertarsuaq is a community located on Disko Island in Qeqertalik municipality. Qeqertarsuaq has a population of 839 (as of 2019, at the time of the survey), the majority of whom are Kalaallit (Greenlandic Inuit). The community has a mixed subsistence-cash economy composed of hunters and fishers, as well as paid employment (Caulfield, 1993). The wage economy of Qeqertarsuaq is based on commercial fishing, seafood processing, public administration, tourism and seasonal labor. People living in Qeqertarsuaq use the land, the sea and the sea-ice for hunting and fishing.

The town of Qaanaaq was established in 1953, following a forced relocation from the old Thule settlement where the United States Air Force had planned the construction of an air defence site nearby. Today Qaanaaq is the northernmost town in Greenland, with a population of 646 in Avannaata municipality (as of 2019, at the time of the survey). The people of Qaanaaq migrated from Canada around 1100 CE and belong to the Inughuit tribe (Hastrup, 2018). They have a unique dialect and their own specific cultural traits, for example in their usage of harpoons when hunting. In the Qaanaaq area, fishing and marine mammal hunting deliver significant income and direct subsistence for local households. Many professional hunters still hunt the traditional way, using kayaks and harpoons to catch whales. The long winters, in which the sea-ice covers the entire coast, mean that only two Royal Arctic Line ships (one in July and one in September) are available to supply the town with materials for the built environment and other purposes.

Extent to which permafrost is perceived as a reason for different challenges (%)

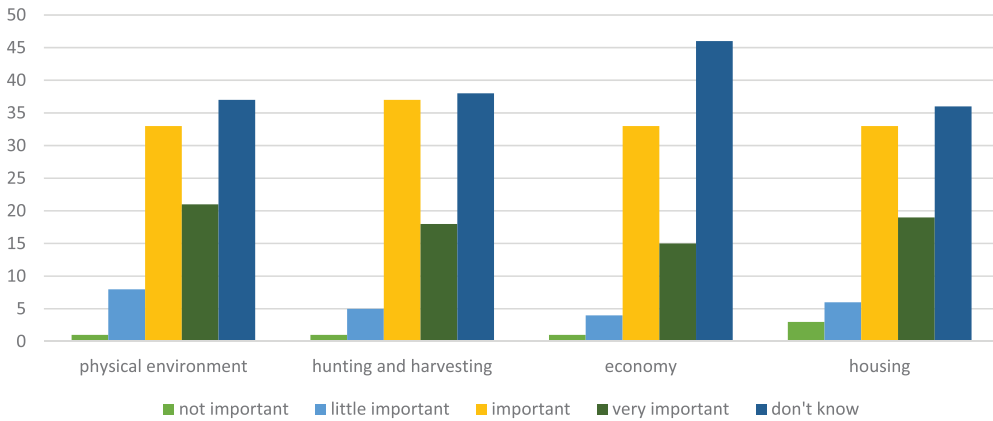


Figure 1. The extent to which permafrost is perceived as significant for different challenges in Qeqertarsuaq.

Results and discussion

Our results are structured in line with the three dimensions presented in our theoretical framework: *community awareness*, *institutional organization*, and *scientific knowledge available to inform decision-making*. Each of these analytical dimensions is examined through the lens of adaptation capacity.

Community awareness of permafrost change

There is community awareness of change in the frozen ground, and the local people experience these changes in the permafrost in the same way as they experience other climatic changes. This section concerning community awareness of permafrost illustrates how experience of changes in the permafrost interconnects with different aspects of everyday life.

Perceived impact of changes in the permafrost

People in Qeqertarsuaq experience the impact of changes in the frozen ground in several ways. **Figure 1** illustrates how participants perceived whether their physical environment (54%), hunting and harvesting (55%), economy (51%) and housing (52%) were an important or very important area in relation to the challenge of permafrost degradation.

However, we should note that the most common answer is ‘don’t know’. This indicates that many participants don’t feel confident to assess connections between societal challenges and permafrost. Even so, qualitative empirical data illustrates how inhabitants experience a diverse range of impacts, varying in effect between minor damage and large damage. The next sections present our results concerning the perceived impact of permafrost on the physical environment, hunting and harvesting, the economy and housing.

Physical environment, hunting and harvesting

Community members in Qeqertarsuaq and Qaanaaq observed changes in their physical environment during travel for recreational purposes, as well as hunting and fishing trips. The physical environment contains elements such as soil, water and air. While traveling and hunting, local people experience how these elements change the landscape. Several participants in Qeqertarsuaq had experienced natural phenomena related to permafrost, such as slumping (31%), the drying of wetland areas (16%), an increase in wetland areas (8%), the deepening of the active layer (7%) and coastal erosion (7%). Observations pointing towards permafrost degradation are changes in vegetation, increase in wetland areas, deepening of the active layer, slumping and coastal erosion.

In Qaanaaq, 58% of respondents had observed the ‘ground sinking’ in different parts of the area. In winter, the ground is covered with ice and snow, but in summer one Inughuit, aged 49, observed ‘round holes in some trails, as if the ground had sunk’. Another observation by an Inughuit, aged 62, was that ‘I see more landslides today than before’. The physical environment is a prerequisite for hunting and fishing, which remain extremely important for the Inuit people. Overall, 55% of participants in Qeqertarsuaq found that the thawing of the frozen ground had some impact on their ability to obtain food and other resources (e.g. spring water) from the land. For those working as hunters, permafrost thaw may lead to changes in hunting routes, resulting in less favorable conditions. In Qeqertarsuaq, hunting and harvesting are of great importance for households and participants estimated that subsistence activities are important for 84% of their household’s food supply, with 61% of the respondents’ diets consist of Greenlandic food (Vanderlinden et al., 2020).

Among the animal products most consumed are muskox, reindeer, hares, rabbits, sea-mammals, fish, crabs, seashells and antlers (see Figure 2). Participants also mentioned angelica plant (that grows wild) and Greenlandic lamb (which they received by ship) in the ‘other’ category. Family was considered an important source of Greenlandic food, with 90% of participants receiving food from their families several times a year.

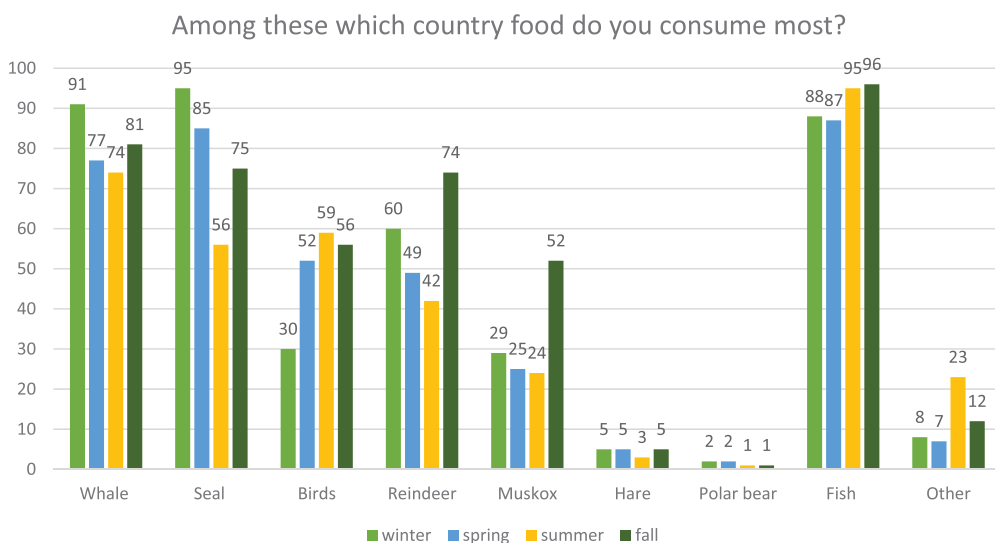


Figure 2. Most consumed species in different seasons, as a percentage of respondents in Qeqertarsuaq.

Eighty-two per cent of respondents collect berries and herbs, and a further 28% of these had observed changes in berry picking areas. These areas are sensitive and permafrost degradation, along with changes in the balance of sun and rainfall, can lead to a decrease in the volume of berries. Nature is a very important part of Inuit and Inughuit culture. Sixty-one per cent use nature for recreational activities, which illustrates its importance for the culture of the community. One woman aged 36, told of how she grew up in a family consisting of hunters and fishers. These days she goes hunting and fishing as a leisure activity. The family have a small hut where they can stay overnight during winter and summer trips. In summer they go sailing, and during those trips, they hunt, fish, and collect berries. However, with changes to the frozen ground, they have not found as many berries as usual around Qaanaaq during the rainy seasons.

Changes in the frozen ground may also limit access to recreational travel routes, or to summer cottages. One Inughuit hunter (aged 62) from Qaanaaq told us how *'old hunting cabins are now drifting into the water due to the eroding coast'*. Several other hunters who live in Qaanaaq and Qeqertarsuaq confirmed this observation. They observed how some of their small hunting cabins are now starting to slip into the water, due to coastal eroding and/or landslides. High dependence upon subsistence activities makes the local people particularly vulnerable to changes in wind, temperature, sea-ice and the permafrost. A close connection to nature and to local hunting and harvesting practices indicates a correspondingly high dependence upon the surrounding ecosystems. Permafrost degradation is already changing landscapes, and the participants report on several changes that impact their livelihood.

Housing and economy

Since more houses in Qeqertarsuaq are built on bedrock than in Qaanaaq, a higher proportion of the population has experienced problems with housing in Qaanaaq. In Qeqertarsuaq, 52% said that they see challenges for housing, buildings and roads. One of the Inuit respondents, aged 45, elaborated further, noticing *'... changes in the foundation of buildings'*. In Qaanaaq, most houses are built on sedimentary deposits, and are therefore more prone to deformations due to thawing, making built structures more vulnerable to differential settlement making the house had become skewed. Several Inughuit inhabitants explained how they experienced problems with their houses after the summer period. Typical experiences included floors slanting, doors or windows not closing, and window glass cracking due to differential settlement. One Inughuit woman, aged 62, said:

Suddenly the main entrance door wouldn't close any more. I had to call a man to come help me look at it, and he said that it was [happening] because the ground is changing. Now, I can only close the inner door – [so it's] good we live in a small town.

Many houses in Northwest Greenland have an entrance space with no heating. Due to changes in the ground, the woman we have just quoted cannot lock her main entrance door, just the secondary door off the small entrance space. A young man (aged 23) told us that after living for seven years in Denmark he returned to his hometown last year, to live with his grandparents. He noticed that the house had changed, so that now one door would not close, and always had an open gap of some 10 cm. In the bathroom, the floor was leaning in the wrong direction from the outlet drain, so that it now takes a lot of work to sweep water the right way after a shower.

One Inughuit woman (aged 36) explained that she had built her own house with her husband 11 years ago. Two years ago, the house started to move a little. She has been able to recognize this from the doors, the windows and the stairs inside. Her husband has fixed the doors, and fortunately the windows still open and shut. Another house owner explained how he had trouble closing one door in the house every winter, but during summer it seemed as if the ground had moved back into place, so the door could close again properly. In Qaanaaq, 73% of respondents said that they have observed differential settlement affecting their house. Another interviewee in Qaanaaq explained how two house owners were fixing the foundation themselves, using a jack to lift the foundation and adding soil and rocks to make it more stable.

Participants in both Qaanaaq and Qeqertarsuaq perceived permafrost as a challenge to the local economy. Financial capital is important when living in a house where slanting floors, deformed walls and cracked window panes occur, since these problems require additional materials (and sometimes external professional services) to repair them. This is, of course, mainly the case for owner occupiers (rather than renters), who are responsible for the repairs. Approximately 52% of respondents in Qaanaaq said that they owned the house they live in, and 25% (of the 52%) owned more than one house. Most homeowners with more than one house listed hunting cottages used for leisure trips in the natural environment as a second house. A few people owned up to three or four houses which they were renting out to others, or in which other family members were living.

Those working as professional hunters do not have a regular monthly wage, and with a volatile income, they find themselves more vulnerable to unexpected costs due to changes in the frozen ground. In Qaanaaq, 57% responded that they had a regular monthly income (Figure 3). Close to half of our respondents indicated that they had some level of debt for houses, boats, or other assets. Forty-one per cent said that they had savings and 36% that they had access to savings in case of emergency.

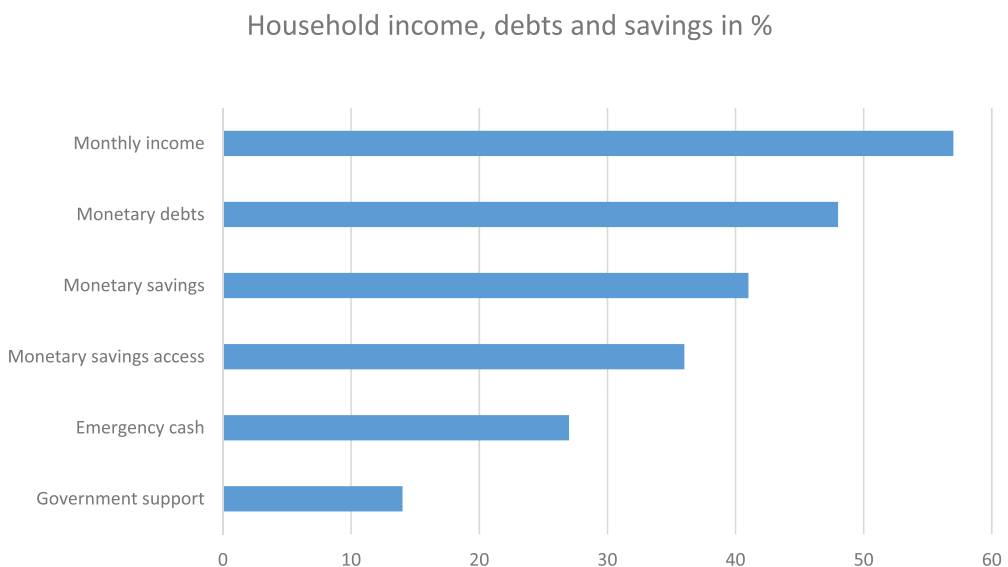


Figure 3. Participants in Qaanaaq receiving a monthly income, having debts, savings, emergency cash or receiving government support.

Men working as professional hunters usually have a volatile seasonal income. For example, during certain parts of the winter season it can be very stormy, which makes it more difficult to hunt and fish. In these situations, hunters need to have savings or to depend upon their wife's income. It is often the men who go hunting and fishing, while the women are occupied in other forms of wage labor which help to guarantee the family a steady income every month. Men without wives or partners are the most vulnerable, since they have to sustain themselves on a fluctuating income.

Assessing adaptive capacity at the community level

In Northwest Greenland, many homeowners take care of structural damage to their houses. If they do not know how to take care of these problems themselves, they hire someone locally to carry out repairs. However, it is also common simply to accept changes such as slanting floors, and wait to see whether this changes back again during the next season. Hunters adapt to the changing physical environment by looking for new hunting grounds and harvesting areas. From the questionnaire data, we can see that there is community awareness about permafrost, although many people also demonstrate that they do not always understand the connection between the changes they are experiencing and permafrost conditions.

Although many express little sense of urgency, there are also some voices expressing more urgent concern about whether communities in Northwest Greenland are properly prepared to deal with landslides, for example. In 2017, a landslide caused a huge tsunami, flooding Nuugatsiaq, and to some extent Illorsuit, two villages in Northern Greenland. Four people died, and other inhabitants living in the two affected villages were evacuated to the nearest town, Uummanaq. In such cases, institutional responsibility becomes clear. However, in the questionnaire focusing on preparedness for community adaptation, the most common answer is *other*. In their comments, respondents often say that they do

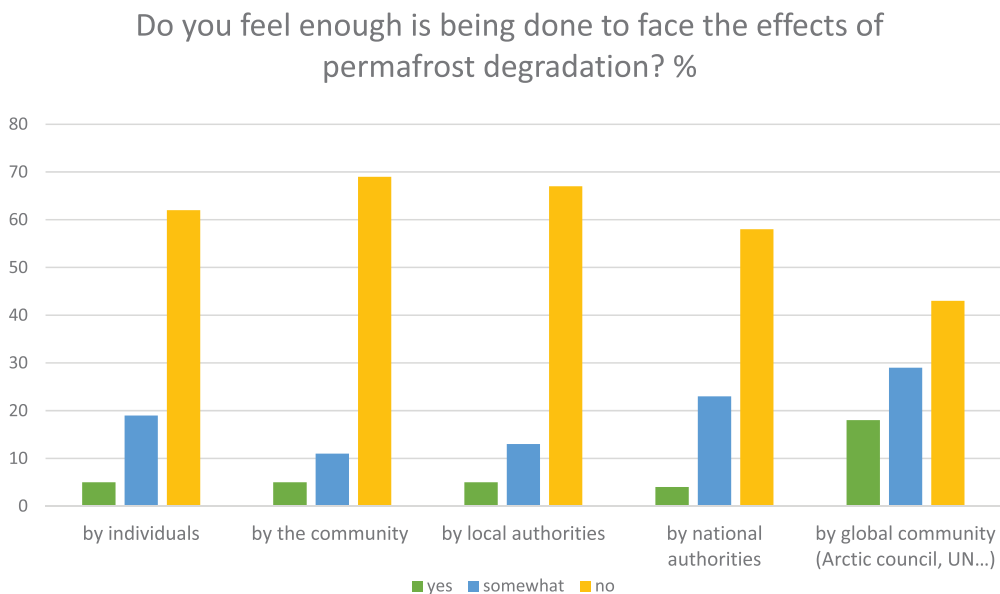


Figure 4. Participants in Qeqertarsuaq assessing whether enough is being done by different actors to face the effects of permafrost degradation.

not feel ready to face upcoming changes, and do not think any areas are better prepared than others. That said, respondents in Qeqertarsuaq and Qaanaaq expressed a need and desire for institutional efforts to support the community in making the required adaptations. Overall, participants illustrated autonomous adaptations – taking care of the adaptation needs when problems occurred. This indicates an adaptive, local capacity to manage pressing challenges related to permafrost.

Institutional organization adaptation measures for permafrost

In response to the question, ‘*Do you feel enough is being done to face the effects of permafrost thaw*’, 69% of the participants answered *no* at the community level, and 67% *no* in terms of local authorities. Expectations of what individuals and national bodies do were only slightly less negative (Figure 4).

Participants in Qeqertarsuaq gave a general impression that more needs to be done to improve adaptive capacity for dealing with permafrost degradations. The literature on adaptive capacity confirms the role of institutions in coping with environmental change (Engle, 2011; Gupta, 2010; Siders, 2019). To assess adaptive capacity at an institutional level, the following section will examine the organizational approach to infrastructure management and planning for permafrost degradation in Northwest Greenland.

Infrastructure management

Responsibility for all public infrastructures – roads, airstrips, harbors, buildings, and houses, as well as sewerage systems, drainage and water pipes – lies with the municipalities and government. Houses and buildings include office space, classrooms, and all rental housing. Rental houses are managed by the government-owned housing company, INI. In some smaller communities, INI collaborates with the municipality’s technical department. In Qaanaaq, member of staff responsible for INI at the municipal office is aware that a number of rental houses are impacted by the permafrost thawing. Each winter the floor moves 5–8 cm, and some doors cannot close. However, since the floors even out in the summer, there is currently no plan to intervene and renovate the structures.

According to one local interviewee working in the construction sector, much building activity in the 1950s and 1960s left a heritage of rapidly built houses. Today many houses with structural deficiencies are seen to have been caused more by poor building work of this kind, than by a deepening of the active layer. Our interviewee explained that although construction practices have evolved since the early days, mistakes are still being made in communities across Northwest Greenland, largely due to a lack of experience and resources. Currently, many houses are affected by active ground layer movements and by permafrost degradation.

The main strategy for both Avannaata and Qeqertalik municipalities is to build on bedrock whenever possible. Engineers and construction companies are aware of the problems occurring when building and repairing houses, and other infrastructure, in ice-rich permafrost terrain. Roads are seen as one of the biggest challenges, according to interviewees employed at Avannaata and Qeqertalik municipalities. It is common for roads to ‘sink’ due to permafrost degradation, and for these to be repaired with temporary measures such as the accumulation of asphalt layers (with some roads now having more than a meter of asphalt, since it keeps sinking). This is a short-term solution that needs to be repeated on a regular basis. According to our interviewees in the municipal planning departments, town

plans are shaped by the landscape because the current practice is to build on bedrock. However, even in Qeqertalik municipality, permafrost challenges still exist – for instance in the town of Qasigiannuit, where the foundations underneath some of the older buildings are sinking.

In Avannaata municipality, the head of planning describes the situation in Ilulissat as more manageable, compared to that in more northerly areas. In smaller communities in the Upernavik area (e.g. in Nuussuaq), several buildings and accompanying infrastructure have been damaged by the ground sinking. Skilled manpower is available to mend the resulting damage temporarily, but not in a way that is sustainable in the long term. Sometimes, sustainable long-term solutions become so complicated that specialists must be flown in, which is very expensive. Complex solutions also increase the risk of mistakes, which can be challenging when no one living locally has the necessary construction and repair expertise.

Planning for change

Our interviewees from municipal planning departments stressed that there is a need for readily accessible knowledge about permafrost conditions. From reviewing the planning strategies that set the vision and priorities for Avannaata and Qeqertalik municipalities (Avannaata, 2020; Qaatsiutsup, 2017a), we can see that there is a vision for a sustainable and economically prosperous future in both municipalities, and that the impact on society of climate change is already being mentioned. Qeqertalik still relies on the strategy from Qaatsiutsup municipality (from back when the two municipalities were one). It has not yet been able to publish a new strategy of its own. Avannaata did publish a new strategy, using the Un Sustainable Development Goals (SDGs) as a framework. The action points include Avannaata's municipal town plan considering the risk of storm surges and permafrost thaw when zoning new areas for housing. In Qeqertalik, the sector plan for traffic specifically addresses permafrost as a challenge for public infrastructure (Qaatsiutsup, 2017b).

Although the local authorities in Qeqertalik and Avannaata are aware of changes in the permafrost, there are many other development issues higher up their agenda, as evidenced by their planning strategies. Some of these priorities focus on economic development, including the expansion of the tourism industry, local democracy and citizen engagement, waste management and the local environment, access to water and sanitation and lowering social inequality. To summarize, the planning strategies in both municipalities mention permafrost, but as one challenge among many other pressing ones. As there are many other issues which require planning resources, this partly explains the autonomous adaptation response that focuses on repairing roads and other infrastructure on an ad hoc basis. One remaining component in the management of permafrost conditions for the relevant institutions is the availability of knowledge to inform decision-making about permafrost degradation. To understand this component better, the next section assesses different types of knowledge concerning permafrost change and how these can or cannot inform decision-making.

Scientific knowledge to inform decision-making on permafrost

Institutional organization requires knowledge to inform decisions on both where to build and how to repair structural damage to infrastructure. Scientific knowledge to understand

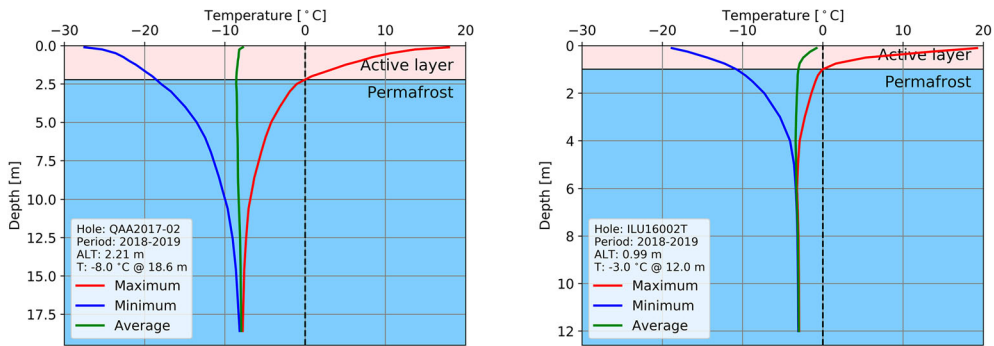
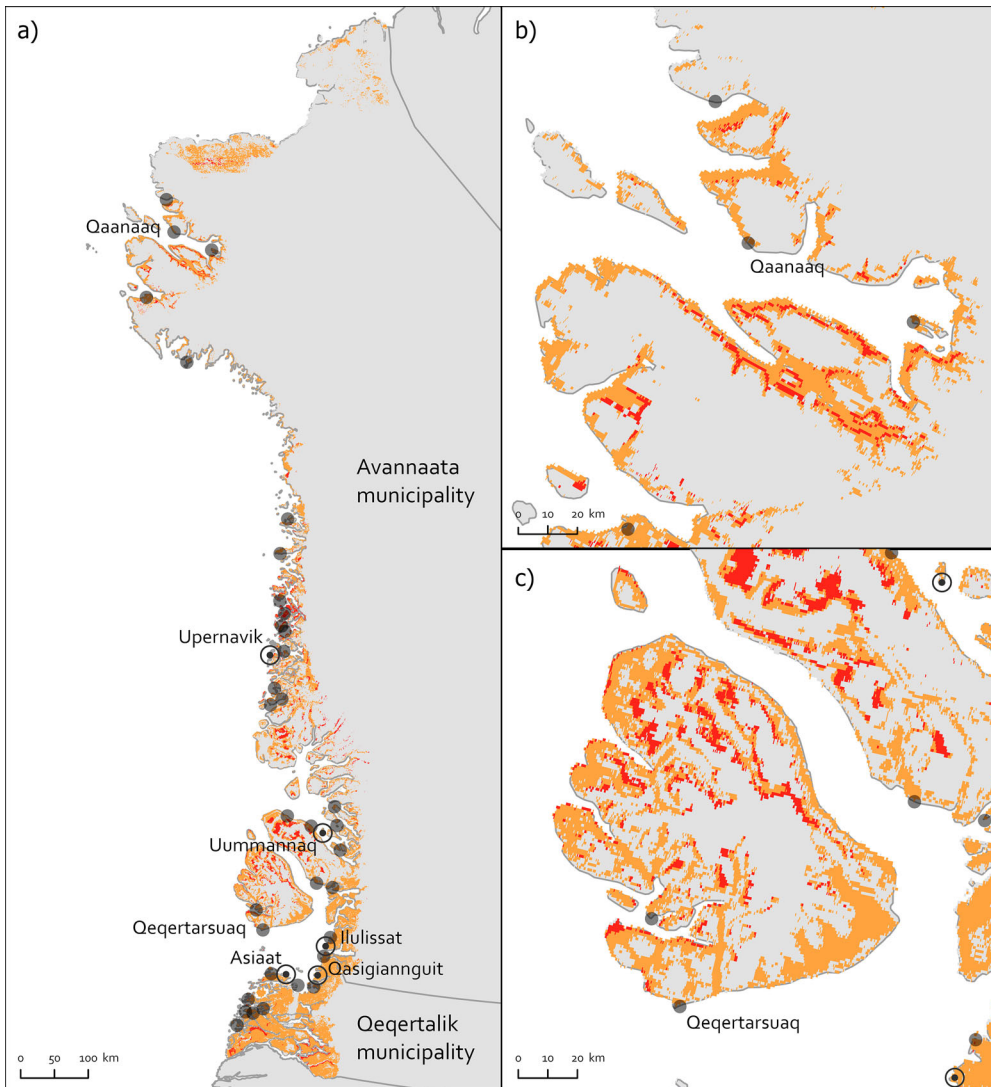


Figure 5. These trumpet diagrams show the thermal regime in the ground at the towns of Qaanaaq (left) and Ilulissat (right). The annual maximum (red), minimum (blue) and average (green) ground temperatures are plotted for the period 2018–2019. The plots also show important properties such as the active layer thickness, permafrost temperature and depth of seasonal variation.

ongoing changes is monitored from datasets of active layer thickness, ground temperature and modeling products. Some data processing is of a purely technical, scientific interest and it cannot easily be translated into planning purposes. However, in this section, we examine data derived from the physical sciences and from modeling science which could be of interest for the purposes of building adaptive capacity. Data from boreholes in Ilulissat and Qaanaaq facilitates the monitoring of changes in active layer thickness and in permafrost temperature. Figure 5 shows active layer thickness and permafrost temperatures in Qaanaaq and Ilulissat from 2018 to 2019.

The active layer in Qaanaaq deepened slightly in the period from 2017 to 2019 from 1.95 to 2.36 m. The time series is too short to conclude whether this is a trend or just the result of unusually warm summers. In Ilulissat, borehole temperature records suggest a deepening of the active layer from 0.75 m in 2016 to 0.93 m in 2018. Permafrost in Ilulissat is more vulnerable to thermal regime disturbances than in Qaanaaq, due to warmer ground temperatures, high ice content at the top of the permafrost, and increased salinity in the deeper sections of the soil profile – which causes the ground to start thawing at sub-zero temperatures. These borehole temperature measurements provide information about the current temperature regime. They serve as calibration data for ground thermal models. Calibrated thermal models can be used to produce projections of active layer thickness. Aalto et al. (2018) used a statistical model to extrapolate data on active layer thicknesses in the Arctic, including Greenland. We have used their model data to produce an active layer thickness map that also shows settlements in Northwest Greenland. The active layer thickness dataset also includes projections for 2050 to provide an idea of which areas may be expected to warm the most.

Figure 6 shows the active layer in a resolution of 1 km². The general trend is towards active layer deepening, with differences of up to 29.5 cm. A deepening of the active layer is an important cause of structural damage to buildings and other infrastructure. The top of permafrost is typically the most ice-rich portion, the thawing of which results in the largest volume changes to the ground. In mountainous and sloping terrain, the thawing of ice-rich permafrost may result in slope destabilization, landslides, and rock avalanches. According to the map, the active layer thickness in Qaanaaq and Qeqertarsuaq is expected



Changes in active layer thickness (ALT) a) Northwest Greenland b) Qaanaaq c) Qeqertarsuaq

Difference between baseline (2000 - 2014) and future (2041 - 2060, RCP4.5) ALT, in cm *

0 - 10 - Deepening of ALT
10 - 29,5

Settlement

- ⊙ Settlement with more than 1 000 inhabitants in 2020
- Settlement with less than 1 000 inhabitants in 2020



* The data represent the active layer thickness (ALT, in cm) forecasts over northern hemisphere land areas (>30°N) presented in the manuscript by Aalto et al., (2018) "Statistical forecasting of current and future circum-Arctic ground temperatures and active layer thickness" published in Geophysical Research Letters. The data has been produced with a spatial resolution of 30 arc seconds. The difference is between the baseline and future rasters (future ALT - baseline ALT):
ALT_Baseline.tif # Forecasted ALT 2000-2014
ALT_2050RCP4.5.tif # 2041-2060 RCP 4,5
Areas with difference above zero are presented on the map.

Data source: Statistics Greenland: Aalto, J.; Karjalainen, O.; Hjort, J.; Luoto, M (2019)

Figure 6. Map 1: Changes to active layer thickness in Northwest Greenland.

to deepen by 0–10 cm, which can cause quite a number of detrimental effects for the built environment. Other settlements, such as Uummannaq, are in an area where the active layer is expected to deepen by 10–29.5 cm, which could indicate an even higher level of risk.

However, because this is based on assumptions, there is a need for local validation to confirm these results.

Despite the obvious benefits of modeling products, the models are usually too approximate to be truly useful for local scale applications. It appears that there is no consistent collection of data to form a reliable regional database for supporting local planning. For this, information about geotechnical ground properties (including soil type, ice contents, thaw settlement projections and estimates of changes in ground mechanical properties upon thawing) would be of more practical use. The absence of further local-level projections for the active layer data is a challenge for both local and national institutions, as they seek to engage in planned adaptation activities. There is therefore a continuing need to examine local and regional soil conditions, to facilitate projections for the next few decades. Adaptation capacity is lowered by the fact that the information available to inform decision-making is limited to data of lesser value in a practical setting and on long-term development and planning.

Concluding remarks

This study has assessed the adaptive capacity to managing permafrost change by applying a theoretical framework encompassing three dimensions. The first dimension, *community awareness of permafrost change*, demonstrates that community members tend to engage in autonomous adaptation, whereby individual homeowners repair damage themselves, but also rely on support from family and friends in the local area.

For modest damage, people often accept living with various minor defects – such as not being able to close a door for half of the year, or thin cracks in the walls. Regarding larger issues, such as severe foundation settlement, people in the community help each other to repair the damage. In these cases, local networks are supportive in assisting the repair work. Sometimes extra costs are incurred because homeowners needed to hire machines or to find professional craftspeople to carry out the repairs.

The second dimension, *institutional organization of adaptation measures for permafrost*, shows that although the municipalities are aware of the impact from permafrost, there are many other issues high on their agenda, as stated in their planning strategies. The main adaptation strategy for municipalities entails building on bedrock whenever possible, and town plans are determined by the landscape to avoid building in zones with permafrost soils whenever possible. Even so, the municipalities also engage in autonomous adaptation practices involving repairing roads and other public infrastructure on an ad hoc basis. These often consist of short-term solutions that need to be repeated on a regular basis. Competing priorities partly explain the autonomous adaptation response that focuses on repairing roads and other infrastructures as damage occurs, given that there are many other issues that require public spending.

The third dimension, *scientific knowledge to inform decision-making on permafrost*, illustrates the gap between the available scientific knowledge and the type of information needed to make strategic, long-term decisions. Because the modeled projection for ALT is too coarse it does not fulfill the need for town planners and engineers. They require specific, local information for building design and construction, usually of the type obtained from field sampling and observations. With this, the study shows a need to strengthen the

dialogue between researchers and the municipality to develop meaningful and societally beneficial future research questions.

Acknowledgements

The research leading to this study received support from the Nunataryuk project, funded by the European Union's Horizon 2020 Research and Innovation Program under grant agreement No. 773421, the ERC Consolidator Grant (agreement No. 771056-LICCI-ERC-2017-COG) and contributed to the 'María de Maeztu Unit of Excellence' (CEX2019-000940-M). The authors also wish to thank Mads Ole Kristensen for valuable support and help with the questionnaire data in Qaanaaq, and also Kirsten Pedersen in Qeqertarsuaq, as well as those employees working with planning in Avannaata and Qeqertalik.

Disclosure statement

No potential conflict of interest was reported by the author(s).

Funding

The research leading to this study received support from the Nunataryuk project, funded by the European Union's Horizon 2020 Research and Innovation Program under grant agreement No. 773421, the ERC Consolidator Grant (agreement No. 771056-LICCI-ERC-2017-COG) and contributed to the 'María de Maeztu Unit of Excellence' (CEX2019-000940-M).

ORCID

Leneisja Jungsberg  <http://orcid.org/0000-0002-1283-5318>

Lise Byskov Herslund  <http://orcid.org/0000-0002-6085-3094>

References

- Aalto, J., Karjalainen, O., Hjort, J., & Luoto, M. (2018). Statistical forecasting of current and future circum-Arctic ground temperatures and active layer thickness. *Geophysical Research Letters*, 45(10), 4889–4898. <https://doi.org/10.1029/2018GL078007>
- Allard, M., Lemay, M., Barrette, C., L'Hérault, E., Sarrazin, D., Bell, T., & Doré, G. (2012). *Permafrost and climate change in Nunavik and Nunatsiavut: Importance for municipal and transportation infrastructures*. Nunavik and Nunatsiavut: From Science to Policy. An Integrated Regional Impact Study (IRIS) of Climate Change and Modernization, p. 27.
- AMAP. (2018). *Adaptation actions for a changing Arctic—Perspectives from the Baffin Bay/Davis Strait Region*. Arctic Monitoring and Assessment Program.
- Arctic Council. (2017). *Arctic Resilience Action Framework* (Working Paper). Arctic council Working Paper.
- Avannaata, K. (2020). 2020 *Planning Strategy Avannaata Municipality* [Strategi].
- Baker, I., Peterson, A., Brown, G., & McAlpine, C. (2012). Local government response to the impacts of climate change: An evaluation of local climate adaptation plans. *Landscape and Urban Planning*, 107(2), 127–136. <https://doi.org/10.1016/j.landurbplan.2012.05.009>
- Berman, M., Baztan, J., Kofinas, G., Vanderlinden, J.-P., Chouinard, O., Huctin, J.-M., Kane, A., Mazé, C., Nikulkina, I., & Thomson, K. (2020). Adaptation to climate change in coastal communities: Findings from seven sites on four continents. *Climatic Change*, 159(1), 1–16. <https://doi.org/10.1007/s10584-019-02571-x>
- Berrang-Ford, L., Ford, J. D., & Paterson, J. (2011). Are we adapting to climate change? *Global Environmental Change*, 21(1), 25–33. <https://doi.org/10.1016/j.gloenvcha.2010.09.012>

- Biskaborn, B. K., Smith, S. L., Noetzli, J., Matthes, H., Vieira, G., Streletskiy, D. A., Schoeneich, P., Romanovsky, V. E., Lewkowicz, A. G., Abramov, A., Allard, M., Boike, J., Cable, W. L., Christiansen, H. H., Delaloye, R., Diekmann, B., Drozdov, D., Etzelmüller, B., Grosse, G., ... Lantuit, H. (2019). Permafrost is warming at a global scale. *Nature Communications*, 10(1), Article 264. <https://doi.org/10.1038/s41467-018-08240-4>
- Bronen, R., & Chapin, F. S. (2013). Adaptive governance and institutional strategies for climate-induced community relocations in Alaska. *Proceedings of the National Academy of Sciences*, 110(23), 9320–9325. <https://doi.org/10.1073/pnas.1210508110>
- Caulfield, R. (1993). Aboriginal subsistence whaling in Greenland: The case of Qeqertarsuaq municipality in west Greenland. *Arctic*, 46(2), 144–155. <https://doi.org/10.14430/arctic1336>
- Doloisio, N., & Vanderlinden, J.-P. (2020). The perception of permafrost thaw in the Sakha Republic (Russia): Narratives, culture and risk in the face of climate change. *Polar Science*, 26, Article 100589. <https://doi.org/10.1016/j.polar.2020.100589>
- Doré, G., Niu, F., & Brooks, H. (2016). Adaptation methods for transportation infrastructure built on degrading permafrost. *Permafrost and Periglacial Processes*, 27(4), 352–364. <https://doi.org/10.1002/ppp.1919>
- Engle, N. L. (2011). Adaptive capacity and its assessment. *Global Environmental Change*, 21(2), 647–656. <https://doi.org/10.1016/j.gloenvcha.2011.01.019>
- Ford, J. D., & King, D. (2015). A framework for examining adaptation readiness. *Mitigation and Adaptation Strategies for Global Change*, 20(4), 505–526. <https://doi.org/10.1007/s11027-013-9505-8>
- Forsyth, T., & Evans, N. (2013). What is autonomous adaption? Resource scarcity and smallholder agency in Thailand. *World Development*, 43, 56–66. <https://doi.org/10.1016/j.worlddev.2012.11.010>
- GEUS. (2018). *6 Supplerende kort over kritiske lokaliteter*. De Nationale Geologiske Undersøgelser for Danmark og Grønland.
- Greenland Statistics. (2020). *Statistikbanken Grønland*. <https://bank.stat.gl/pxweb/da/Greenland/>
- Gupta, J. (2010). The adaptive capacity wheel: A method to assess the inherent characteristics of institutions to enable the adaptive capacity of society. *Environmental Science*, 13, 459–471. <https://doi.org/10.1016/j.envsci.2010.05.006>
- Hansen, K. G. (2015). *Greenland is rethinking the 2009 merging of municipalities*. Nordregio.
- Hastrup, K. (2018). A history of climate change: Inughuit responses to changing ice conditions in North-West Greenland. *Climatic Change*, 151(1), 67–78. <https://doi.org/10.1007/s10584-016-1628-y>
- Healey, P. (2009). In search of the “strategic” in spatial strategy making. *Planning Theory & Practice*, 10(4), 439–457. <https://doi.org/10.1080/14649350903417191>
- Hjort, J., Karjalainen, O., Aalto, J., Westermann, S., Romanovsky, V. E., Nelson, F. E., Etzelmüller, B., & Luoto, M. (2018). Degrading permafrost puts Arctic infrastructure at risk by mid-century. *Nature Communications*, 9(1), Article 5147. <https://doi.org/10.1038/s41467-018-07557-4>
- Hong, E., Perkins, R., & Trainor, S. (2014). Thaw settlement hazard of permafrost related to climate warming in Alaska. *Arctic*, 67(1), 93–103. <https://doi.org/10.14430/arctic4368>
- Ingeman-Nielsen, T., Lemay, M., Allard, M., Barette, C., Bjella, K., Brooks, H., Carbonneau, A.-S., Doré, G., Foged, N., Lading, T., L’Hérault, E., & Mathon-Dufour, V. (2018). Built infrastructure. In AMAP, Arctic Monitoring and Assessment Programme (Ed.), *Adaptation actions for a changing Arctic—Perspectives from the Baffin Bay/Davis Strait Region* (pp. 261–305) Oslo, Norway: AMAP.
- Instanes, A., & Anisimov, O. (2008, June 29–July 3). *Climate change and Arctic infrastructure*. Ninth International Conference on Permafrost University of Alaska Fairbanks (pp. 1–8).
- Jeff Birchall, S., & Bonnett, N. (2020). Thinning sea ice and thawing permafrost: Climate change adaptation planning in Nome, Alaska. *Environmental Hazards*, 19(2), 152–170. <https://doi.org/10.1080/17477891.2019.1637331>
- Koop, S. H. A., Koetsier, L., Doornhof, A., Reinstra, O., Van Leeuwen, C. J., Brouwer, S., Dieperink, C., & Driessen, P. P. J. (2017). Assessing the governance capacity of cities to address challenges of water, waste, and climate change. *Water Resources Management*, 31(11), 3427–3443. <https://doi.org/10.1007/s11269-017-1677-7>

- Larsen, J. N., Schweitzer, P., Abass, K., Doloisio, N., Gartler, S., Ingeman-Nielsen, T., Ingimundarson, J. H., Jungsberg, L., Meyer, A., Rautio, A., Scheer, J., Timlin, U., Vanderlinden, J.-P., & Vullierme, M. (2021). Thawing permafrost in Arctic coastal communities: A framework for studying risks from climate change. *Sustainability*, 13(5), 1–18. <https://doi.org/10.3390/su13052651>
- Løvschall-Wedel, J. (2016, October 10). *Demokrati koster men Qaasuitsup betalte ikke*. KNR.
- McNamara, K. E., & Buggy, L. (2017). Community-based climate change adaptation: A review of academic literature. *Local Environment*, 22(4), 443–460. <https://doi.org/10.1080/13549839.2016.1216954>
- Mersha, A. A., & van Laerhoven, F. (2018). The interplay between planned and autonomous adaptation in response to climate change: Insights from rural Ethiopia. *World Development*, 107, 87–97. <https://doi.org/10.1016/j.worlddev.2018.03.001>
- Naalakkersuisut. (2012). *Muligheder for klimatilpasning i fangst og fiskerierhvervet—Status og handlemuligheder*. Departement for boliger, infrastruktur, og trafik (klima og energikontoret) og Departement for fiskeri og landbrug.
- Naalakkersuisut. (2017). *Ice & MetOcean Overview Northeast Greenland*. Government of Greenland & Danish Meteorological Institute.
- Nordic Council of Ministers. (2018). *State of the Nordic Region 2018*. Nordic Council of Ministers. <https://doi.org/10.6027/NORD2018-001>
- Obu, J., Westermann, S., Bartsch, A., Berdnikov, N., Christiansen, H. H., Dashtseren, A., Delaloye, R., Elberling, B., Etzelmüller, B., Kholodov, A., Khomutov, A., Käab, A., Leibman, M. O., Lewkowicz, A. G., Panda, S. K., Romanovsky, V., Way, R. G., Westergaard-Nielsen, A., Wu, T., ... Zou, D. (2019). Northern Hemisphere permafrost map based on TTOP modelling for 2000–2016 at 1 km² scale. *Earth-Science Reviews*, 193, 299–316. <https://doi.org/10.1016/j.earscirev.2019.04.023>
- Piggott-McKellar, A. E., McNamara, K. E., Nunn, P. D., & Watson, J. E. M. (2019). What are the barriers to successful community-based climate change adaptation? A review of grey literature. *Local Environment*, 24(4), 374–390. <https://doi.org/10.1080/13549839.2019.1580688>
- Qaatsiutsup, K. (2017a). *Planstrategi 2017 for Qaatsiutsup Kommunia*.
- Qaatsiutsup, K. (2017b). *Sektorplan for trafik, Qaatsiutsup Kommunia*.
- Ramage, J., Jungsberg, L., Wang, S., Westermann, S., Lantuit, H., & Heleniak, T. (2021). Population living on permafrost in the Arctic. *Population and Environment*, 43, 22–38. <https://doi.org/10.1007/s11111-020-00370-6>.
- Schultz-Nielsen, J. (2019). *Her er der fare for alvorlige fjeldskred*. Sermitsiaq.
- Shiklomanov, N. I., Streletskiy, D. A., Grebenets, V. I., & Suter, L. (2017). Conquering the permafrost: Urban infrastructure development in Norilsk, Russia. *Polar Geography*, 40(4), 273–290. <https://doi.org/10.1080/1088937X.2017.1329237>
- Siders, A. R. (2019). Adaptive capacity to climate change: A synthesis of concepts, methods, and findings in a fragmented field. *Wiley Interdisciplinary Reviews: Climate Change*, 10(3), Article e573. <https://doi.org/10.1002/wcc.573>
- Smit, B., & Wandel, J. (2006). Adaptation, adaptive capacity and vulnerability. *Global Environmental Change*, 16(3), 282–292. <https://doi.org/10.1016/j.gloenvcha.2006.03.008>
- Smith, A., Stirling, A., & Berkhout, F. (2005). The governance of sustainable socio-technical transitions. *Research Policy*, 34(10), 1491–1510. <https://doi.org/10.1016/j.respol.2005.07.005>
- Streletskiy, D. A., Shiklomanov, N. I., & Nelson, F. E. (2012). Permafrost, infrastructure, and climate change: A GIS-based landscape approach to geotechnical modeling. *Arctic, Antarctic, and Alpine Research*, 44(3), 368–380. <https://doi.org/10.1657/1938-4246-44.3.368>
- Turnowsky, W. (2016, November 21). *Qaasuitsup Kommunia deles i to. Et stort flertal i Inatsisartut har besluttet at den nordlige kommune skal deles i to*. Sermitsiaq, 1.
- Vanderlinden, J. P., Jungsberg, L., Ramage, J., Codier, M., Wang, S., Doloisio, N., Gartler, S., Meyer, A., & Vullierme, M. (2020). *Report on the social representation of permafrost thawing, including economic impact within Arctic communities: A qualitative and quantitative analytical framework* (p. 104). Nunataryuk Project Report.
- Vincent, W. F., Lemay, M., Michel, A., & Wolfe, B. B. (2013). Adapting to permafrost change: A science framework. *American Geophysical Union (AGU)*, 94(42), 373–375. <https://doi.org/10.1002/2013EO420002>

Appendices

Appendix A: Questionnaire assessment of actor's involvement in the social innovation

Appendix B: Questionnaire in Sodankylä & Storuman

Appendix C: Questionnaire in Qeqertarsuaq and Qaanaaq

Appendix A: Assessment of different actor's involvement in the social innovation

<p>1. Initiation & Development: Where did the resources (not including labour) come from? (0 = no resources; 1 = <20%; 2 = 20-40%; 3 = 40-60% ; 4 = 60-80%; 5 = >80% of resources)</p>	
(a) Civil society (community)	
(b) Civil society (organisation)	
(c) Public sector - Local	
(d) Public sector - Regional / National / International	
(e) Private sector	
<p>2. Initiation & Development: What was the source of ideas and inspiration? (0 = no role; 1 = minor inputs; 2 = some inputs; 3 = equal partnership; 4 = leading the process; 5 = sole contributor)</p>	
(a) Civil society (community)	
(b) Civil society (organisation)	
(c) Public sector - Local	
(d) Public sector - Regional / National / International	
(e) Private sector	
<p>3. Initiation & Development: Who makes decisions? (0 = no role; 1 = minor inputs; 2 = some inputs; 3 = equal partnership; 4 = high level of control; 5 = complete control)</p>	
(a) Civil society (community)	
(b) Civil society (organisation)	
(c) Public sector - Local	
(d) Public sector - Regional / National / International	
(e) Private sector	
<p>4. Initiation & Development: Who does the work? (0 = no outputs; 1 = minor outputs; 2 = less outputs than others; 3 = outputs equivalent to others; 4 = main group delivering outputs; 5 = only group delivering outputs)</p>	
(a) Civil society (community)	
(b) Civil society (organisation)	
(c) Public sector - Local	
(d) Public sector - Regional / National / International	
(e) Private sector	

<p>5. Implementation: Where do ongoing resources (not including labour) come from? (0 = no resources; 1 = <20%; 2 = 20-40%; 3 = 40-60% ; 4 = 60-80%; 5 = >80% of resources)</p>	
<p>(a) Civil society (community) (b) Civil society (organisation) (c) Public sector - Local (d) Public sector - Regional / National / International (e) Private sector</p>	
<p>6. Implementation & ongoing operation: Where do new ideas and inspiration come from? (0 = no role; 1 = minor inputs; 2 = some inputs; 3 = equal partnership; 4 = leading the process; 5 = sole contributor)</p>	
<p>(a) Civil society (community) (b) Civil society (organisation) (c) Public sector - Local (d) Public sector - Regional / National / International (e) Private sector</p>	
<p>7. Implementation & ongoing operation: Who makes decisions about ongoing operations? (0 = no role; 1 = minor inputs; 2 = some inputs; 3 = equal partnership; 4 = high level of control; 5 = complete control)</p>	
<p>(a) Civil society (community) (b) Civil society (organisation) (c) Public sector - Local (d) Public sector - Regional / National / International (e) Private sector</p>	
<p>8. Implementation & ongoing operation: Who does the work? (0 = no outputs; 1 = minor outputs; 2 = less outputs than others; 3 = outputs equivalent to others; 4 = main group delivering outputs; 5 = only group delivering outputs)</p>	
<p>(a) Civil society (community) (b) Civil society (organisation) (c) Public sector - Local (d) Public sector - Regional / National / International (e) Private sector</p>	

REGINA

Remote communities & resource-based industries

Appendix B: Questionnaire in Sodankylä & Storuman

1. To what extent do the following statements match your opinion about Sodankylä?

Circle the alternative that corresponds to your view.

	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
The atmosphere in Sodankylä is active	5	4	3	2	1
The place is a nice/comfortable to live in	5	4	3	2	1
Sodankylä is a safe place to live in	5	4	3	2	1
The image of the municipality is positive	5	4	3	2	1
The municipal authorities responsibly promote the interests of the local people	5	4	3	2	1
The environment is clean and tidy	5	4	3	2	1
There are people with similar interests and thoughts as I have	5	4	3	2	1
I have a good social network (e.g. friends and relatives) in the locality	5	4	3	2	1

2. How satisfied are you with the following issues in Sodankylä municipality?

Circle the alternative that corresponds to your view.

	Very satisfied	Satisfied	Dissatisfied	Very dissatisfied	I don't know
Public services provided by the municipality	4	3	2	1	0
Private services in the locality	4	3	2	1	0
The condition of the roads and streets	4	3	2	1	0
Safety	4	3	2	1	0
Recreation, parks and playgrounds	4	3	2	1	0
Opportunities for outdoor activities in nature	4	3	2	1	0
Free time activities	4	3	2	1	0
Supply of cultural and other events	4	3	2	1	0
Education, work and career opportunities	4	3	2	1	0
Land use and town/local planning	4	3	2	1	0
The price level of housing	4	3	2	1	0
The selection of houses/properties	4	3	2	1	0

If you wish, you can explain or complete your answers below.

3. How would you assess the impacts of mining on your life now and in the future?

Please describe your views below.

Present	What are the positive impacts of mining on your life?	What are the negative impacts of mining on your life?
Future	What future possibilities does mining bring to your life?	What threats does mining bring to your life?

4. To what extent do the following statements match your opinion?

Circle the alternative that corresponds to your view.

	Strongly agree	Agree	Netural	Disagree	Strongly disagree
Mining has had a positive impact on the atmosphere in the locality	5	4	3	2	1
Mining has increased the attractiveness of the locality	5	4	3	2	1
Mining has decreased safety in the locality	5	4	3	2	1
Mining has uplifted the image of the municipality	5	4	3	2	1
The municipal authorities listen to local people in mining-related issues	5	4	3	2	1
Mining has harmed the environment	5	4	3	2	1
Mining has brought to the area people who share my views	5	4	3	2	1
Mining has brought new possibilities for social networking	5	4	3	2	1

5. Has mining affected the following issues in Sodankylä municipality?

Circle the alternative that corresponds to your view.

	Signifigant positive impact	Positive impact	Negative impact	Significant negative impact	No impact
Services provided by the municipality	4	3	2	1	0
Private services in the locality	4	3	2	1	0
The condition of the roads and streets	4	3	2	1	0
Safety	4	3	2	1	0
Recreation, parks and playgrounds	4	3	2	1	0
Opportunities for outdoor activities in nature	4	3	2	1	0
Free time activities	4	3	2	1	0
Supply of cultural and other events	4	3	2	1	0
Education, work and career opportunities	4	3	2	1	0
Land use and town/local planning	4	3	2	1	0
The price level of housing	4	3	2	1	0
The selection of houses/properties	4	3	2	1	0

If you wish, you can explain or complete your answers below.

6. To what extent do you agree/disagree with the following statements?

Circle the alternative that corresponds to your view.

	Strongly agree	Agree	Neutral	Disagree	Strongly disagree	I don't know
I find mining and the related things it interesting	5	4	3	2	1	0
The mining operations at the locality are acceptable	5	4	3	2	1	0
The locally experienced adverse effects of mining are outweigh the benefits	5	4	3	2	1	0
Economic growth should be a priority, even if it means that the environment suffers to some extent	5	4	3	2	1	0
Mining companies should fund the public services (e.g. the infrastructure) more than they presently do	5	4	3	2	1	0
Mining companies operating in Finland should have Finnish ownership	5	4	3	2	1	0
There should be a special tax on mining companies operating in Finland	5	4	3	2	1	0
Economic fluctuation makes mining communities vulnerable	5	4	3	2	1	0
I can accept a decrease in my standard of living to protect nature	5	4	3	2	1	0
Mining operations can be organized more responsibly in Finland than in the least developed countries	5	4	3	2	1	0
Mining and sustainable development don't rule each other out	5	4	3	2	1	0
Science and technology can solve the problems of sustainability in future mining operations	5	4	3	2	1	0
Mining is essential to sustain the present standard of living	5	4	3	2	1	0
The self-sufficiency of the European Union in ore production needs to be strengthened	5	4	3	2	1	0

If you wish, you can explain or complete your answers below.

7. How would you rate the Kevitsa mine and Pahtavaara mine projects regarding the following issues?

The easiest way to rate the mining projects is to fill one column at a time. Use Finnish school grades: 10 outstanding, 9 excellent, 8 good, 7 satisfactory, 6 moderate, 5 passable, 4 unsatisfactory/fail.

If you don't want to or can't estimate some of the sections you can leave them empty.

	Kevitsa	Pahtavaara
Sufficiency of information in mining related issues		
Reliability of the information concerning the mining project		
The location of the deposit		
Estimated operating time of the mine		
The possibilities of the local people to participate in decision making		
Compensation of possible adverse effects		
Monitoring of the operations		
The company's engagement in aftercare		
Possibility to express one's opinion openly		
The company's engagement in developing the municipality		

8. How would you rate the Sakatti research project regarding the following issues?

Use Finnish school grades: 10 outstanding, 9 excellent, 8 good, 7 satisfactory, 6 moderate, 5 passable, 4 unsatisfactory/fail.

If you don't want to or can't estimate some of the sections you can leave them empty.

	Sakatti
Sufficiency of information in mining-related issues	
Reliability of the information concerning the mining project	
The location of the deposit	
The possibilities of the local people to participate in decision making	
Compensation of possible adverse effects	
Monitoring of the operations	
Possibility to openly express one's opinion	

If you wish, you can explain or complete your answers below.

9. To what extent do you agree/disagree with the following statements?

Circle the alternative that corresponds to your view.

	Strongly agree	Agree	Neutral	Disagree	Strongly disagree	I don't know
The allocation of responsibility in monitoring of the mining activities is clear	5	4	3	2	1	0
Monitoring of the mining activities is not effective enough	5	4	3	2	1	0
The environmental authorities are trustworthy in monitoring the impacts of the mining activities in Sodankylä	5	4	3	2	1	0
Mining-related legislation and monitoring should be tightened even if it would decrease foreign investments	5	4	3	2	1	0
The licensing of mining activities is not binding enough	5	4	3	2	1	0
The licenses for mining are given on reasonable grounds	5	4	3	2	1	0

10. To what extent do you agree/disagree with the following statements?

Circle the alternative that corresponds to your view.

	Strongly agree	Agree	Neutral	Disagree	Strongly disagree	I don't know
The mining sector has employed local people	5	4	3	2	1	0
There is enough skilled labor force in the locality for the needs of the mining sector	5	4	3	2	1	0
The municipal authorities have enough knowledge about mining-related issues	5	4	3	2	1	0
The decision-making processes of mining are comprehensible	5	4	3	2	1	0
It is easy for the local people to take part in decision-making processes related to mining	5	4	3	2	1	0
The local people are informed about mining-related issues right after the information becomes available	5	4	3	2	1	0
The linkage between the municipality and the mining companies is too strong	5	4	3	2	1	0
Mining has had a positive impact on the population	5	4	3	2	1	0
The local economy has benefitted from the mining activities	5	4	3	2	1	0
The mines have not created enough possibilities for local businesses	5	4	3	2	1	0
Mining is essential to the vitality of the municipality	5	4	3	2	1	0
The reconciliation of mining and other livelihoods in the locality has been successful	5	4	3	2	1	0

11. Have you experienced any of the following adverse impacts of mining?

Circle the alternative that corresponds to your view.

	Significant impact	Moderate impact	Minor impact	No impact
Impact on water systems	1	2	3	4
Impact on land animals/fish/plants	1	2	3	4
Impact on landscape	1	2	3	4
Dust	1	2	3	4
Noise	1	2	3	4
Mining tremors	1	2	3	4
Smell	1	2	3	4
Lighting	1	2	3	4
Radiation/hazardous chemicals	1	2	3	4
Traffic safety	1	2	3	4
Impact on picking berries or mushrooms	1	2	3	4
Impact on fishing/hunting	1	2	3	4
Impact on recreation	1	2	3	4
Impact on the tourism industry	1	2	3	4
Impact on reindeer herding	1	2	3	4
Impact on agriculture/forestry	1	2	3	4

12. Have mining operations had some other significant impacts? Please specify.

13. Please describe the emotions the mining operations in the locality raise in you?

Finally, we would like to ask a few background questions in order to group the answers.

The background data are used for scientific purposes only. The results will be published in a way that an individual respondent cannot be identified.

If you don't want to answer a question, you can leave it empty.

<p>14. Gender</p> <p>1 Female</p> <p>2 Male</p> <p>16. Year of birth</p> <p>_____</p>	<p>15. For how long have you lived in Sodankylä?</p> <p>_____ years</p> <p>17. How many people live in your household?</p> <p>_____</p>
--	--

18. Location of your house/apartment

<p>1 Sodankylä Centre</p> <p>2 Aska</p> <p>3 Hinganmaa</p> <p>4 Jeesiö</p> <p>5 Kelujärvi</p> <p>6 Kersilö</p> <p>7 Kierinki</p> <p>8 Kukasjärvi</p> <p>9 Lismanaapa</p> <p>10 Lokka</p>	<p>11 Luosto</p> <p>12 Madetkoski</p> <p>13 Moskuvaara</p> <p>14 Orajärvi</p> <p>15 Petkula</p> <p>16 Puolakkavaara</p> <p>17 Purnumukka</p> <p>18 Rajala</p> <p>19 Raudanjoki</p> <p>20 Riipi</p>	<p>21 Sassali</p> <p>22 Sattanen</p> <p>23 Seipäjärvi</p> <p>24 Siurunmaa</p> <p>25 Syväjärvi</p> <p>26 Tankavaara</p> <p>27 Torvinen</p> <p>28 Uimaniemi</p> <p>29 Unari</p> <p>30 Vaalajärvi</p> <p>31 Vuojärvi</p> <p>32 Vuotso</p>
--	--	--

REGINA

Remote communities & resource-based industries

19. Do you or does someone else in your household work at a mine?	20. Do you or does someone else in your household own property on an existing or planned mine site?
1 Yes	1 Yes, where? _____
2 No	2 No

<p>21. Life situation (<i>choose an option closest to your life situation</i>)</p> <p>1 Entrepreneur</p> <p>2 Manager / Professional</p> <p>3 Technician / associate professional</p> <p>4 Employee</p> <p>5 Unemployed</p> <p>6 Student</p> <p>7 Pupil</p> <p>8 Retired</p> <p>9 Other, please specify</p> <p>_____</p>	<p>16. Gross income (<i>an estimate of the combined monthly income of your household in euros</i>)</p> <p>1 Less than 1000</p> <p>2 1,000 – 2,999</p> <p>3 3,000 – 4,999</p> <p>4 5,000 – 6,999</p> <p>5 7,000 – 8,999</p> <p>6 9,000 – 10,999</p> <p>7 11,000 euros or more</p>
--	--

<p>17. Education (<i>The highest level of education completed</i>)</p> <ol style="list-style-type: none">1 Primary and secondary or corresponding school2 High school or vocational school3 College or polytechnic4 University5 Something else, please specify <hr/>	<p>18. What is the field of your vocational or higher education?</p> <ol style="list-style-type: none">1 Education / teaching2 Arts and Humanities3 Business and economics4 Tourism and/or catering5 Transport6 Social sciences7 Natural sciences, mathematics and statistics8 Technical education9 Agriculture and forestry10 Health care and social services11 I don't have a vocational education12 Something else, please specify <hr/>
--	--

If you have anything else in mind about your municipality, mining, or this questionnaire, feel free to write down your thoughts here.



Nordregio



Appendix C: Questionnaire in Qeqertarsuaq and Qaanaaq

Social impact survey related to permafrost (Qeqertarsuaq)¹

How important is frozen ground thaw in explaining each of the following:

	Not important	Little important	Important	Very important	Don't know
Challenges associated to hunting and harvesting					
Challenges associated to economic activity					
Challenges associated to the changes in the physical environment					
Challenges associated to human health					
Challenges associated to culture					
Challenges associated to housing, buildings and roads					

Pls. provide examples of any changes we haven't mentioned above:

Do you hunt or fish?

- Yes
- No

Do you get country food from family members, friends and or donation?

- Yes
- No

If yes, how often do you receive country food from family members, friends and or donation?

- Once a week
- two times per month
- Once a month
- Once a year

¹ These questions are an excerpt from a survey with a total of 42 questions. Data collection is in Qeqertarsuaq and the focus are on the Social impacts of permafrost thaw.



Nordregio



Do you share country food with other households in your community?

- Yes
- No

Among these, which country food do you consume most in WINTER?

- Whale
- Seal
- Polar bear
- Fish
- Birds
- Reindeer
- Musk ox
- Hare
- Other (please specify)

Among these, which country food do you consume most in SPRING?

- Whale
- Seal
- Bird
- Fish
- Polar bear
- Reindeer
- Musk Ox
- Hare
- Other (please specify)

Among these, which country food do you consume most in SUMMER?

- Whale
- Seal
- Birds
- Fish
- Polar bear
- Reindeer
- Musk Ox
- Hare
- Other (please specify)

Among these, which country food do you consume most in FALL?

- Whale
- Seal
- Bird
- Fish
- Polar bear
- Reindeer
- Musk Ox
- Hare
- Other (please specify)

Do you collect berries and/or medicinal plants/foods'?



Nordregio



- Yes
- No

If yes, have you seen changes in the number of berries and/or medicinal plants in your best picking spots?

- Decrease in the number of berries
- Stable
- Increase in the number of berries

Have you lost some picking spots because they became flooded or submerged?

- Yes
- No

Have you been affected by some of these physical changes when travelling or hunting?

- Coastal erosion
- Slumping
- Deepening of the active layer
- Increase in the wetland areas
- Drying of wet areas
- Gullying
- Decrease in sea ice thickness
- Decrease in sea ice season
- Storms and high waves
- Flood
- Other physical changes (please specify)

Do you feel thawing ground is having an impact on your ability to obtain food and other resources for daily use from the land?

- Yes
- Somewhat
- No
- Other (please specify)

11. Do you feel that enough is being done to adapt or face the effects of permafrost thaw?

	Yes	Somewhat	No
by individuals			
by the community			
by local authorities			
by regional authorities			
by national authorities			
by the global community (Arctic Council, United Nations ...)			



Nordregio



Local Indicators of Climate Change survey – LICCI - (Qaanaaq)²

Observation corresponding to LICCI (Local indicator of climate change)

- sinking ground - Yes/No
- differential settlement affecting their house – Yes/No

Over the last couple of years, which have been the main livelihood activities of the household?

Household income, debts and savings:

- In the last year, did anyone in your family have any source of cash income? (does not include cash from sales revenue)
- Does your household have any monetary savings?
- If your household needs to access your monetary savings immediately, could you access it right away?
- Does your household owe money?
- In the last year, has anyone in the household received any support from the government (financial assistance, material help)?
- In case of an emergency/necessity, are there people you could borrow money from [substantial amount]?

How many houses does your household have?

Is this house yours, is it rented, or are you borrowing it from someone?

² These survey questions are an excerpt from a survey comprising 50 questions focusing on livelihood, economy, and experienced change in the local environment.