

Pre-Study for the Arctic Resilience Forum 2018

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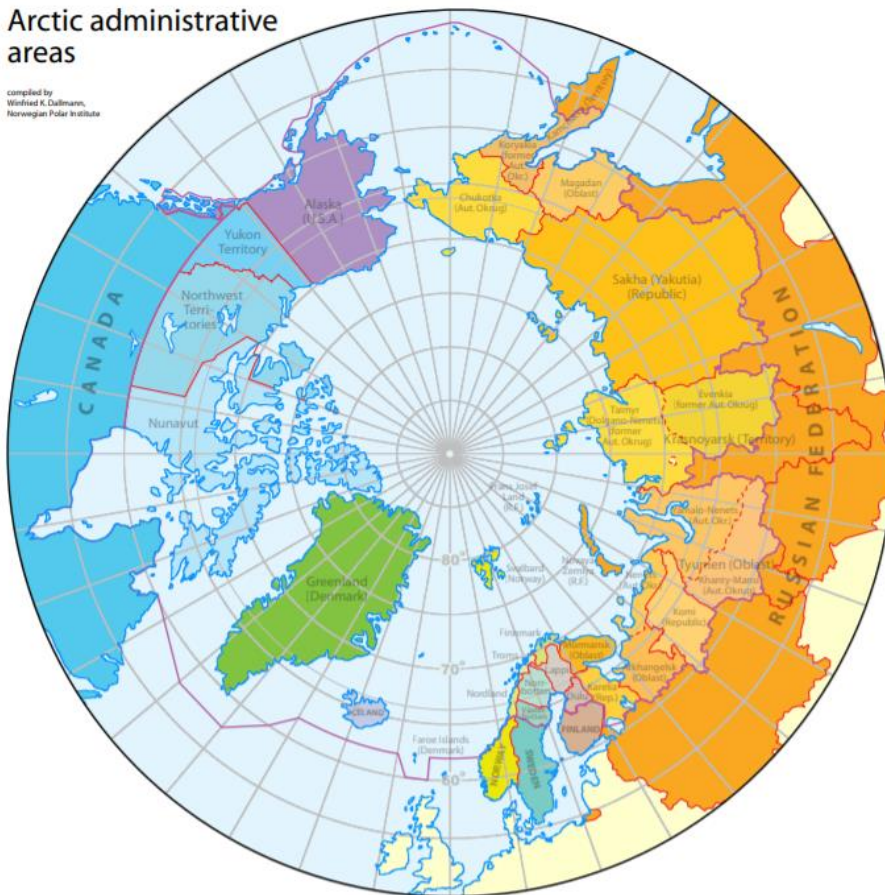
1. Introduction

1.1. Background – setting the context

This pre-study focuses on the best Finnish examples of climate resilience in the Arctic (Picture 1). Multiple Arctic and non-Arctic actors have already collected and analysed resilience and adaptation case examples in the Arctic (ARR, page xv). The main actors, such as the Arctic Council Working Groups and other major stakeholders, have published some of the key publications related to Arctic resilience, such as the Arctic Resilience Action Framework (ARAF) and Synthesis for Arctic Leaders (SAL), Arctic Resilience Report (ARR), Adaptations Actions for a Changing Arctic (AACA), the Arctic Human Development Report (ADHR) and the Arctic Social Indicators (ASI).

Arctic administrative areas

compiled by
Winfried K. Dallmann,
Norwegian Polar Institute



Picture 1: Arctic Administrative areas (Compiled by Winfried K. Dallmann, Norwegian Polar Institute)

This pre-study builds on these publications but directs the focus to concrete *climate resilience* adaptation actions. The aim and reason for limiting the focus of this pre-study is to find, analyse and share the concrete tools available for the urgently needed immediate resilience building in the Arctic. The guiding principle for this pre-study is “to mobilize and use the broad competence and expertise of all Arctic Council Member States, Permanent

Participants, Working Group secretariats and Observers, along with other Arctic stakeholders, to provide the information, tools, analysis, and capacity necessary to address immediate and future resilience and adaptation needs in the circumpolar Arctic (ARAF, 16)".

A concrete framework is needed to increase our understanding of the risks and uncertainties around climate change, and its impacts, and to improve the resilience of threatened Arctic communities and ecosystems (ARAF, 2). Climate change is a major threat to ecosystems and human communities in the Arctic, as the region is changing at an unprecedented pace, on multiple levels, and in ways that fundamentally affect both people and the ecosystems (AACA, 3).

The rate of warming in the Arctic is double compared to the rest of the planet and change drivers, such as increasing globalization, urbanisation, digitalization and the growing tourism industry, have significant effects in the region. Overall, the significant and interconnected climate impacts manifest themselves in various ways in the Arctic (ARR, pages x-xiii). In this pre-study, the main focus will be on the challenges posed by climate change.

The Arctic Council, as the leading intergovernmental forum on issues of sustainable development and environmental protection in the region, is well-positioned to establish a coordinated, regional response to social, economic and environmental changes. ARAF provides a mechanism for increasing the resilience in the Arctic. It provides the Arctic Council with a common set of guiding principles and priorities for action as well as a platform to further discuss required actions, resources and to share lessons learned.

As the Arctic climate is changing, there will be a significant challenge to the region's ecosystems and human societies. Therefore, concrete actions are needed to increase both the overall resilience, and in particular the climate resilience, in the Arctic. For this purpose, the ARAF defines nine "Guiding Principles" to increase the overall adaptive capacity of Arctic communities. They are:

1. Build on the strengths of the Arctic Council and its Working Groups as a regional mechanism for cooperation.
2. Value and draw on Indigenous/Traditional Knowledge and local knowledge.
3. Build upon existing global, regional and national strategies for sustainable development, climate change adaptation and mitigation, and disaster risk reduction.
4. Support multi-stakeholder engagement.
5. Empower local communities.

6. Address multiple risks (related to communities and ecosystems) and look for co-benefits.
7. Consider risk and resilience across temporal and spatial scales.
8. Encourage innovative investments that prevent and proactively mitigate risk.
9. Monitor progress and adjust strategies as needed.

While several factors pose a challenge to long-term planning and sustainable development in the Arctic, these principles should be used to effectively build capacities to increase resilience and adaptive capacity against the various threats. Exceptional challenges will require innovative solutions and multiple actors. Key actors include politicians, indigenous peoples, academia, public and private sectors, among others. Special attention is required to utilize indigenous traditional knowledge to build the capacity against the rapid changes (AHDR, 495).

Social and ecological systems are strongly interlinked in the Arctic, which means that holistic solutions utilizing the best research available, including indigenous knowledge, need to be developed. Indigenous peoples in the Arctic have always adapted to environmental and societal changes; however, the current rate and intensity of climate change makes adaptation extremely challenging in today's Arctic and, for this reason, "it is important for governments, Indigenous Peoples and local communities to work collaboratively to build resilience to the social-ecological changes that are already underway" (ARAF, 2).

1.2. The Arctic Resilience Forum in September 2018 - the aim of this document
The 1st Arctic Resilience Forum will be held in Rovaniemi, Finland, in September 2018 during Finland's Chairmanship of the Arctic Council. The Arctic Resilience Forum has as its aim to explore practical concrete tools to implement the nine guiding principles in a way that enables the sharing of best practises. More particular focus is on examining what are the risks that climate change poses on ecosystems and human communities, and how the resilience of the region be increased. Since technological innovation provides new possibilities for capacity development and collaboration among countries and peoples (ARR 35), it is also important to explore and share technical best practises to increase climate resilience.

It is clear that building resilience is timely. There is a universal momentum for responding to climate and other environmental changes, and, in particular, how those challenges relate to

human development (AACA, 14-15). For these reasons, it is of crucial importance to better understand the risks and uncertainties and come up with measures to improve the resilience of threatened communities and ecosystems.

While chapter 2 provides an overview of the resilience terminology, noting special aspects linked to the Arctic region, chapter 3 introduces a snapshot of past and on-going resilience work in Finland. A number of best practises and tools for promoting Arctic climate resilience is presented in chapter 4. Finally, chapter 5 further elaborates on next steps towards the September 2018 forum.

With this narrower focus, it is possible to make progress to attain the four goals set for the Arctic Resilience Forum, keeping in mind that ARAF is not limited to climate risks and responding only to these. It is suggested that it is better to start from a more limited focus on climate risks and solutions, and then later on to take on the whole gamut of risks facing the Arctic and various ways and tools to respond to these.

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2. Definition of Arctic Resilience

This project focuses on examining the existing tools and best practices that can help respond to the direct geophysical, ecological and societal impacts of climate change in the Arctic. This building of climate resilience in the region should be done not only in view of governmental actions but also in light of what private companies can do to increase climate resilience. Even though this is the core focus of the project, in some cases it is justifiable to take a slightly broader focus.

In the Arctic, the role of the public sector is central to enable “bouncing back” effectively against the risks of climate change. In order to uphold effective climate adaptation processes, private-public partnerships and private actors are also crucially needed. Business opportunities open possibilities for effective climate adaptation “...an adjustment

in natural or human systems, in response to climate change, which is intended to minimize disruption or take advantage of opportunities” (ARAF, 2).

As is stated in ARAF, effective climate adaptation measures help build resilience, while actions fostering resilience can build the capacity to adapt. Therefore, both resilience and climate adaptation are closely linked. We understand climate adaptation as the core of Arctic resilience, since without climate adaptation, Arctic social-ecological systems cannot bounce back against the significant, immediate and profound impacts of the rapid warming of the Arctic. In building climate resilience, it is of much importance to rely on the guiding principles adopted as part of the ARAF (ARAF, 6-7).

ARAF defines a social-ecological system as an integrated system that is composed of human societies and ecosystems. Its structure is characterized by reciprocal feedbacks between the two. It is of much importance to emphasize that in the Arctic, social and ecological systems are very tightly connected. For this reason, it is imperative to consider the linked social-ecological system to understand changes in the Arctic and to identify and implement strategies for adaptation and resilience. (ARAF, 2).

As social-ecological systems are particularly linked in the Arctic, resilience actions aim to generate a measurable improvement in the capacity of Arctic States and communities to understand and respond to risks and changes in ways that support “socio-economic development and healthy, functioning ecosystems and ecosystem services”. (ARAF, 4).

Hence, building strongly on previous arctic assessments and initiatives, this pre-study uses the resilience definition from the Arctic Resilience Action Framework (2017) which describes resilience as “The capacity of people to learn, share and make use of their knowledge of social and ecological interactions and feedbacks, to deliberately and effectively engage in shaping adaptive or transformative social-ecological change”. (ARAF, 8)”. However, within this project, the focus is specifically on climate change and climate resilience, with the aim to identify concrete and replicable best practices and tools that support urgently needed climate adaptation in one of the most vulnerable regions globally.

3. Snapshot of Arctic resilience work in Finland

Finland has decades of experience of Arctic resilience work and this chapter describes major structures of Finnish resilience actions as regards the challenges posed by climate change.

International cases of Arctic resilience work collected and suggested by key actors in the Arctic Council cooperation¹, will be welcomed during the preparatory process to the Forum and will be presented at the Arctic Resilience Forum.

Finland is an Arctic country with a few fast-developing growth centres, regions with stable development and regions with challenges to adapt to change drivers. The whole country needs to adapt to significant changes, but the sparsely populated north of Finland faces the most profound climate risks. Therefore, the most urgent need to increase adaptation capacity is in the northern parts, where changes happen the fastest and socio-ecological structures are more vulnerable than in the rest of the country. Northern Finland is also the home of the European Union's only indigenous people, the Sami people, who are divided into three culturally rich groups: Inari Sami, North Sami and Skolt Sami. Northern Finland, while having only a few growth centres and being the most sparsely populated region in the country, also is endowed with significant natural resources.

The Barents region, including northern Finland is different from most of the Arctic. The Gulf stream warms the area and in spite of the northern location, the area is covered mostly by boreal forests. Due to favorable climate conditions, most of the northern Finland has a long history of inhabitants and well-developed infrastructure as well as diverse livelihoods based on natural resources. These conditions have allowed the development of agriculture, forestry and other economic activities based on natural resources, endowing Finland a rather special position as an arctic country.

Arctic resilience work in Finland aims to build climate resilience and adaptation capacity through a variety of implementation measures. Experience of fate control is one significant factor for Arctic communities, since if social structures support fate control, communities have better resilience against the external threats such as changes in their environment (Arctic Social Indicators, 2013, 15). The aim for resilience work in Finland is to enable social structures that support fate control of Arctic communities and protect the ecological structures of the vulnerable Arctic environment. To support resilience against the external and internal stress factors, changes are needed on several levels.

Some of the areas where resilience building actions are urgently needed in Finland are broad spheres such as education, finance, and empowerment of indigenous peoples. Beyond these broader spheres that generally enable effective and sustainable action to take

¹ including Working Groups, and possibly representatives of Member States and Permanent Participants

place, more targeted action is also needed in sectors such as weather forecasting services, agriculture, tourism, reindeer herding, forestry and variety of sustainable utilization of natural resources. Also, urban planning (e.g. soft-mobility², flood protection and smart infrastructure), security of critical infrastructure (e.g. electricity supply, maritime safety and crisis management) and innovative technologies are some of the key sectors to develop in Finland. In section 4 below “Best Practices and Tools of Arctic Resilience” these Finnish best practises are identified. More concrete examples are presented in Appendix 1.

4. Best practises and tools of Arctic climate resilience

To make it easier to understand the multidimensionality of resilience, this pre-study categorizes climate resilience actions in Finland on three interconnected levels: *uncertainties*, *changing environment*, and *long-term risks*. Examples demonstrate some of the best Finnish tools to increase Arctic climate resilience of Arctic states, indigenous peoples and local residents to respond to common problems in the Arctic caused by climate change. The focus of the following sections is on examining climate change related risks and their solutions.

4.1. Managing uncertainties

Climate change increases uncertainties in the Arctic. These include climate risks such as extreme weather conditions, less soil frost and growing weather and climate unpredictability in the Arctic. These risks pose a threat to a variety of sectors in the Arctic communities. This sub-chapter highlights resilience building in some of the affected sectors, in particular agriculture, forestry and wood based bioeconomy and soft-mobility in urban environments.

4.1.1. Agriculture

Finnish farmlands reach from the 60th latitude to north of the Arctic Circle and although the growing season is short, Finland has good possibilities for agriculture such as grain production. Finland is for example one of the biggest producers and exporters of oats in the world.

Climate change challenges agriculture in a variety of ways in the Arctic. Different parts of the Arctic face different risks, but there are also common challenges. These risks include

² "non-motorised human movement", Climatic barriers to soft-mobility in winter: Luleå, Sweden as case study. Chapman, David; Nilsson, Kristina; Larsson, Agneta & Rizzod, Agetino. Sustainable Cities and Society. Volume 35, November 2017, Pages 574-580.

weather extremes, such as the growing frequency of storms and rising mean temperatures. These risks force agriculture to adapt to new circumstances as most parts of the Arctic face increases in the soil moisture and changes in the growing seasons. Moreover, invasive species may pose challenges to traditional agriculture.

Finland has significant expertise in agriculture in Arctic environments and some Finnish companies produce world leading solutions for agriculture in challenging Arctic environments, such as grain processing devices. Finnish know-how can be utilized in preparations for climate risks, which supports adaptive capacity building. There might be a need for switching over to new crop species and harvest seasons. Finnish agriculture explores also new technical solutions such as vertical farming and advanced grain processing, which may enable agriculture even if climate risks increases.³

For example, Antti Teollisuus Ltd. grain dryer devices are designed to endure cold and harsh weather conditions. Grain dryers are widely used in Finland to decrease the moisture of grain. These improve the quality and preservation of food. The Finnish Natural Resources Institute Finland (Luke) carries out research and provides a variety of business solutions to ensure agriculture in harsh Arctic conditions.

Innovative climate resilient techniques have also been developed by Suomen Siemenperunakeskus Ltd. Their new aeroponic method enables climate resilient production of seed potatoes. The idea behind the aeroponic method is that potato roots grow hanging in the air in a dark, enclosed chamber. Position of high grade seed potato production in such a Northern site in Europe utilises the benefit of very low infestation risk of pest organism from external surrounding of the greenhouses. The keep up of high purity grade is thus very efficient.

According to calculations, almost 50% of available money in the Northern villages is spent on purchasing fossil energy. Therefore, in terms of economic, social and environmental resilience, it would be very important that fossil energy could be substituted with renewable

³ "Defining Vertical Farming (VF), it is a system of commercial farming whereby plants, animals, fungi and other life forms are cultivated for food, fuel, fibre or other products or services by artificially stacking them vertically above each other." Banerjee, Chirantan "Up, Up and Away! The Economics of Vertical Farming" *Journal of Agricultural Studies* 2014, Vol. 2, No. 1. "Vertical Farming (VF) is an agricultural technique involving large-scale food production in high-rise buildings that enables fast growth and planned production by controlling environmental conditions and nutrient solutions to crops based on hydroponics". Kalantari, F., Tahir, O. M., Joni, R. A., & Fatemi, E. Opportunities and Challenges in Sustainability of Vertical Farming: A Review. *Journal of Landscape Ecology*, 0(0). <https://doi.org/10.1515/JLECOL-2017-0016>

energy sources, preferably with side flows from agriculture and from the forest sector. That would benefit the local economy and gradually open up possibilities to invest to biorefinery capacity and even up to modern methane-based economy.

The green economy approach and its new structures (Agrohub), open data and advancing digitization are forming the foundation of a new platform economy combining economic activities in a new way and integrated those with the fast recreation and tourism activities that are growing fast, at present. This enhances many ways a more holistic and multidimensional approach to decentralised regional economy, which, also, creates value for resilience.⁴

4.1.2. Forestry and forest-based bioeconomy

Arctic wood based bioeconomy is a specialty of the Barents area: in northern Finland, Sweden and Norway and Northwestern Russia. Economically sound forestry is practiced in Finland all the way up to 69th latitude. The Lapland region covers 9000 km³, with a wood volume 390 mill. m³ growing stand and with yearly growth of >13 mill. m³ and 4 mill.m³ loggings. The forest industry and forestry are economically the biggest livelihoods in the Finnish Lapland, with tourism and mining coming next. In forestry and wood procurement there have been developed modern technologies that have been adapted for arctic conditions. Forest machine industry based in Finland, companies like Ponsse Ltd are technology leaders in the world in cut-to-length wood procurement.

Northern boreal forests in the region are rather resilient to climate change due to their location at the northern edge of the large vegetation zone. Projected increases in the temperature will alter the conditions into more equal to those now present in the southern Finland. Extreme weather conditions would however simultaneously raise the risk for forest damages. Also, the period of frozen soil is expected to become shorter and it challenges both the wood procurement and freight transportation on soft soils and smaller roads.

As within forestry, overall, key to sustainability of the natural resource management in the Arctic is inclusive planning and providing local people possibilities to influence the use, management and protection of their living surroundings. Access to traditional use of natural

⁴ See also Appendix 1: Climate resilient agriculture

resources, such as berry picking, fishing, hunting, use of plants for handicrafts, food and fodder, need to be ensured.⁵

4.1.3. Safe access to soft-mobility

Safe access to soft-mobility is an important factor in all urban environments. Climate change increases weather extremes in the Arctic and warmer temperatures raise new challenges, such as slipperiness, in the milder wintertime. Pedestrians often face hazardous walking conditions and changes may present major risks to multiple Arctic communities (e.g. cities, villages and business entities).

Finnish companies and cities have some solutions to increase access to safe soft-mobility in urban environments. Comprehensive plans for avoiding accidents, especially during milder winter months, prevent accidents and significantly increases citizens' and cities' social and economic resilience. Examples of Finnish know-how include actions of the city of Kuopio, which aim to decrease accidents in winter months. Practical solutions include text messages to citizens and road maintenance when streets are slippery or in bad condition. The city of Kuopio is also de-icing the most popular streets with district heating. Sievi Jalkine Ltd. produces safety shoes for professional needs. Their spike shoes are especially safe for walking on slippery surfaces, such as on ice. Their shoes are popular also in leisure use. The 112 Suomi mobile application is useful when a person calls the emergency telephone number. The application tracks GPS coordinates and forwards them to an emergency telephone centre, which in turn speeds up emergency services. The application has been chosen as "The Best Android Service in Finland 2017".⁶

4.2. Coping with a rapidly changing environment

Climate change is rapidly transforming Arctic environments. Alterations include abiotic changes such as melting of permafrost, changes in sea ice conditions, more intense floods in some parts of the Arctic, and, eventually the change of climate zones. Biotic changes include alterations in species distributions, species becoming threatened such as arctic fox, and the emergence of invasive species. According to the Arctic Biodiversity Assessment (ABA 2013) climate change caused by human activities is by far the most serious threat to biodiversity in the Arctic. Northward movement of boreal species may increase the number of species found in the Arctic, but this does not represent a net gain in global biodiversity,

⁵ For more examples on inclusive planning and public participation aiming at resilience in the Arctic, see Appendix 1 (Metsähallitus Forestry Ltd).

⁶ See also Appendix 1: Pedestrian safety in changing climate

since species common in for example boreal habitats may outcompete Arctic species. The overall geographic extent of terrestrial Arctic habitats is therefore expected to reduce.

According to ABA (2013) also Arctic freshwater ecosystems are undergoing rapid change in response to the influence of both environmental and anthropogenic stressors. In the marine Arctic, climate-induced effects on species and ecosystems, associated with a decrease in sea ice extent and duration, are already being observed.

ABA (2013) also states that “Until the second half of the 20th century, overharvest was the primary threat to a number of Arctic mammals, birds and fishes. Since the middle of the 20th century, a variety of contaminants have bioaccumulated in several Arctic predator species to levels that threaten the health and fecundity of both animals and humans. However, due to concerted global action to reduce the release of contaminants, there are, as yet, few demonstrated effects on Arctic species at the population level. Lack of data may mask such impacts, however. New contaminants, and changing fluxes of others, continue to be introduced to Arctic ecosystems and related food webs with unknown ecosystem effects.”

These multiple risks pose a threat to a variety of sectors in the local Arctic communities. This sub-chapter focuses on resilience building in particular in maritime safety and flood protection.

4.2.1. Maritime safety

Climate change is affecting maritime safety as ice conditions and the movement of ice are changing in the Arctic. This will contribute to a changing risk landscape in the Arctic in the coming years, with repercussions to maritime and human safety. Finland has prepared for these risks in advance with strong expertise in Arctic weather forecasting, special vessel development and shipbuilding, and advanced rescue activities.

Examples of Finnish know-how include the icebreaker *Polaris*, which can perform emergency towing and rescue operations, as well as oil spill response operations, on the open sea all year round thus strengthening overall resilience. *Polaris* can also aid in improving logistic accessibility in remote areas, as well as assist first aid crews to reach crisis victims at sea. *Arctia Ltd* provides icebreaking and specialised multipurpose vessel services in polar areas. *Arctech Helsinki Shipyard* builds icebreakers and arctic offshore and

special vessels and Lamor offers efficient oil recovery solutions with excellent ice handling capabilities.⁷

4.2.2. Flood risks

Climate change raises flood risks in many parts of the Arctic. Some major reasons for this are changes in the seasons and rain quantities, and also increased frequency of storms. Urban areas and agriculture suffer significantly from floods, but nature faces major risks too. For example, sewage, fertilizers and a variety of waste might end up in waters or cause other environmental risks. Flood and rescue plans are needed to minimize flood risks. These include improved urban planning, runoff water mitigation and dredging of rivers. Also, hydroelectric power plants are useful for small scale flow regulation. In addition, tailored forecasting models may help to prevent damages.

Many parts of Finland suffer from floods and also have expertise in flood protection. The Department of Rescue Services has strong expertise in rescue activities and risk prevention in the Arctic. The Finnish Meteorological Institute (FMI) has world leading expertise in weather forecasting. The Finnish Environment Institute (SYKE) has developed hydrological modelling combined with GIS approaches that support sustainable land use planning and climate adaptation. Moreover, several Finnish cities, for example the City of Rovaniemi, have developed advanced plans and capacities for flood protection.⁸

4.3. Addressing long-term risks caused by climate change

Climate change increases the variety of long-term risks in the Arctic. There are known climate risks, such as rising mean temperatures (even if the pace of change differs in various parts of the Arctic) and wicked problems such as erosion in some parts of the Arctic. Climate change may also pose risks that are not well defined in advance such as less frozen soils than earlier with multiple implications e.g. within forestry and agriculture. These known and unknown risks pose a threat to a variety of sectors in the Arctic communities. This chapter focuses on resilience building in vulnerable indigenous communities and to the role of education and research as a solution to many climate risks.

4.3.1. Indigenous people

Climate change is changing dramatically climate zones and Arctic environments. This is a major challenge to all communities, but indigenous people are especially vulnerable to climate risks as their cultures and knowledge are often heavily tied to their surrounding

⁷ See also Appendix 1: Maritime safety

⁸ See also Appendix 1: Flood protection

environment. The Sami and other Arctic indigenous people have also been historically marginalized, and their traditional homelands suffer most profoundly from the climate risks. Marginalized groups are more vulnerable to climate risks and special attention should be paid to increasing their resilience especially through fate control. Many indigenous people in the Arctic highlight that fate control is “a matter of profound importance to them” (Arctic Social Indicators, 2013, 15).

One of the major climate risks for indigenous people are the impacts of climate change to their traditional livelihoods. Professions such as reindeer herding, fishing and whaling are forced to adapt. As problems in the Arctic are often caused from outside the region, local communities are forced to adapt to changes without having control over their fate. This way climate change is a direct threat to indigenous peoples’ wellbeing, income and cultures.⁹

In Finland, there are some successful examples of promoting resilience building by including indigenous and local people in the processes. Snowchange Cooperative is using a mixture of indigenous Skolt Sami knowledge and western science for holistic rehabilitation of salmon rivers. Akwé:Kon is “the conduct of cultural, environmental and social impact assessments regarding developments proposed to take place on, or which are likely to impact on, sacred sites and on lands and waters traditionally occupied or used by indigenous and local communities” (Akwé:Kon Guidelines, 5). Akwé:Kon has been used in co-operation between Sami communities and Metsähallitus. As indigenous knowledge is also tied to traditional arts and crafts, and both bring economic profit (cultural economy) to indigenous people (ADHR, 167), the Sami Duodji label, which protects indigenous handicraft, is important for resilience building for the Finnish Sami people.¹⁰

4.3.2. Education and research

Education can enable better preparation for multiple climate risks. As climate change causes significant changes to Arctic nature, research knowledge and education have tools to prepare local communities for changes and may minimize the problems caused by locals. As indigenous peoples suffer possibly the most from these changes, proper and easily accessible climate education would increase their resilience against the climate risks.

Because of several uncertainties related to how climate change impacts the Arctic (including multiple feedback loops) and the exceptional speed of change in the Arctic, it is not possible

⁹ See Appendix 1: Reindeer herding (climate change forces traditional livelihoods to adopt)

¹⁰ See Appendix 1: Empowerment of indigenous people

to prepare plans that match every risk scenario. Wicked problems such as rising sea levels and increasing erosion are challenging to solve or cope with, but improved climate education offers tools for local communities for more rapid and effective harnessing of adaptation measures.

Climate education might include lessons about how to cope with weather extremes and unexpected circumstances, while simultaneously promoting sustainable livelihoods and consumption patterns that protect ecosystems. Climate education improves climate awareness, offers tools to adapt to changes and may increase the overall economic, ecological and social resilience of individuals and communities.

Climate change and resilience building could be integrated into the curriculum at all levels of education. Higher education needs a special focus with an “Arctic touch” to ensure that there will be experts on climate change issues in many fields of society. Arranging education for sparsely populated Arctic regions needs special attention.

Finland has strong expertise in both educational and Arctic affairs. We have high level knowledge and competence concerning sustainable use of natural resources in the area. Institutes like Natural Resources Institute Finland and Finnish Environment Institute have strong knowledge in this area in addition to universities. Finland has also world leading expertise in digitalization of education services and natural resources. The Finnish Ministry of Education and Culture manages the country’s world leading educational systems. According to the Finnish National Adaptation Plan, climate change adaptation education will be added to all educational levels (Source: Finland’s National Climate Change Adaptation Plan 2022 p. 26). The Ministry of Education and Culture and some Finnish key stakeholders publish already a “Climate.now” study module. It is a multidisciplinary study and teaching module on the basics of climate change. It contains open access written material, video lectures and interviews, assignments, tests and a guide for teachers that will help anyone familiarise themselves with the basics of the climate change. The study module can be integrated as a part of Finnish higher education studies. The Sami Educational Institute have strong expertise in offering education among indigenous people in sparsely inhabited Finnish Lapland. They also have a long experience in distance teaching.¹¹

¹¹ See Appendix 1: Climate education and awareness with an Arctic touch

5. Mobilizing ARAF targets through the Arctic Resilience Forum

As noted in the ARAF, the main outcome of the framework should be “A measurable increase in the capacity of Arctic States and Arctic communities to understand and respond to risks and changes in ways that support socio-economic development and healthy functioning ecosystems and ecosystem services”. This outcome is to be achieved by pursuing the following goal: “To mobilize and use the broad competence and expertise of all Arctic Council Member States, Permanent Participants, Working Groups and Observers, along with other Arctic stakeholders, to provide the information, tools, analysis and capacity necessary to address immediate and future resilience and adaptation needs in the circumpolar Arctic. One of the major implementing measures to attain the outcome and the goal of ARAF is organizing a regular Arctic Resilience Forum by the chair state to “...a) assess progress toward the ARAF outcome and priorities, b) showcase best practices and resilience learning, c) identify and plan for emerging or urgent priorities, and d) encourage public/private resilience investment opportunities” (ARAF, 14).

As has been mentioned above, the main focus of this pre-study is to examine how Arctic resilience can be strengthened, in particular by addressing climate change caused risks in the Arctic and showcase some of the best Finnish practices that the public sector, indigenous and local residents and business enterprises have implemented to respond to these climate risks. Hence, the broad focus of ARAF is limited in this pre-study to those risks caused by climate change in the Arctic.

The aim of the Arctic Resilience Forum (taking place in September 2018) is to take the Arctic Resilience Action Framework into practice, in order to have a meaningful discussion and sharing of best practices in the Arctic Resilience Forum, it is seen as necessary in this first phase to focus on climate risks and the measures that the Arctic states, indigenous and local residents and economic actors have taken to respond to these risks.

With this narrower focus, it is possible to make progress to attain the four goals set for the Arctic Resilience Forum, keeping in mind that ARAF is not limited to climate risks and responding only to these. It is suggested that it is better to start from a more limited focus on climate risks and solutions to these, and then later on to take on the whole gamut of risks facing the Arctic and various ways and tools to respond to these.

References

Arctic Biodiversity Assessment (ABA 2013), Status and trends in Arctic Biodiversity Conservation of Arctic Flora and Fauna (CAFF), Arctic Council, 2013

Adaptation Actions for a Changing Arctic: Barents Area Overview Report (2017) AMAP Secretariat.
<https://www.amap.no/documents/doc/Adaptation-Actions-for-a-Changing-Arctic-AACA-Barents-Area-Overview-report/1529>

Akwé:Kon Guidelines (2004) Secretariat of the Convention on Biological Diversity,
<https://www.cbd.int/doc/publications/akwe-brochure-en.pdf>

Arctic Human Development Report, Regional Processes and Global Linkages (2015) Nordic Council of Ministers. <http://norden.diva-portal.org/smash/record.jsf?pid=diva2%3A788965&dswid=-5023>

Arctic Resilience Action Framework; cooperating for a More Resilient and Prosperous Arctic Region (2016-09-02), https://oaarchive.arctic-council.org/bitstream/handle/11374/1790/EDOCS-3821-v1A-ACSAOUS203_Portland_2016_5-3-1_ARAF_Framework_Draft.PDF?sequence=1&isAllowed=y

Arctic Resilience Report (2016) <http://arctic-council.org/arr/>

Arctic Social Indicators: ASI II, (2013) <https://oaarchive.arctic-council.org/handle/11374/48>

Banerjee, Chirantan "Up, Up and Away! The Economics of Vertical Farming" Journal of Agricultural Studies 2014, Vol. 2, No. 1.

Chapman, David; Nilsson, Kristina; Larsson, Agneta & Rizzod, Agetino. Sustainable Cities and Society. Volume 35, November 2017.

Finland's National Climate Change Adaptation Plan 2022 <http://mmm.fi/en/national-climate-change-adaptation-plan>

Kalantari, F., Tahir, O. M., Joni, R. A., & Fatemi, E. Opportunities and Challenges in Sustainability of Vertical Farming: A Review. Journal of Landscape Ecology, 0(0). <https://doi.org/10.1515/JLECOL-2017-0016>.

Appendix 1 Examples of building Arctic resilience – good practices from Finland

1. Inclusive planning and public participation aiming at resilience in the Arctic (Metsähallitus Forestry Ltd)
2. Climate resilient agriculture
3. Animal husbandry
4. Fish farming in the Arctic
5. Security of critical infrastructure services
6. Pedestrian Safety in Changing Climate
7. Maritime Safety (incl. also presentation of Maritime SAR, Safety, and Cooperation - OPV Turva)
8. Flood Protection
9. Safety promoting innovative technologies
10. Reindeer Herding (Climate change forces traditional livelihoods to adopt)
11. Empowerment of indigenous people
12. Climate resilient tourism services in the Arctic
13. Climate education and awareness with an Arctic touch
14. Access to financial instruments for building resilience

Inclusive planning and public participation aiming at resilience in the Arctic - Metsähallitus Forestry Ltd

Introduction

- The key to Sustainability of the natural resource management in the Arctic is inclusive planning and providing local people and interest groups possibilities to influence the use, management and protection of their living surroundings. Access to traditional use of natural resources, such as berry picking, fishing, hunting, use of plants for handicrafts, food and fodder, need to be ensured.
- Due to favourable climate conditions, most of the northern Finland has a long history of inhabitants and well-developed infrastructure as well as diverse livelihoods based on natural resources.

Risk

Disturbance in land-use balance between livelihoods in the Arctic causes conflicts

Solution

Involvement of local communities and interest groups in land-use planning

Solutions to manage climate risks and build resilience

- In order to combine the various uses of state lands, Metsähallitus has adopted a holistic land use planning, Natural Resource Management. Natural resource plan combines the various land uses and the needs of local communities to natural resources, state ownership governance and customer needs. The Plans are made in wide interest group participatory processes. New participation methods are developed, such as collecting data of sites of public interest via open internet maps.
- Reindeer herding is a traditional livelihood in Lapland which has been practiced by both Finns and the Sámi indigenous people for centuries. The reindeer herding co-operatives are given an opportunity to influence on all logging-, soil preparation and road construction plans as well as touristic routes.
- To ensure the indigenous rights of the Sámi in land use issues Metsähallitus and the Sámi parliament have developed together the practical methods to implement the Akwé: Kon principles based on the International Biodiversity convention 8J § of the heritage of indigenous peoples.
- Land use decisions as well as decisions concerning the use of natural resources are essential to strengthen resilience in the Arctic.

Existing expertise in Finland and business opportunities

- Wild berry gathering and berry industry is also based on commercial forest areas. 9 mills. ha of forests which is 99 % of the forest area in Lapland is certified as organic gathering areas of natural products. This means that no chemicals, such as fertilization, pesticides or herbicides are used in these areas.
- New wood based bioplants are planned to be open in northern Finland in few years. Development from oil-based materials and fuels to renewables opens new opportunities to our Northern forests.
- Practicing sustainable forestry forms the economic and social backbone of the areas in Northern Finland. It is one of the vital sources of livelihoods for the communities in these areas.
- For this reason, both forestry practices as well as an inclusive, responsible and participatory approach to planning need to be state of the art.

Climate resilient agriculture

New farming strategies and technologies for a changing Arctic climate

Introduction

- Climate change challenges agriculture in a variety of ways in the Arctic. Different parts of the Arctic face different risks, but there are also common challenges.
- Risks include weather extremes such as the growing frequency of storms. Most parts of the Arctic face also rising mean temperatures, increases in the soil moisture and changes in the growing seasons, which may entail for example invasive species.

Solutions to manage climate risks and build resilience

- Making use of new strategies and technologies to adopt for changing conditions reduce climate risks in the Arctic and may improve social, ecological and economical resilience.
- Adaptive capacity may be increased by switching over to new crop species and harvests seasons. Also technical solutions such as vertical farming and advanced grain processing increases climate resilience and might be essential for Arctic agriculture.

Existing expertise in Finland and business opportunities

- Finland has significant expertise in agriculture in Arctic environments and some Finnish companies produce world leading solutions for agriculture in challenging environments.
- Opportunities for promoting more resilient agriculture exist for several Finnish public and private sector actors, such as:
 - ✓ Suomen Siemenperunakeskus Oy use a new aeroponic method for more climate resilient production of seed potatoes. Thanks to the method, seed potatoes can be done indoors, which is effective against invasive species, disease and other climate risks.
 - ✓ Antti Teollisuus Oy grain dryer devices are designed to endure cold and harsh weather conditions. Grain dryers are widely used in Finland to decrease the moisture of grain. These improve the quality and preservation of food.
 - ✓ The Finnish Natural Resources Institute Finland (Luke) carries out research and provides business solutions to ensure agriculture in harsh Arctic conditions.

Risk



Changing environments challenge farming and allow invading species

Solution



New farming strategies and technical solutions, such as vertical farming

Animal husbandry

Climate change forces traditional livelihoods to adopt

Introduction

- Climate change warms most parts of the Arctic. This has an effect on animal husbandry in the Arctic, as it might generally decrease the quality of forage production and production of animals. * While production quantities might generally increase, a number of environmental risks might simultaneously increase, e.g. related to sustainability of water systems.
- Existing husbandry animals and forage species in the Arctic are optimized for existing weather conditions and their production will be challenged when mean temperatures rises. Also several invading species, diseases and parasites are expected to enter Arctic ecosystems.

Solutions to manage climate risks and build resilience

- Climate risks can be managed by systematically adapting to new farming seasons. This may accelerate the growth rate of some animals, while it hinders others. The effects will depend on where the farms are located and how much the temperatures will rise. Due to uncertainties around the climate change, further research is needed to find out how to exactly manage the direct climate risks.
- Selective breeding programs of farmed animals and forage species support the adaptation to new environments and changing climate. New technologies can enable better productivity while also contributing to cost-savings.

Existing expertise in Finland and business opportunities

- Finland has high quality research and know-how in animal husbandry in challenging Arctic environments. Finland has also developed technical solutions that enable better productivity and simultaneously can help strengthen socioeconomic capacity to cope with climate change impacts.
- Opportunities for promoting more resilient animal husbandry approaches exist for several Finnish public and private sector actors:
 - ✓ Finnish Ministry of Agriculture and Forestry organize large variety of animal husbandry related programs and processes in Arctic conditions.
 - ✓ Demeca offers solutions for better productivity of milk and beef production, ease and expedite daily routines in farms and savings in lifetime costs. They are designing, manufacturing and testing all products to withstand and fulfill the needs of Northern conditions.
 - ✓ Figen Ltd. is the major Finnish swine genetics supplier that offers high-performance live animals and fresh boar semen for breeding purposes.

Risk



Rising mean
temperatures

Solution



New strategies,
technologies, breeding
programs and research

* Source: <https://ilmasto-opas.fi/fi/ilmastonmuutos/vaikutukset/-/artikkeli/26223b8c-dc64-4e4b-96d7-de11cc56fb53/ilmastonmuutos-tuo-suomen-kotielaintaloudelle-mahdollisuksia-ja-haasteita.html>

Fish farming in the Arctic

Climate change forces to adopt new strategies and approaches for fish farming.

Introduction

- Climate change rises the average temperature in the Arctic. This effects fish farming, as it generally drops water oxygen content. Simultaneously the oxygen consumption of fish increases, which limits the growth rate of fish and cause them health problems.
- Extreme weather events increases production risks in fish farming and limits especially open-water cage farming. Also several parasites and pathogens thrive in warmer water.

Solutions to manage climate risks and build resilience

- Climate risks can be limited by adapting to new farming seasons. This may accelerate the growth rate of some fish, while it hinders others. The effects will depend on where the fish farms are located and how much the temperatures will rise. Due to uncertainties around the climate change, further research is needed to find out how to exactly manage the direct climate risks.
- Selective breeding programs of farmed fish support the adaptation of fish to new environments. In the future, the optimal farming locations will move to open water areas and fish farming will become more efficient in the north. This also means that the equipment should be proofed to withstand extreme conditions during the farming season.

Existing expertise in Finland and business opportunities

- Finland has high quality research and know-how in fish farming in challenging Arctic environments.
- Opportunities for promoting new approaches and solutions for fish farming exist for several Finnish public and private sector actors:
 - ✓ Natural Resources Institute Finland (LUKE) develops production processes and materials for fish farming and has excellence in research in the field of fish farming in the Arctic.
 - ✓ Finnish Fish Farmer's Association has excellence in fish farming in Arctic environment.
 - ✓ Koillis-Suomen Lohi Oy has strong expertise in fish farming in harsh Arctic environment. They operate five fish farms, all located north from the Arctic Circle.

Risk



Rising mean
temperatures and
extreme weather
conditions

Solution



New strategies,
research and open
water fish farming.

Security of critical infrastructure services

Increasing the resilience of critical Arctic infrastructures

Introduction

- Climate change increases extreme weather conditions. Milder winters make snow heavier, which challenges the resilience of urban infrastructure. Especially electricity supplies and lines suffer from heavy snow.
- Security of supply aims to ensure a functioning society under all circumstances. Potential disruptions caused by climate change in energy supply, water supply, health services or data-communication networks, pose a major challenge in all societies.* In highly vulnerable communities, often the status in Arctic regions, even short failures in critical infrastructure services, e.g. electricity supply can have dire consequences.

Solutions to manage climate risks and build resilience

- A series of actions are needed to protect core infrastructure from the direct impacts of climate change. Power and transmission lines can be placed underground and back up power sources can be built to minimize the risks. Education and hereby increasing awareness and personal and communal readiness capacity in cases of emergencies, is essential for effective and cost-efficient crisis management.
- Decentralization of key infrastructure is a way of decreasing the potential magnitude of risks. Renewable energy sources, such as solar, bio and wind energy, can complement or replace diesel generators. Emergency stockpiling can also serve to minimize risks.

Existing expertise in Finland and business opportunities

- Finland has strong expertise in security of supply solutions, both in strategies and in technical solutions to adapt to changes. Finnish companies produce some of the most advanced solar, bio and wind energy solutions for harsh Arctic environments.
- Opportunities for building private-public partnerships and international business for several Finnish actors exist:
 - ✓ National Emergency Supply Agency is a key actor for security of supply related issues in Finland.
 - ✓ Areva Solar is an expert in solar energy in the Arctic and produce solar panels for demanding conditions. Solar energy is environmentally friendly solution for decentralized energy production for the most of the Arctic.
 - ✓ The Finnish Energy Authority is an expert in smart energy and highly competent in issues pertaining to renewable energy, energy efficiency and energy security. The Energy Authority is a globally valued developer and partner.

Risk



Extreme weather conditions and milder winters

Solution



Decentralization and underground power and transmission lines

* Source: Karttunen, V., Halonen, M., Vanhanen, J., Raivio, T., Lunabba, J., Gregow, H., Saku, S., Jokinen, P., Lehtonen, I., Ruosteenoja, K., Pellikka, H., Vainio, J., Tanskanen, E., Peitso, P., Laitinen, T., Viljanen, A. & Hynönen, R. (2014) Äärevien sää- ja avaruussääilmiöiden vaikutus kriittisiin infrastruktuureihin. Gaia Consulting Oy ja Ilmatieteen laitos. Saatavilla: <http://www.huoltovarmuus.fi/static/pdf/637.pdf>

Pedestrian safety in changing climate

Comprehensive plans for decreasing accidents in urban areas

Introduction

- Climate change increases weather extremes in the Arctic and warmer temperatures raise new challenges especially in the milder wintertime. These changes may present major risks to multiple Arctic communities (e.g. cities, villages and business entities) as well as Arctic logistics, transportation and infra development.
- Especially pedestrians face often hazardous walking conditions. Urban environments face direct climate risks, such as increasing slipperiness. Some roads and buildings in the Arctic have been build to the permafrost and those are in direct danger of milder winters.

Solutions to manage climate risks and build resilience

- Making use of comprehensive plans for avoiding accidents especially during milder winter months prevents accidents and significantly increases citizens' and cities' social and economical resilience.
- Making use of technical solutions such as the latest measurement and sensor devices, in combination with smart mobile applications reduce climate risks in the Arctic region. Also practical solutions such as spike shoes can decrease significantly accidents on slippery winter time surfaces.

Existing expertise in Finland and business opportunities

- Finland has strong expertise in Arctic winter time street safety, weather forecasting, world leading excellence in sensor and measurement solutions, digitalization in public services and overall broad experience in working in Arctic conditions.
- Opportunities for improving pedestrian safety exist for several public and private sector actors, also through innovative private-public partnerships:
 - ✓ City of Kuopio has comprehensive plans for decreasing accidents in winter months. Practical solutions includes text messages to citizens and maintainers when streets are slippery or in bad condition. The city of Kuopio is also for example de-icing the most popular streets with district heating.
 - ✓ Sievi produces safety shoes for professional needs. Their spike shoes are especially safe for walking and running on slippery surfaces, such as on ice.
 - ✓ 112 Suomi mobile application is useful when person call to emergency telephone number. It tracks GPS coordinates and forward them to emergency telephone center. This speeds up emergency services. Application has been chosen as "The Best Android Service in Finland 2017".

Risk



Unpredictable weather
and rising slipperiness
in streets.

Solution



Strategies for
decreasing accidents
in winter months

Maritime safety

Multipurpose icebreaker with emergency response capabilities in extreme conditions

Introduction

- While the longer term scenarios indicate clear increases in mean temperatures as well as reduced sea ice, uncertainties are linked in particular to the evolution of weather extremes.
- Ice conditions and the movement of ice will also contribute to a changing risk landscape in the Arctic in the coming years, with repercussions to maritime and human safety.

Solutions to manage climate risks and build resilience

- Multipurpose icebreaker vessels can simultaneously increase maritime safety as well as provide crises management in emergency situations (SAR, modality)
- Possibilities for pooling and sharing resources (e.g. Finnish Red Cross SAR – field hospital project)

Existing expertise in Finland and business opportunities

- Finland has strong expertise in arctic weather forecasting, special vessel development and shipbuilding, as well as rescue activities, oil spill prevention capabilities, and ice navigation training
- For example, LNG icebreaker Polaris can perform emergency towing and rescue operations as well as oil spill response operations on the open sea all year round strengthening overall resilience. It can also aid in improving logistic reachability in remote areas, as well as assist first aid crews reach crisis victims at sea.
- Examples of Finnish maritime safety expertise:
 - ✓ Arctia: Provider of icebreaking and specialised multipurpose vessel services in polar areas.
 - ✓ Arctech Helsinki Shipyard: Builder of icebreakers and arctic offshore and special vessels.
 - ✓ Lamor: Efficient oil recovery solutions with excellent ice handling capabilities.

Risk



Ice conditions at sea

Solution



Crisis management in icy conditions

Maritime SAR, Safety, and Cooperation - OPV Turva

Introduction

–The transversal traffic of busy passenger ships, cargo ships and tankers in the Gulf of Finland, as well as challenging winter navigation, create opportunities for serious cross-sectoral accidents at sea.

– Maritime SAR is challenging and there is lot of different scenarios. In Finland, it is desired to cost-effectively build an excellent performance to respond to threats at sea.

Solutions to manage climate risks and build resilience

– The starting point for planning a new Coast Guard vessel was to bring the same ship under the functions of several different authorities: themes were Baltic sea, security, environment and Co-operation.

-Coast Guard patrol vessel Turva was built to meet those requirements. Ship is capable of long-term work in challenging search and rescue operations at sea. The latest radar and camera technology provides excellent surveillance and search capability. Highly integrated and sophisticated bridge as well as command facilities, creates possibilities to manage serious cross-sectoral accidents at sea.

- Other than search and rescue co-operation is for example exploration of the sea with Finnish Meteorological Institute. Turva has a weather station, dry and wet laboratories for researchers, CTD- measurements and water sampling equipment.

Existing expertise in Finland and business opportunities

– Finland has strong expertise in co-operation between authorities. The design of offshore patrol vessel Turva was based on the functions of several authorities at sea in all operating environment throughout the year.

– Shipbuilding has demonstrated the ability to build a compact ship that itself is able to perform in all possible types of accidents at sea. It is ChemRec classified and oil collection equipment is also designed for winter collection. Bollard pull is 100t which means ability to emergency tow any oil tanker at the Baltic Sea. While search and rescue missions other units can rely on shipboard maintenance, for example in refueling the helicopters. In large-scale accidents helicopters and boats can be evacuated to elusions by hundreds of people and the ship has a ship hospital for treating patients.

–Examples of Finnish maritime safety expertise:

- ✓Co-operation and shared database between authorities
- ✓ Finnish maritime industry and RD

Risk

Maritime SAR in multidisciplinary accident in arctic weather conditions

Solution

Crisis management and co-operation between authorities

Flood protection

Comprehensive approaches to manage flood risks

Introduction

- Climate change raises flood risks in many parts of the Arctic. Some major reasons for this are changes in the seasons and rain quantities, and also increased frequencies of storms.
- Urban areas and agriculture suffer significantly from floods, but nature faces major risks too. For example sewage, fertilizers and variety of waste might end in to waters or cause other environmental risks.

Solutions to manage climate risks and build resilience

- A series of actions are needed to minimize flood risks. These includes improved urban planning, runoff water mitigation and dredging of rivers. Also hydroelectric power plants are useful for small scale flow regulation.
- Flood and rescue plans are needed. Effective rescue capacities such as professional fire and rescue departments with appropriate equipment are important. Also tailored forecasting models may help prevent damages.

Existing expertise in Finland and business opportunities

- Finland has strong expertise in Arctic weather forecasting as well as rescue activities in Arctic environments.
- Examples of Finnish flood protection expertise:
 - ✓ The Department of Rescue Services has strong expertise in rescue activities and risk prevention in the Arctic.
 - ✓ Finnish Meteorological Institute (FMI) has world leading expertise in weather forecasting.
 - ✓ Finnish Environment Institute (SYKE) has develop hydrological modelling combined with GIS approaches that support sustainable land use planning and climate adaptation.
 - ✓ Several Finnish cities , including the City of Rovaniemi, have developed advanced plans and capacities for flood protection.

Risk



Floods

Solution



Urban planning and
crisis management

Safety promoting innovative technologies

Communication and intelligent solutions reduce climate risks

Introduction

- Climate change challenges the status quo in many sectors of Arctic societies. Changes in mean temperatures and extreme weather conditions modify the risk landscape, create new risks as well as increase the level of several climate related risks in the Arctic.
- Weather conditions and the living spaces of animals change due to climate change. Because of this urban infrastructure and its maintenance are facing more disrupts such as storms and wild animals in the roads.

Solutions to manage climate risks and build resilience

- Developed communication structures increases resilience in the Arctic as they offer tools to stay safe against the direct climate risks. Reliable and effective communication networks and weather forecasting are in many ways at the core of resilience in remote areas.
- Intelligent solutions such as smart phone applications, climate scenarios, sensor devices and intelligent roads may reduce significantly climate risks in the Arctic.

Existing expertise in Finland and business opportunities

- Finland has strong expertise in communication networks and producing world leading high tech intelligent solutions, such as smart phone applications.
- Opportunities for building private-public partnerships and international business for several actors. Key actors include:
 - ✓ Nokia Networks has world leading expertise in arranging communication networks even to most remote environments. Know-how includes advanced wireless accesses, internet of things and cloud services.
 - ✓ Intelligent Road Aurora is a smart road designed to endure cold and harsh weather conditions. It prevents accidents in the roads and promotes safe transportation.
 - ✓ Porokello application is a smartphone application that warns drivers about the reindeers on the roads and decreases significantly the amount of accidents.

Risk



Weather extremes and differences in main temperatures

Solution



Developed technology and advanced communication

Reindeer herding

Climate change forces traditional livelihoods to adopt

Introduction

- Climate change is changing climate zones and plant and animal populations are forced to shift geographically. This is especially challenging to traditional livelihoods and indigenous peoples whose culture and livelihood are often closely tied to their environment.
- Reindeer herders are one of the major sufferers of changing climate. They are forced to adapt to keep their professions productive in the middle of challenges. Some of the direct climate risks to reindeer herding are thicker ice crusts that reindeers cannot break, invasive species such as deer fly (hirvikärpänen) as well as erosion and deterioration of pastureland due to increasing business in the area, such as mining and tourism.

Solutions to manage climate risks and build resilience

- Successful adaptation processes include long term solutions to land use and coordination with other businesses. Well planned co-operation with actors such as tourism industry may provide important synergies and co-benefits.
- Some successful adaptation measures include supplementary feeding, new medicines and higher degree of meat processing.
- There are also innovative technical solutions such as GPS devices for reindeers and drones that can be utilized in multiple ways, such as finding or collecting reindeers.

Existing expertise in Finland and business opportunities

- In Finland reindeer herders are already using a variety of technical solutions to adapt to inevitable changes. Often meat and other animals products are processed and sold as high value products.
- Herders gain extra income from co-operation with tourism. In Finland the capacity for large scale supplementary feeding responds to the direct climate risks, such as thick ice crusts.
- Opportunities for promoting more resilient herding approaches exist for several Finnish public and private sector actors:
 - ✓ Reindeer Herders' Association is key actor for all reindeer related issues in Finland.
 - ✓ *Visit Rovaniemi (Rovaniemi Tourism and Marketing Ltd.)* utilizes widely reindeers in tourism. This bring income for reindeer herders.
 - ✓ Tracker Oy (Tracker Boazu) GPS-devices are effective tools for reindeer herders and are widely used. GPS-devices may cut for example searching expenses of dead reindeers to half.

Risk



Changing climate zones and invasive species

Solution



New strategies, such as supplementary feeding and technical assistant

Empowerment of indigenous people

Strengthened fate control and protection of indigenous peoples' rights

Introduction

- Climate change is changing dramatically climate zones and Arctic environments. This is a major challenge to all communities, but indigenous people are especially vulnerable to climate risks as their cultures and knowledge are often tied to surrounding environment. Rising mean temperatures open new business opportunities, such as energy production, transportation, tourism and mining industries. All actors claim land and resources, but might not understand the needs of local people.
- One of the major climate risk for indigenous people are their suffering traditional livelihoods. Professions such as reindeer herding, fishing and whaling are forced to adapt. As problems in the Arctic are often caused outside the region, local communities are forced to adapt to changes without fate control. This way climate change is a direct threat to indigenous peoples wellbeing, cultures, income and the dynamics of communities.

Solutions to manage climate risks and build resilience

- Fate control is at the core of indigenous peoples adaptation capacity and necessary to build resilience against the external threats, such as loss of traditional environments and pasturelands. Stronger rights to land and compensation for loss of land are needed to increase communities social and economical resilience.
- Empowerment of locals, indigenous and non-indigenous people strength the fate control. More interlinked co-operation between interest groups would benefit most of the stakeholders.

Existing expertise in Finland and business opportunities

- Sami people live in Finland, Norway, Russia and Sweden. They are the only indigenous peoples in Nordic countries and the EU. Finland has some successful examples of protecting indigenous peoples rights.
- Opportunities for promoting resilience building through strengthened fate control and protection of indigenous peoples' political rights exist for several public and private sector actors:
 - ✓ Metsähallitus has used Akwé:Kon method successfully in co-operation with Sami people. Akwé:Kon aim to protect indigenous people traditional relation to their surrounding environment.
 - ✓ Sami Duodji label protect indigenous handicraft.
 - ✓ Snowchange Cooperative is using mixture of indigenous Skolt Sami knowledge and western science for holistic rehabilitation of salmon rivers, among their other projects.

Risk



Rising mean
temperatures brings
new actors in the Arctic

Solution



Empowerment of local
actors strengthen the
fate control

Climate resilient tourism services in the Arctic

Tailored weather services enabling more sustainable tourism & business development

Introduction

- Climate change increases extreme weather conditions. Simultaneously milder winters and changing conditions are challenge for many communities and business entities.
- An already rather volatile and seasonal tourism industry suffers from climate change in the Arctic. Shorter winters and the lack of snow are major risks, as it's the high season in the region. Also extreme weathers such as heavier rains are a risk for tourism around the year.

Solutions to manage climate risks and build resilience

- New strategies and weather forecasting can be used to minimize the risks and optimize the expenses. Setting focus to snow-free phenomenon's such as Aurora Borealis, sustainable tourism and sports & recreation decrease the business risks in snowless winters.
- Weather forecasting can be used to optimize expenses around the year. Tourism ski resorts, restaurants and hotels can optimize tourist seasons and the amount of staff required for certain tasks, with the help of advanced weather forecasting. For example restaurants might need only half of the staff during rainy days. Also weather forecasts can be used to optimize maintenance, artificial snow production, heating costs, and holiday planning applications.

Existing expertise in Finland and business opportunities

- Finland has world leading expertise in Arctic tourism and weather forecasting. For example Finnish winter tourism centers are already adapting their strategies for shorter winters.
- Opportunities for building partnerships and promoting more sustainable Arctic tourism exist for several actors:
 - ✓ Finnish Meteorological Institute (FMI) produces world leading analyses on weather conditions using the best numerical forecasting models, observations and meteorological expertise.
 - ✓ Blue Action produce weather and climate data for Northern Finnish winter tourism centers. They assess the value of improved weather and climate predictions for short-term and mid-term planning of operations especially for ski centers, such as Ruka Ski Resort.
 - ✓ Levi Ski Resort has adopted a strategy to prepare for a shorter winter season. They aim to be the leading holiday destination in Nordic countries around the year. Climate change forces ski resorts to find snow-free business models such as sustainable eco-tourism, wellbeing and sport and recreation activities.

Risk



Extreme weather conditions and milder winters

Solution



Less snow dependent strategies and advanced weather forecast services

Climate education and awareness with an Arctic touch

Climate education to build robust resilience to predictable as well as unforeseen risk

Introduction

- Climate change causes significant changes in particular in Arctic communities and nature. Indigenous people suffer in particular from these changes due to their high dependence on their natural surrounding and the highly vulnerable Arctic ecosystem services.
- Because of several uncertainties related to how climate change impacts the Arctic (including multiple feedback loops) and the exceptional speed of change in the Arctic, it is not possible to prepare plans to every risk scenario. Wicked problems such as rising sea levels and growing erosion are challenging to solve or cope with. Improved education enables more rapidly and effectively harnessing of innovative and robust adaptation measures.

Risk



Unpredictable and
wicked risks

Solutions to manage climate risks and build resilience

- Education and improved climate awareness offers tools to adapt to changes and increases the overall economical, ecological and social resilience of individuals and communities. Climate education might include lessons about how to cope with weather extremes and unexpected circumstance, while simultaneously promoting sustainable livelihoods and consumption patterns that protect Arctic ecosystems.
- Climate change & resilience building could be integrated into the curriculum at all levels of education. Higher education needs special focus with an “Arctic touch” to ensure that there will be experts on climate change issues in many fields of society. Arranging education to sparsely populated Arctic regions needs special attention.

Solution



Education offers tools
to adapt and prepare

Existing expertise in Finland and business opportunities

- Finland has strong expertise in both educational and Arctic affairs. Finland has also world leading expertise in digitalization of education services.
- Opportunities for promoting resilience building through improved education and climate awareness exist for several public and private sector actors:
 - ✓ Finnish Ministry of Education and Culture manage Finnish world leading educational systems. According to the Finnish national adaptation plan, climate change adaptation education will be added to all educational levels (Source: Kansallinen ilmastonmuutokseen sopeutumissuunnitelma 2022, p. 26).
 - ✓ The Sami Educational Institute has long experience in distance teaching. They have also strong expertise in offering education among indigenous people in sparsely inhabited Finnish Lapland.
 - ✓ Service Innovation Corner (SINCO) is a service prototyping laboratory at the Faculty of Art and Design in University of Lapland. It is excellent for demanding distance teaching sessions as well as other forms of remote access services.

Access to financial instruments for building resilience

Dependence on external funding limits Arctic empowerment

Introduction

- The consequences of climate change are harmful for most of the Arctic communities with major unpredictability caused by changing climate zones and extreme weather conditions. The Arctic is encountering multiple direct and indirect climate risks, covering the exceptionally rapidly advancing physical risks. Major challenges are also related to (climate) regulatory, reputational as well as overall market transition risks. These climate related risks increase further the challenges in securing funding for sustainable and climate resilient livelihoods and communities development in the Arctic. Many of the investments in the Arctic are of significant scale and enabled through private-public partnerships or multinational corporations. However, the enabling environment and capacities overall are not aligned to support accelerated mobilization of demand driven, climate resilient investments.
- Arctic communities and individuals often face limited access to financial instruments. Lending money to peripheral regions, with higher real or perceived climate risk, is not a core preoccupation of traditional financial institutions. Limited access to flows of capital limits communities income, development, wellbeing and the dynamics of communities in the Arctic. While climate change has simultaneously opened some business opportunities in the Arctic, the subsequent flows of investments and capital haven't changed the constant need of external funding in the Arctic.

Solutions to manage climate risks and build resilience

- Fate control is important for adaptation capacity and necessary to build resilience against the external threats. Solid and predictable structures, in some cases government subsidies and reasonably priced insurances against the climate threats are needed to increase communities social and economical resilience. Improved access to finance can help break vicious cycles of dependency and significantly increase the resilience of communities and individuals.
- Addressing various risks caused by climate change for the finance sector could encourage traditional financial actors, such as banks, to increase their activities in Arctic communities. Also strengthening the flexibility and introducing alternative, innovative finance services, such as crowdfunding, blockchain, microfinance and peer to peer -lending, can expand opportunities to ordinary people and small companies to increase their access to financial capital. Strengthening the local capacities and enabling environments is also important for ensuring direct access to resilience finance provided through major bilateral and multilateral climate funds.

Existing expertise in Finland and business opportunities

- Finland has, often in close collaboration with other Nordic countries, been a forerunner in climate adaptation (nationally) and has an international fora strongly advocated for mainstreaming of climate adaptation into international (development) cooperation and finance.
- Finland's biggest banks are researching and investing in blockchain solutions and adopting them as a part of their services. Some Finnish companies are appreciated pioneers in alternative finance services such as crowdfunding. Opportunities for promoting resilience building through alternative finance services:
 - ✓ OP financial group is offering traditional bank services and insurances. They also offer alternative finance services such as crowdfunding and are adopting blockchain solutions to their daily services.
 - ✓ Fellow Finance Oy is the first crowdfunding platform in the Euro area serving both consumers and businesses. The Platform is used in 43 different countries and we have over 280,000 customers. Crowdfunding is based on peer to peer -lending, and interest rates are set by individual borrowers.
 - ✓ Joukon Voima Oy is a crowdfunding platform for sustainable energy projects. Many of their successful projects did not reach funding from traditional finance services. Joukon Voima Oy is the *Finnish Energy Startup of the Year 2016*.

Risk



Unpredictability and limited access for flows of capital

Solution



Access to financial instruments strengthen the fate control and enable local investments