English summary of the Saami Climate Council's report **Current and Projected Impacts of Climate Change on Saami Culture (Original title: Ilmastonmuutoksen nykyiset ja ennakoidut vaikutukset saamelaiskulttuurille)**

N.B. This English summary of the Finnish original report has been produced by Copilot AI and may contain some errors in the content!

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Description sheet

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Abstract

The report presents the results of the Saami Climate Council's project: Establishing the Saami Climate Council's knowledge base – PRESAAMI2. The purpose of the project has been to produce information on the current and anticipated effects of climate change on the climate of the Saami homeland, to the Saami culture and the traditional Saami livelihoods. The material has included research literature, a workshop for holders of Saami traditional knowledge, and meteorological material. The report examines the average temperature and precipitation of the Saami homeland in different climatological normal periods and seasons, as well as average wind speed and wind direction in different seasons. Windiness was chosen as one of the subjects of review because the holders of Saami traditional knowledge have reported changes in wind intensity, and direction.

The ongoing climate change is already visible in the Saami homeland: temperatures have risen by 2-3 degrees in the last 60 years and precipitation has increased. The change is the greatest in winter. On period 1961-2023, the average wind speed has increased in the spring throughout the region, and the average wind direction has opposite changes in different seasons. However, a large year-to-year variability influences wind condition trends and therefore changes in winds cannot be directly linked to be a result of climate change. In the future, temperature and precipitation are expected to continue to increase, which will have a major impact on the livelihoods of the Saami.

The research findings support the observations of Saami traditional knowledge holders on the effects of climate change on the Saami living environment. Holders of traditional knowledge have observations on causal relationships, of which there is no researched information. Understanding the cultural impacts of climate change on Saami culture requires co-production of knowledge with Saami traditional knowledge holders. Climate change affects the health and well-being of Saami traditional knowledge holders, to possibilities to practice traditional livelihoods, the economy, the belief in the future and the transfer of Saami traditional knowledge. Climate change brings new threats to the Saami, but

	holders of Saami traditional knowledge have the ability, desire and belief that the Saami can adapt to climate change in a culturally sustainable way with the support of society and cooperation between the scientific community and the Saami. Based on the data collected by the project, Finland lacks systematic knowledge and foresight on the Saami health, Saami culture and traditional livelihoods, and adaptation to climate change. No provisions have been made for climate change adaptation and mitigation in the legislation governing the traditional livelihoods of the Saami. The project has identified further research needs and it proposes the need to anticipate the future of Saami culture and population. The key result of the project is a draft of 59 indicators that can be used to monitor the effects of climate change on the Saami culture and the Saami homeland. The finalisation of the indicators requires a follow-up project and collaboration between the research institutes producing the data. Some of the indicators can be implemented with existing data sources and their analysis. Some require data collection and resourcing. The Saami Climate Council should create a map-based observation system in which Saami traditional knowledge holders, authorities and researchers could report observations related to indicators and climate change.
Keywords	Saami people, Saami culture, climate changes, anticipation, adaptation https://finto.fi/juho/en/
Saami Climate Council	The task of the Saami Climate Council, established under the Climate Act, is to produce a knowledge base on climate change from the point of view of the Saami culture to the authorities and the Saami community for decision-making and to raise awareness of the impacts of climate change on the Saami culture. The Climate Council produces information that supports adaptation to and mitigation of climate change in the Saami culture. The Saami Climate Council promotes the interaction between science and Saami traditional knowledge. The activities of the Climate Council are based on researched knowledge and Saami traditional knowledge.
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6. THE FUTURE OF SAAMI CULTURE IN A CHANGING CLIMATE
7. SUMMARY

Summary of the Introduction

The purpose of the Saami Climate Council project, specifically the PRESAAMI2 initiative, is to establish a knowledge base for the Saami Climate Council regarding the current and anticipated impacts of climate change on the climate and environment of the Saami homeland, Saami culture, and traditional Saami livelihoods such as reindeer herding, fishing, hunting, gathering, and Saami handicrafts (duodji).

The report's data sources include research literature from 2018 to 2024, meteorological data, and a workshop with holders of traditional Saami knowledge. The methods used in the workshop are detailed in a separate report. The report compiles information on the impacts of climate change on Saami culture and the perspectives of traditional knowledge holders on climate change. It examines the average temperature, precipitation, wind speed, and direction in the Saami homeland across different comparison periods and seasons. Windiness and its potential changes were included as a focus area due to reports from traditional knowledge holders about changes in wind strength and direction.

The report analyzes the impacts in various regions: the boreal area (Sallivaara, Hammastunturi, Ivalo, and Lapland reindeer herding cooperatives), the northern boreal area (Muotkatunturi, Muddusjärvi, Näätämö, Paatsjoki, and Vätsäri cooperatives), and the mountain area (Käsivarsi, Näkkälä, Paistunturi, and Kaldoaivi cooperatives). This division is based on the classification used in the SAAMI project on Saami adaptation to climate change.

Saami culture includes the Saami language and traditional livelihoods (reindeer herding, fishing, hunting, gathering, and handicrafts). The Saami languages spoken in Finland—Northern Saami, Inari Saami, and Skolt Saami—are endangered. Economically viable traditional livelihoods are limited to reindeer herding and handicrafts.

There is no systematic, up-to-date research data available on Finnish Saami culture and population. While the impacts of climate change on Saami reindeer herding have been studied, the effects on other traditional livelihoods have not. The impacts on other traditional livelihoods can be assessed by combining research data on the effects of climate change on vegetation, water bodies, and species with observations from traditional knowledge holders. There is no research data available on the health and well-being of the

Saami in Finland, but data from Sweden and Norway can be used to assess factors affecting the health of the Saami in Finland.

The report analyzes research findings and observations from traditional knowledge holders on the impacts of climate change and compares these observations with those from the SAAMI project in tabular form. The main goal of the SAAMI project was to create continuity and a monitoring system for tracking the impacts of climate change on Saami culture, but this goal has not yet been achieved. The PRESAAMI2 project did not have the opportunity for as extensive and comprehensive data collection as the SAAMI project, and the report includes only those observations and change factors for which data is available from both the SAAMI and PRESAAMI2 projects.

Summary of "The Living Environment, Culture, and Livelihoods of the Saami in a Warming Climate"

Saami Living Environment and Cultural Landscape

The Saami homeland covers about 10% of Finland's total area (approximately 32,500 km^2), with around 90% of its land and water areas managed by Metsähallitus (Finnish Forest Administration). About 80% of this area is protected. The region's natural habitats range from boreal forests to alpine tundra. The biodiversity of the Saami homeland is endangered due to various factors, including climate change and reindeer grazing. Over one-third of Finland's mountain habitats are endangered, most of which are in the Saami homeland. The primary causes of endangerment are climate change and reindeer grazing, along with their combined effects. Climate change is altering the economic and cultural landscape, with forestry being a significant change factor in the boreal area. Local impacts in the boreal and northern boreal areas include tourism, wear and tear on tourist routes and centers, littering, construction of tourism infrastructure, and mechanized gold mining.

Spread of Pines and Shrubs

Environmental changes have been widely observed in the Saami homeland, with the spread of pines and shrubs, forest densification, and their impacts on reindeer and human movement, reindeer nutrition, and the landscape being major concerns. These changes have accelerated and are observed throughout the Saami homeland. The extent of pine spread, forest densification, and the rise of the tree line have not yet been reliably assessed using laser scanning and aerial imagery, but AI-based methods are expected to improve analysis. Factors slowing pine spread in mountain areas include rocky soil, wind, heavy snow, spring drying, fungal diseases, insect damage, and reindeer grazing. However, based on existing knowledge, forests will spread to mountain habitats, and new areas will

become forested unless significant conservation measures are taken. Traditional knowledge holders have attempted to curb pine spread by uprooting seedlings or driving over them with off-road vehicles, but there are too many seedlings for individual reindeer herders to manage.

Participants in the study expressed concerns about the spread of pines and shrubs, noting that it complicates reindeer herding and increases predator risks. Forested areas make it easier for predators to hunt, harder to find reindeer carcasses, and more difficult to track predators. Forest densification affects snow accumulation and melting rates in spring. Observed vegetation changes were compared between the SAAMI and PRESAAMI2 projects.

Invasive and New Species

Invasive and new species have spread to the Saami homeland, affecting vegetation and traditional livelihoods. Fireweed has been observed spreading widely, replacing traditional vegetation and taking up space needed for important reindeer forage plants. Reports of harmful invasive species in the Saami homeland have been submitted to the invasive species service, which could threaten native vegetation and fauna.

Supplemental Feeding of Reindeer

Reindeer are supplementally fed in all reindeer herding cooperatives in the Saami homeland, but the intensity varies. Reasons for supplemental feeding include climate change adaptation, difficult winter conditions, competing land use, lack of sufficient seasonal pastures, the condition of winter pastures, and the low number of reindeer herders. Supplemental feeding is regulated by municipal environmental protection regulations, agreements between Metsähallitus, the Saami Parliament, the Skolt Village Meeting, and reindeer herding cooperatives, as well as legislation. Reindeer cannot be fed on water bodies except for herding purposes. Exceptions to supplemental feeding restrictions can be sought from Arctic Lapland Environmental Protection. There are differing views among Saami reindeer herders on supplemental feeding. While it is seen as beneficial for climate change adaptation, there are concerns about its negative impacts on reindeer and pastures. Proper management of supplemental feeding is crucial to prevent the spread of invasive species and eutrophication. The need for supplemental feeding is not expected to decrease due to climate change.

Participants emphasized the importance of preventing the spread of invasive species and suggested that permits should be required for feeding areas to mitigate negative impacts.

Summary of "Reindeer Pastures and Influencing Factors"

Condition of Reindeer Pastures

Reindeer pastures in the Saami homeland are particularly worn in areas subjected to year-round grazing pressure. The movement of reindeer during the snow-free season significantly impacts lichen heaths, which are crucial for winter nutrition. Participants in traditional knowledge workshops observed that lichen no longer grows as it used to. Dry summers are harmful to lichen, making it very sensitive to trampling. Lichen has not grown even in areas where reindeer do not graze, indicating that conditions have changed in ways that lichen cannot adapt to.

Observations from Traditional Knowledge Holders

Participants noted that the northern soil is very delicate, and dry summers prevent the growth of fungi, which are important for reindeer. Birch and lichen also need moisture, and lichen crumbles during dry summers. Historically, lichen grew back quickly, but this is no longer the case. Reindeer naturally manage their grazing areas, eating lichen flowers without completely depleting the lichen. Reindeer follow specific paths and do not trample their food sources.

Research Findings

Studies suggest that reducing reindeer numbers or grazing pressure is necessary for lichen and mountain birch recovery. Grazing pressure prevents mountain birch from regenerating after pest damage. Participants highlighted that while reindeer grazing affects lichen heaths, changing conditions hinder lichen regeneration, leading to replacement by other vegetation. Finnish nature and pasture inventories have not made similar observations, attributing lichen heath wear to year-round reindeer grazing in mountain areas. Lichen is sensitive to mild winter weather and freeze-thaw cycles, which threaten lichen adapted to cold conditions. Studies have found that lichen is destroyed under conditions where it freezes beneath a dark ice layer without air circulation. Soil freezing before snow cover has been observed in the Saami homeland, preventing reindeer from accessing food. Extended growing seasons and increased precipitation negatively impact lichen, as warming conditions favor vascular plant growth, which competes with lichen. Dry periods, erosion, and heavy rainfall also adversely affect lichen.

Mold and Mycotoxins

Participants reported pasture mold due to moist soil before permanent snow formation and warm temperatures, keeping the soil warm and damp. The presence of mycotoxins

(mold toxins) in the soil, combined with difficult snow conditions, is linked to reindeer deaths and low productivity in reindeer herding. Reindeer do not eat moldy food.

Positive Effects of Grazing

Reindeer grazing based on pasture rotation has positive local effects on climate change mitigation. Summer grazing effectively curbs the spread of mountain birch to tundra heaths and has a positive, biodiversity-enhancing effect in leafy mountain birch forests. Open tundra areas are expected to become overgrown with shrubs and conifers, but summer grazing prevents and slows this development, thereby mitigating climate warming. Open tundra areas reflect heat radiation back into the atmosphere more effectively in winter. Grazing increases vegetation diversity in tundra areas, preventing the disappearance of small, slow-growing species and combating climate change-related biodiversity loss. Grazing can also influence carbon sequestration or its response to climate warming in tundra heaths, mires, mountain birch zones, and coniferous forests. In coniferous forests and mountain mires, restricting grazing has been shown to increase carbon release from the soil.

Summary of Observations and Research

Table 2 summarizes the observations of traditional knowledge holders and key research findings on the condition of reindeer pastures and influencing factors.

Participants emphasized that reindeer are the only species in the northern hemisphere that effectively control shrub growth, with no other species having a similar impact.

Extended Growing Season

The growing season in the Saami homeland has lengthened and continues to do so. This extension, along with the prolonged snow-free period, facilitates reindeer nutrition. However, it also promotes shrub and forest growth, increasing the coverage of nutrient-poor shrubs like crowberry, which can degrade the quality of available forage. The positive and negative impacts of climate change can vary by region and may counterbalance each other.

Observations from Traditional Knowledge Holders

Participants noted that as vegetation starts to grow in the mountains, permafrost disappears. Shrub and tree roots penetrate deeper into the soil, and seeds are dispersed by increased wind. Without permafrost, seeds can grow, leading to the spread of pines and birches. Buildings constructed on permafrost have collapsed as the ground thaws. Activities like geothermal construction and mineral exploration create holes that accelerate permafrost melting. Lichen grows poorly and is overtaken by moss.

Carbon Sequestration Dynamics

Recent research indicates a significant shift in carbon sequestration dynamics in the Arctic, which has been a carbon sink for millennia. However, about 40% of the Arctic is now becoming a net carbon source, likely due to permafrost thawing, accelerated bacterial activity, soil drying, vegetation changes, and forest fires. Increased carbon-sequestering vegetation in the Arctic does not offset this effect. This change is believed to have started before the 1990s. The Saami homeland has significant peatlands (approximately 7,150 km^2), which are important carbon sinks. Early summer warming increases annual carbon sequestration, while warmer late summers and autumns reduce it.

Reindeer Grazing and Carbon Sequestration

Reindeer grazing plays a role in carbon sequestration. Spring and summer grazing and trampling are crucial for curbing willow spread, while winter grazing does not have the same effect. Reindeer do not use willow as winter forage, and their winter movement does not impact willow growth conditions. After 25 years without reindeer grazing, carbon dioxide emissions increased, followed by a recovery in ecosystem carbon sequestration. Climate change also affects reindeer pastures in other ways, summarized in Table 3.

Participants emphasized that reindeer are essential for controlling shrub growth in the northern hemisphere, with no other species having a similar impact.

Lichen growth is negatively impacted by the changing and variable conditions of summer, early winter, and winter, in addition to grazing pressure. Studies indicate that warming adversely affects lichen growth. Finnish pasture inventories suggest that reindeer grazing has a more detrimental effect on pasture condition than climate change. However, traditional knowledge holders observe that lichen does not grow or regenerate in areas where reindeer do not graze, creating a contradiction that requires further investigation. Resolving this discrepancy would necessitate collaboration between traditional knowledge holders and the scientific community. This project would be well-suited for the Saami Climate Council to investigate lichen regeneration and influencing factors in a warming climate in the Saami homeland, establishing the basis for ongoing monitoring research.

Summary of "Saami Population"

Population Statistics

The Saami Parliament records the number of eligible Saami voters and their underage children during Saami Parliament elections. In the 2023 elections, there were 11,589 individuals listed in the electoral register, including their children. Of these, 29.09% live in

the Saami homeland. Since the early 2000s, the number of Saami living outside the homeland has exceeded those living within it. Most children (0-17 years old, about 72%) and young adults (18-24 years old, nearly 75%) are born and reside outside the homeland.

Reasons for Migration

According to traditional knowledge holders and research, climate change has not influenced the migration of Saami away from the homeland. Instead, individual and societal factors, along with the poor profitability of traditional livelihoods, are the main reasons. Saami move to cities for education, better services, employment, and relationships. The younger Saami generation has grown up in an environment and culture already adapted to climate change and continues to evolve and adapt.

Impact on Saami Culture

Migration away from the Saami homeland affects Saami culture, the viability of traditional livelihoods, the linguistic environment, and the preservation of Saami livelihoods and culture. The small size of the Saami community in the homeland makes it difficult to practice traditional livelihoods and pass on traditions, negatively impacting the vitality of the Saami homeland and culture.

Challenges and Solutions

Participants noted that the push for formal education in the 1960s led many Saami to lose their connection to Saami culture. There is a need for incentives to encourage young Saami to take responsibility and support the preservation of Saami culture. Combining traditional livelihoods with education is crucial for preserving Saami traditional knowledge and livelihoods.

Several reports have proposed measures to safeguard Saami traditional knowledge and skills related to livelihoods, suggesting a hybrid model that allows for both the transfer of traditional knowledge and education. However, these measures have not been implemented. To ensure the Saami population remains vibrant in the future, especially in a global warming context, rapid action is needed to develop education and training that integrates Saami language and culture.

Summary of "Health and Well-being of the Saami"

Factors Affecting Saami Health in Finland

Research on the health and well-being of the Saami in Finland is limited, with most results published in research reports. The overall health and well-being of the Finnish population have been assessed through two population-based studies: the School Health Survey and

the FINTerveys study. Data on health and well-being are available by municipality for the Saami homeland but not classified by ethnic background or Saami language proficiency. A comparison of the 2021 School Health Survey results between the Saami homeland and the whole of Finland showed no significant differences in self-reported health and well-being among students. The Finnish Institute for Health and Welfare (THL) provides health and well-being data by university hospital responsibility areas. According to THL's morbidity index, morbidity in the Saami homeland (including the entire municipality of Sodankylä) does not significantly differ from the national average. Due to the low population in the Saami homeland municipalities, even a few cases of morbidity can impact the annual index. The general trend in morbidity is declining both in Finland and in the Saami homeland.

Social and Health Services

Social and health services have been the most comprehensively studied. Studies indicate that the linguistic rights of the Saami in social and health services are not fulfilled, and the examined reports and recommendations have not improved Saami-language services. There is no research on whether deficiencies in the service system negatively affect Saami health and well-being. The Sárá project investigated the identity, use of well-being services, and well-being of Saami living outside the homeland. Respondents strongly connected to Saami culture were the most satisfied with their lives. Previous studies have found that living in core Saami areas and the ability to maintain Saami culture enhance Saami well-being. Young respondents (born 1980-1999) in the Sárá project reported poorer mental well-being compared to others. Older age groups showed more variation, with some feeling very well and others poorly. Men reported poorer mental well-being than women.

Importance of Nature

Nature is a central source of well-being for the Saami. Saami well-being is a holistic phenomenon connected to Saami culture, intertwining physical, social, linguistic, mental, and spiritual dimensions. The use of the Saami language, wearing traditional Saami clothing, and Saami food traditions support and enhance individual well-being. Family and community are important sources of well-being, as are Saami values. Continuing traditional ways of life, practicing traditional livelihoods, and spending time in nature are crucial for well-being.

Participants emphasized the importance of being in nature and practicing traditional livelihoods like reindeer herding for maintaining health and well-being. They noted that reindeer herding is a Saami way of life, and many older herders stay healthy by spending

time in the forest. The continuation of traditional practices and ensuring safety while engaging in these activities are essential for well-being.

Summary of "Discrimination Experienced by the Saami and Vulnerable Individuals"

Discrimination and Its Impact

A survey on discrimination experienced by the Saami and other vulnerable individuals revealed that 51% of the 133 Saami respondents had faced repeated discrimination due to their Saami identity. The most common forms of hate speech or harassment occurred online. Two-thirds of those affected reported negative impacts on their mental health, and 58% felt their sense of security was compromised, leading them to avoid areas where harassment occurred. Life satisfaction among those who experienced discrimination was slightly lower than those who did not.

Regional Differences in Discrimination

According to the Saamebarometri survey, half of the Saami living in the homeland had not experienced discrimination, prejudice, or harassment for speaking Saami, while two-thirds of those living elsewhere in Finland had not faced such issues. Publicly expressing Saami identity by speaking the language or wearing traditional clothing increases the risk of discrimination outside the homeland. Those strongly connected to the Saami language and identity face the most discrimination. Saami individuals with disabilities experience discrimination due to both their Saami identity and disability. The legacy of assimilation policies negatively affects Saami well-being.

Structural Racism

Traditional knowledge holders reported that Saami face racism, impacting their well-being. Structural discrimination is most evident in politics and the management of traditional Saami livelihoods. Participants noted that structural racism requires further research and that political competition in Lapland often involves who can discriminate against the Saami the most.

Changes in Traditional Livelihoods

Changes in traditional livelihoods have affected the physical fitness of the Saami. The use of heavy machinery in reindeer herding requires good physical condition. Supplemental feeding of reindeer and handling heavy bales of hay and feed also demand physical strength. Annual reindeer herding tasks are physically demanding, increase energy expenditure, and pose accident risks. There is no up-to-date information on the health and well-being of reindeer herders, with the last comprehensive study published in 1993. Fishing is considered one of the most dangerous occupations, with high accident risks,

especially for older fishermen. Difficult winter conditions and changes in ice thickness increase accident risks for fishermen.

Health Risks and Stress

Participants noted that mechanization in reindeer herding has brought risks and that physical fitness has declined compared to the past. Dust from hay and feed can cause respiratory issues, including asthma and allergies. The hectic nature of modern life, climate change, and societal pressures contribute to stress and affect well-being. The Saami lifestyle and diet have begun to resemble those of the majority culture, increasing the risk of lifestyle diseases. Traditional knowledge holders observed that stress and individualism have become part of daily life, negatively impacting well-being, especially among the youth.

Economic Challenges

The low income from reindeer herding affects pension size, and many herders continue working past retirement age without receiving animal-specific or investment support. Adequate equipment is essential for reindeer herding, and low pensions and exclusion from support systems can cause financial stress.

Gender Roles and Equality

Traditionally, Saami reindeer herding culture and lifestyle were bilateral, with both men and women participating in all tasks. However, mechanization, societal changes, and difficulties in balancing work and family life have led to a male-dominated livelihood. Participants noted that modern societal expectations of gender equality can create stress for young reindeer herders and their families, as the unpredictable nature of reindeer herding does not always align with rigid domestic responsibilities.

Summary of "Increased Accident Risk and Stress"

Current Health Impacts of Climate Change

Climate change has increased accident risks and stress among the Saami. Historical colonialism and the fear that climate change may initiate a new process of cultural endangerment, potentially leading to the loss of parts of Saami culture, negatively impact Saami well-being. Concerns about climate change can exacerbate mental health issues within the Saami population.

Dangerous Conditions in Reindeer Herding

Reindeer herding is a dangerous occupation, with accidents and fatalities occurring. Changing snow conditions, such as snowdrifts forming in previously safe areas, and

weakened ice stability pose significant risks. Reindeer have drowned due to thin ice, and snowmobiles can overturn in hazardous spots. Increased lake cracking makes snowmobile travel unsafe, and heavy snowmobiles are difficult to escape from in emergencies. Women, who may have less physical strength, face higher risks in such situations. Simple, often homemade tools used for supplemental feeding may also pose safety risks.

Stress Factors

Young Saami face significant stress due to climate change, impacting their livelihood choices. Variable yearly conditions add stress, as herders must constantly assess whether to feed reindeer and manage financial pressures. Selling reindeer often results in all proceeds going towards fuel and feed, creating financial strain, especially for young herders with small herds. Prolonged stress can lead to other health issues.

Accident Risk Factors

Accident risks are increased by:

1. Changed snow conditions (accumulation and composition)
2. Weakened ice stability
3. Thawing of palsas (mounds of frozen peat)
4. Heavy rains and erosion
5. Rain and freeze-thaw cycles in late autumn
6. Rocks exposed by wind and snow conditions
7. Reduced alertness due to fatigue and stress

Coping Strategies

To mitigate risks, Saami move in groups and carry thermal blankets and tools. Reindeer herding, fishing, and hunting are practiced in areas with poor mobile coverage, making it difficult to call for help in emergencies. Near-miss incidents are common but often not reported due to stigma.

Political and Environmental Risks

Global political situations pose new environmental risks to the Saami and reindeer. The legacy of the Chernobyl nuclear disaster and Novaya Zemlya nuclear tests still affects Saami food and pastures. Concerns about neighboring Russia and distant China, their military activities, and environmental destruction are current issues that may bring new health threats.

Participants emphasized the importance of not dwelling too much on threats to maintain mental well-being. Poor mobile coverage in reindeer herding areas adds to family concerns, as modern expectations require constant availability, unlike the past when extended periods in the forest without contact were normal.

Summary of "Increased Accident Risk and Stress Among Saami Youth"

Vulnerability to Climate Change

A study in Norway found that Saami youth involved in reindeer herding are particularly vulnerable to the negative impacts of climate change, including accidents due to changing conditions and climate anxiety. These young people experience anxiety about the future of their culture and livelihood in the face of climate change. Increased stress, concerns about reindeer, environmental conditions, and the economic viability of their livelihood are everyday realities. This stress affects not only those working in reindeer herding but also their families, who worry about the safety of those involved in herding.

Impact of Motorization

Before the motorization of reindeer herding, there were fewer concerns about accidents, as dogs provided safety and conditions were more predictable. Uncertainty about the future, living conditions, and the economic viability of reindeer herding threatens its future and creates doubts among young people about their ability to continue in the profession.

Need for Support and Collaboration

Participants highlighted the need for creating a sense of security and bringing experienced Saami and youth together to share knowledge and solve problems collaboratively. A "survival package" that unites different generations and facilitates the transfer of knowledge and skills is essential. Not all families successfully pass down traditional knowledge and skills.

Coping with Stress and Anxiety

Intergenerational cooperation and sharing experiences are seen as ways to adapt to the negative impacts of climate change and alleviate stress and anxiety. Teaching and supporting young people in reindeer herding are crucial for preserving the livelihood and culture.

Participants emphasized the importance of collective learning and support to help young Saami navigate the challenges posed by climate change and maintain their cultural and economic practices

Summary of "Predicted Health Impacts of Climate Change on the Saami"

Rising Temperatures and Extreme Weather

Climate change is expected to continue raising atmospheric temperatures and increasing extreme weather events, impacting Saami health and well-being. Environmental changes caused by climate change lead to indirect health effects, including the spread of vector-borne diseases, increased wildfire risk, extended pollen seasons, and more moisture and mold damage in buildings.

Vector-Borne Diseases

Significant vector-borne diseases in Finland include Lyme borreliosis and tick-borne encephalitis (TBE), spread by ticks, which are moving further north due to warming temperatures. In 2024, ticks were found in all municipalities of the Saami homeland, though no TBE cases have been reported there yet. Ticks are spread by birds, hunting dogs, and deer, with roe deer occasionally appearing in the Saami homeland due to human activity and feeding. Mosquitoes can spread tularemia (rabbit fever), with a single case reported in Utsjoki, potentially spreading from Norway.

Heat-Related Health Issues

Warm and hot weather significantly impacts mortality and morbidity, increasing respiratory diseases, cardiovascular diseases, and mental health issues. Vulnerable groups include the chronically ill, elderly, children, and outdoor workers like reindeer herders and fishermen. Those living in cold climates are particularly sensitive to the negative effects of heatwaves.

Moisture and Mold Damage

Climate change alters precipitation patterns, increasing winter rainfall and wind-driven rain, which can lead to more moisture and mold damage in buildings, especially exterior walls. Flooding risk is expected to rise, further increasing moisture damage. Mold and moisture damage in buildings can lead to higher rates of asthma, allergies, and respiratory infections.

Pollen Exposure

Pollen load has increased over the past 20-40 years across the northern hemisphere, including at the Utsjoki Kevo measurement station. While the health impacts of pollen exposure on the Finnish Saami population have not been assessed, increased exposure likely raises allergy symptoms. In Europe, the pollen season starts 10-20 days earlier than 40 years ago, exacerbating symptoms for those with asthma and other allergic conditions. High alder pollen levels have been linked to increased mortality from respiratory and heart diseases.

Wildfire Risk

Warming and drying conditions increase wildfire risk in the Saami homeland and nearby areas. Smoke from large wildfires, such as those in Russia, can affect air quality. Wildfires increase particulate matter and gaseous pollutants, raising temperatures over large areas. A global study estimated that wildfire-related particulate emissions increased overall mortality by 0.62% from 2000 to 2016. In summer 2024, wildfires occurred in Utsjoki and Inari, some caused by careless handling of fire. Climate change extends the fire season, reduces snow cover earlier, raises summer temperatures, dries the soil, and increases vegetation biomass, enhancing fire spread. Wildfire risk is expected to grow by the end of the century. The largest recent wildfires in Saami-inhabited areas occurred in Sweden's reindeer herding regions in 2018, due to record heat and dry conditions. These fires negatively impacted reindeer and herders' well-being and economy, increasing stress. The vast distances and wilderness areas in the Saami homeland complicate wildfire suppression.

Summary of "Health and Well-being of the Saami in Sweden and Norway"

General Health and Well-being

The overall health and well-being of the Saami in Sweden and Norway are similar to those of the general population. Family and the Saami community are vital sources of support and well-being. A strong Saami identity, social network, and living in core Saami areas enhance well-being. Saami do not have a higher risk of acute myocardial infarction or stroke compared to the general population, nor do they have higher cardiovascular risk factors.

Respiratory and Chronic Conditions

In Sweden, Saami report higher asthma rates (about 20%) compared to the general population (about 11%). Factors influencing asthma prevalence include allergies, obesity, and stress. Obesity is more common among Saami in both Norway and Sweden, and Saami men have more chronic illnesses than men in the general population. Obesity has also increased among Saami youth. Musculoskeletal pain is common in the Saami population. Saami with a strong identity have a diet rich in reindeer meat and fish, leading to healthier lifestyles compared to others in the same regions. However, Saami and Saami youth consume fewer vegetables and fruits than the general population. Most Saami get sufficient vitamin D from their diet. Substance use is lower among Saami, but Saami youth use snus more than their peers. There are no ethnic differences in diabetes prevalence, but prediabetes is more common among Saami women in Sweden, while no ethnic differences are observed in Norway. Dental health is poorer among Saami in both countries. Saami

engage in physical activity as much as the general population, but lifestyle and dietary changes, along with motorization, have health impacts. The concept of health among Saami youth has been influenced by the majority culture.

Mental Health and Discrimination

Saami experience more psychological stress in Norway. In Sweden, Saami and Saami youth have similar or better mental health compared to the general population. However, Saami girls report poorer health and higher rates of suicide attempts (18.4% vs. 9.9%) and depression (29.9% vs. 22.4%) compared to Swedish girls. Historical trauma and discrimination negatively impact Saami mental health, particularly among women. Discrimination is linked to anxiety and depression in Saami women. A study in Sweden found that 73.9% of Saami respondents experienced discrimination and racism in the past year, negatively affecting mental and physical health. Those facing severe discrimination reported more headaches, back pain, stomach pain, sleep difficulties, fatigue, and dizziness. 60% of Saami youth in Sweden reported experiencing discrimination or racism due to their Saami identity. Saami face structural discrimination and inappropriate treatment in health services, with only 11% of Saami youth feeling that health services understand Saami culture, and 10% concealing their ethnicity in health services. Saami who attended boarding schools reported more discrimination, which negatively impacts health behaviors. In Norway, Saami with developmental disabilities have poorer mental health than the general population, with bullying being a significant factor. Nearly half of the Saami in the study reported poor mental health and being bullied. Living outside core Saami areas, weak connections to Saami lifestyle and culture, and loss of the Saami language can increase mental health issues and reduce tolerance to ethnic discrimination.

Need for Further Research

The findings highlight the need for further research on the health and well-being of Saami youth in Finland and the factors affecting them.

Summary of "Health and Well-being of the Saami in Sweden and Norway"

Suicide and Mental Health

A study in Norway found that Saami participants associate suicide with difficulties faced by the Saami, the legacy of assimilation, cultural losses, Saami cultural values of self-reliance, and inadequate mental health services for the Saami. However, Saami youth do not have a higher risk of self-harm or suicidal behavior compared to the general population. Suicidal thoughts and attempts among Saami youth are linked to factors such as gender, a friend's suicide, family relationships, and living in sparsely populated areas. Saami who do not speak the Saami language have more suicide attempts than those who speak Saami as

their first language. Suicidal behavior among Saami youth is less common compared to other Arctic indigenous youth. Close family and friendship ties help mitigate suicidal behavior. Saami youth experience bullying at school and often feel bored with school, partly due to the disconnect between the school environment and Saami culture.

Internal Community Issues

Some Saami in Norway report internal community hierarchy and inappropriate treatment, feeling that they are not truly accepted as community members due to insufficient Saami language skills, a result of Norwegian assimilation policies. The loss of the Saami language due to assimilation causes mental and social problems among the Saami, with the burden passing to future generations. There are also health and well-being disparities within the Saami population. Highly educated Saami have better health and well-being than the general population, but Saami engaged in reindeer herding, especially men, have poorer economic conditions and health. Social capital differences exist, with Saami men participating less in social activities than women, who have greater social capital. However, more Saami women than men report experiencing harassment or offense due to their Saami identity. Saami women report higher rates of intimate partner violence and post-traumatic stress symptoms than other women. In the Saaminor 2 study, 31.3% of Saami women and 28.3% of Saami men reported experiencing violence in childhood, higher than the general population (21.6% for women and 16.6% for men). Those who experienced childhood violence are over three times more likely to suffer from psychological stress than the general population.

Land Use Pressures

The Saami homeland faces land use pressures from mining, wind power construction, and the green transition. Infrastructure projects like mines and wind farms have negative health impacts, and activism has increased discrimination and racism against the Saami. Saami opposing mining projects report that resistance has led to anti-Saami and anti-reindeer herding sentiments and discriminatory behavior. In Sweden, the health impacts of the planned Gállok mine in Jokkmokk municipality have been studied. The planning of the mine has caused anxiety, stress, anger, hopelessness, depression symptoms, and concerns about livelihood and the future of reindeer herding among the Saami in the area. Participants reported decreased well-being and feelings of worthlessness, fearing that life loses its purpose if reindeer herding must end. There is particular concern about whether the current generation will be the last to practice Saami reindeer herding in the area. Saami opposing mining projects are supported by community encouragement, support, and solidarity. Nature and reindeer also provide strength to resist the mining project. If the mine is established, Saami anticipate it will lead to family breakdowns, increased alcohol and

substance use, and more mental health issues. Health impact assessments should be part of the permit processes for mining and land use projects.

Summary of Conclusions

Health and Well-being of the Saami

Research from the 1990s and early 2000s indicated that the Saami lifestyle protected against lifestyle diseases. However, recent studies show that Saami health now mirrors that of the general population, with changes in diet, environment, and physical activity increasing susceptibility to lifestyle diseases. Saami health in Finland is likely similar to that of Saami in Norway and Sweden and the general population. Overall, Saami health and well-being do not significantly differ from the majority population.

Factors negatively impacting Saami health and well-being include the motorization of reindeer herding, economic pressures, structural discrimination, and the low profitability of traditional livelihoods. Climate change-related risks, uncertainty, and stress also adversely affect health. Positive factors include spending time in nature and practicing traditional livelihoods.

Comprehensive research on Saami health and well-being exists in Sweden and Norway, but not in Finland. The impacts of climate change on Saami health have not been systematically studied in Fennoscandia. While linguistic rights in services have been monitored in Finland, research findings have not improved services for the Saami. Societal resources should be allocated to investigate Saami health and well-being and develop the service system.

Saami Reindeer Herding in a Changing Climate

Key features of Saami reindeer herding include Saami identity and cultural heritage, intergenerational continuity, the siida system, reindeer marking system, specialized Saami terminology, cultural understanding of the environment, pasture rotation, environmental relationship, and skills related to reindeer herding and environmental management. Reindeer herding traditions remain within families for generations, with little external entry into the practice.

Reindeer herding practices vary across the Saami homeland. The SAAMI project identified ten different reindeer herding models in Finland, influenced by factors such as environmental conditions (terrain, water bodies, weather, vegetation), cultural conditions (tradition, ethnicity, language), land use conditions (protected areas, competing land use, infrastructure), diffusion and innovations (transfer of livelihood practices), governance

(reindeer herding cooperative system), and the number and age of reindeer herders. For example, the smallest cooperative, Paatsjoki, has fewer than ten reindeer owners, while the largest have nearly 180. Adaptation to climate change depends on the number of active reindeer herders.

Vegetation types vary by region: boreal in the southern area (Lapin, Hammastunturi, Ivalo, Sallivaara cooperatives), northern boreal in the central area (Paatsjoki, Muddusjärvi, Muotkatunturi, Vätsäri, Näätämö cooperatives), and tundra vegetation in the mountain area (Käsivarsi, northern Näkkälä, Kaldoaivi, Paistunturi cooperatives).

Reindeer ownership is increasingly concentrated among fewer owners due to support system limits on animal-specific subsidies and the high cost and low profitability of reindeer herding. This concentration negatively impacts knowledge transfer and the organization of reindeer herding tasks.

Summary of Reindeer Herding in the Saami Homeland

Decline in Reindeer Owners

The number of reindeer owners in the Saami homeland has been decreasing, while the total number of reindeer has remained stable since the 1990s. This indicates a concentration of reindeer herding among fewer owners and a decline in small-scale reindeer owners. The stability in reindeer numbers is partly due to supplemental feeding, which mitigates reindeer losses. Approximately 70-80% of reindeer owners in the Saami homeland are estimated to be Saami, and the region accounts for about 35% of the reindeer in the reindeer herding area.

Professional Reindeer Herders

The number of professional reindeer herders, indicated by those with MYEL (farmers' pension insurance), has been around 290-320 since the 2010s. The number of MYEL-insured reindeer herders began to decline in the 1990s, mirroring the overall decline in reindeer owners.

Economic Viability

Reindeer herding's economic viability is low. The producer price of reindeer meat has fluctuated, with the highest prices just under €12 per kilogram and the lowest below €5 per kilogram. These prices do not cover the calculated unit cost of producing a kilogram of meat. Direct sales and processing can increase the price. Animal-specific subsidies account for about 14-15% of reindeer herding income.

Challenges and Recommendations

The low profitability of reindeer herding and a support system that does not account for climate change adaptation make it difficult to start reindeer herding and maintain resilience during poor years. Professional reindeer herders need at least 300 reindeer to be viable, with 500 reindeer being more sustainable. The current system does not support small-scale reindeer owners adequately, and there are calls for a tiered slaughter quota system to better support both small and large reindeer owners.

Overall, the concentration of reindeer ownership among fewer individuals, combined with economic and systemic challenges, poses significant difficulties for the sustainability and resilience of reindeer herding in the Saami homeland.

Summary of "Impact of Climate Change on Reindeer Health and Behavior"

Health Impacts

Climate change affects reindeer health and well-being in several ways, including food availability, temperature, winter conditions, predator activity, and diseases.

- **Setaria tundra Parasite**: Spread by mosquitoes, this parasite caused mass illness among reindeer in southern and central Finland from 2003 to 2006, leading to severe peritonitis in calves. High temperatures accelerate the parasite's development. Conditions favorable for the parasite's spread can be predicted based on summer temperatures exceeding 14°C. Infected reindeer calves have lower health, and certain body parts like the liver cannot be used. The parasite's spread causes economic losses in reindeer herding. Despite intensive ivermectin treatment, the parasite spread northward, indicating its high transmission efficiency. The parasite's active period in Lapland is short but has been observed to lengthen.
- **Tick-Borne Diseases**: Tick-borne encephalitis (TBE) has not been found in Norwegian reindeer from 2013-2015, nor in Saami homeland reindeer. However, ticks were observed on reindeer in Inari in 2024.
- **Toxoplasma gondii**: This protozoan was found in about 2% of tested reindeer meat in Sweden. It poses a significant health risk to immunocompromised individuals and pregnant women. Climate change may increase its prevalence. In Finland, infections have been observed in southern reindeer herding areas, likely spread from domestic cats. New viruses found in reindeer may pose health risks to reindeer, other animals, and humans. Warming climates facilitate the spread of vector-borne diseases by ticks, mosquitoes, midges, rodents, cattle, sheep, birds, and other deer.

Behavioral Impacts

- **Heat Stress**: Reindeer suffer from heat stress at temperatures above 20°C, reducing their food intake and resting more. Summer heatwaves particularly affect female reindeer, reducing their weight and ability to store fat for winter. High summer temperatures also lower calf weights, impacting their winter survival. Climate change is expected to increase heatwaves in the Saami homeland, exacerbating heat stress.
- **Supplemental Feeding and Penning**: Research in Sweden indicates that supplemental feeding and penning increase the risk of infectious diseases spreading among reindeer. In 2016, reindeer in Norrbotten fed in pens showed signs of necrosis, muscle hypertrophy, skin lesions, and eye infections, with alphaherpesvirus and contagious ecthyma detected. Climate change may facilitate the spread of infectious diseases. The current reindeer herding model, adapted to climate change, makes reindeer herding vulnerable to infections due to supplemental feeding and high reindeer density in specific areas. In Finland, reindeer are not primarily fed in pens, and penning is short-term for calving and marking, likely not affecting disease spread.

Cultural and Economic Factors

The acceleration of climate change and increasing demands for economic efficiency may lead to more penning, though cultural reasons may prevent its widespread adoption. Traditional knowledge holders have observed various physiological and health impacts of climate change on reindeer.

Overall, climate change poses significant challenges to reindeer health and behavior, requiring adaptations in reindeer herding practices to mitigate these impacts.

Summary of "Changes in Conditions Affecting Reindeer Behavior and Herding"

Behavioral Changes

Climate change causes rapid and unpredictable changes in winter conditions, making reindeer herding more challenging. Reindeer become restless and roam over larger areas when the weather changes.

- **Behavioral Shifts**: Reindeer now dig for food in different areas and do not move to the mountains as they used to. They become restless and move southward when the weather changes, often before humans notice the change.

- **Spring and Summer**: Earlier springs and summers improve calving success due to earlier availability of green forage. However, harsh winter conditions negatively impact reindeer health and well-being, leading to starvation and increased predation.

Environmental Impacts

- **Ice Stability**: Reindeer are accustomed to crossing water bodies at specific times and places. Changing ice conditions, with repeated freezing and thawing, increase the risk of reindeer drowning. In October 2024, around 200 reindeer drowned in Kautokeino, Norway, due to thin ice.
- **Insect Season**: The insect season, traditionally starting around midsummer, now begins earlier in warm years. Reindeer suffer from prolonged exposure to various insects, affecting their well-being. The deer fly, not yet widespread in the Saami homeland, poses a significant threat to reindeer health.

Adaptation Measures

- **Supplemental Feeding and Penning**: Supplemental feeding and penning increase the risk of infectious diseases spreading among reindeer. In Finland, reindeer are not primarily fed in pens, and penning is short-term for calving and marking, likely not affecting disease spread. However, increased economic efficiency demands may lead to more penning in the future.
- **Technological Adaptations**: Adaptation measures since the 1990s include supplemental feeding, technology (GPS collars and drones), the siida system, and pasture rotation.

Challenges in Herding

- **Planning Difficulties**: Rapidly changing conditions make it difficult to plan herding activities in advance. Herding in groups and scheduling herding shifts help manage costs and balance herding activities with income.
- **Heatwaves**: High temperatures complicate annual herding tasks. Calf marking cannot be done in high temperatures, leading to delays and interruptions. Supplemental feeding becomes necessary when natural forage is insufficient.

Observations from Traditional Knowledge Holders

- **Unpredictable Weather**: Weather forecasts are often unreliable, making herding akin to "lottery." Shortened winters may benefit reindeer, but warm spells and rain in winter create hard conditions for reindeer to dig for food.

- **Increased Workload**: Difficult conditions, such as reindeer moving to islands on Lake Inari, increase the workload for herders.

Overall, climate change significantly impacts reindeer behavior and herding practices, requiring continuous adaptation and innovative solutions to maintain the sustainability of reindeer herding in the Saami homeland.

Summary of Climate Change Impacts on Saami Traditional Livelihoods

Observations and Research Findings

From 2000 to 2024, climate change has significantly impacted Saami traditional livelihoods. Harsh winter conditions have become more frequent, and the negative effects of climate change are perceived to be accelerating. These conditions are now considered the "new normal," and traditional weather prediction methods are no longer reliable. Reindeer behavior has become the best indicator of weather changes, with reindeer often sensing changes up to two days in advance. Differences in climate change impacts between boreal, northern boreal, and tundra areas are minimal, though forest expansion and shrub growth are more pronounced in boreal and northern boreal areas.

Challenges in Traditional Practices

Implementing traditional pasture rotation systems, which involve different summer, winter, autumn, and spring areas, is increasingly difficult and sometimes impossible in a changing climate. The uncertainty about the future of reindeer herding is a major concern, with many young people considering other professions due to the challenges posed by climate change.

Economic Impacts

Climate change has brought numerous difficulties to reindeer herding, including issues with meat sales during the COVID-19 pandemic and rising costs. Fuel price increases and VAT hikes affect investments and income in reindeer herding. There is a need to create a sense of future viability for the livelihood to attract young people. This could be achieved by transferring traditional knowledge and skills to the younger generation and creating a support network.

Financial Implications

The economic impacts of climate change on Saami culture and traditional livelihoods have not been comprehensively assessed. While estimates of additional costs for reindeer herding due to climate change can be made, a detailed financial assessment requires further research. The global cost of climate change is projected to be €1.5-2.8 trillion

annually by 2050, including damages to infrastructure, property, agriculture, and human health. Supporting the adaptation of endangered cultures to climate change early on is economically beneficial.

Traditional Knowledge Insights

Traditional knowledge holders emphasize that the financial assessments of difficult winter conditions often underestimate the increased costs of fuel and equipment, as well as the cumulative negative economic impacts of reduced calf percentages. Difficult winters significantly affect reindeer herding income, and recovery from poor years can take several years.

Overall, climate change poses substantial challenges to Saami traditional livelihoods, requiring continuous adaptation and innovative solutions to maintain their sustainability.

Summary of Economic Impacts of Harsh Winter Conditions on Reindeer Herding

Limitations of Current Assessments

Current assessments of the economic impacts of harsh winter conditions on reindeer herding, based on bookkeeping and reindeer inventory data, are insufficient. They overlook different herding models, the work of herders, and long-term costs associated with reduced calf percentages. Reduced calf percentages affect the number of reindeer available for sale, the number of breeding females in future years, and overall herd health. The positive impact of harsh winters on lichen biomass does not necessarily improve economic outcomes in subsequent years, as lichen does not regenerate quickly.

Norwegian Data

In Norway, the agricultural administration estimated that 120,000 reindeer suffered from harsh grazing conditions in 2023-2024. Norway has declared emergencies in reindeer herding in 2017, 2020, 2021/2022, and 2024. The agricultural cooperative Felleskjøpet reported a 46% increase in reindeer feed consumption in winter 2023-2024. Similar data is not available for Finland or Sweden without specific research projects.

Finnish Data

In Finland, the government recognized one harsh winter in 2019-2020, during which over 20,000 adult reindeer died, and the calf percentage dropped from 61% to 41%, with a 32% decrease in slaughtered reindeer. Compensation for losses due to harsh winter conditions is regulated by law, covering supplemental feeding costs, reduced calf percentages, and increased reindeer mortality. Compensation is the only way for herders to recover financial

losses due to climate change. However, compensation was not granted to herders in cooperatives with excess reindeer numbers, such as Käsivarsi, Näkkälä, and Paistunturi.

Perceived Inequities

Traditional knowledge holders perceive the compensation system as unfair and ineffective, as it does not account for different herding models and is slow to provide support. They argue that frequent harsh winter conditions should be considered normal, and the system should support climate change adaptation rather than just compensating for losses.

Survey Results

A survey conducted by the Saami Climate Council found that none of the 28 respondents considered the current support system effective. Most respondents suggested changes to provide support during crises, account for different herding models, support herding activities, and incorporate traditional knowledge in damage assessments.

Recommendations

To better support reindeer herding in the face of climate change, the compensation system should be reformed to provide timely support, consider different herding models, and integrate traditional knowledge. The system should focus on climate change adaptation to ensure the sustainability of Saami reindeer herding.

Overall, the economic impacts of harsh winter conditions on reindeer herding are significant and require comprehensive assessments and reforms to support herders effectively.

Summary of Green Transition and Its Impact on Saami Homeland

Year-Round Conditions

Year-round conditions influence the likelihood of harsh winter conditions and the ability of reindeer and herders to adapt. Adaptation measures depend on financial resources, previous years' conditions, reindeer meat sales, and calf percentages.

Green Transition

The green transition in Norway and Sweden has significantly increased wind power production in Saami areas and pressured the opening of new mines to produce metals for green transition projects. In Finland, the Saami homeland has one operational wind power area in Käsivarsi's Lammasoiva. A study commissioned by the Regional Council of Lapland identified nine areas suitable for wind power and seven for solar power in the Saami homeland. Promoting wind and solar power requires detailed zoning, impact assessments,

and transmission connections. These projects may arise in the near future due to growing energy needs from the green transition and tourism. While there are no mines in the Saami homeland, mining minerals are being explored.

Impact of Mines

Studies in Norway and Sweden have examined the impact of mines on Saami culture. Mines have significantly affected reindeer grazing: pastures have shrunk and fragmented, grazing wear has increased, seasonal rotation and migration routes have been disrupted, and reindeer behavior has been affected, complicating herding and increasing herders' workload. Indirect effects include increased traffic, infrastructure, and noise, extending negative impacts within a 10-kilometer radius of the mine. Adaptation measures include supplemental feeding, using helicopters for gathering reindeer, and building fences. Mines have led to the loss of traditional knowledge and uncertainty about the future of Saami reindeer herding. Resistance to mines has exposed Saami to discrimination and bullying, increasing mental stress and health issues. The negative impacts of mines are greater than indicated in permit decisions.

Impact of Wind Power

Wind power construction impacts reindeer herding, as reindeer avoid wind power areas, especially in spring and calving season, and react to turbines when they see them. Reindeer maintain about a 10-kilometer distance from turbines, with seasonal variations.

Legal Issues

Wind power construction has raised legal issues in Norway. The Supreme Court ruled that the construction of the Fosen Vind wind farm on Saami grazing land violated Saami cultural rights. In spring 2024, Nord-Fosen siida and Roan Vind reached an agreement in a state-led mediation process to implement the Supreme Court's decision. The Fosen case highlights the need to consider justice issues before starting large construction projects and to adhere to international human rights obligations, even if they do not specifically address climate change.

Overall, the green transition poses significant challenges to the Saami homeland, requiring careful planning and consideration of cultural rights and environmental impacts.

Research indicates that Saami people may perceive wind farms as a form of colonialism, threatening the existence of Saami culture and reindeer herding in specific regions. Saami feel a responsibility to oppose wind farms and defend their culture. An analysis of research literature (Figure 4) highlights the studied and observed impacts of the green transition on Saami culture. Although there are currently no green transition projects in the Saami

homeland in Finland, it is important to prepare for them, considering the research findings from Norway and Sweden on the impacts of the green transition.

Summary of Fishing in a Warming Climate

Commercial and Subsistence Fishing

Commercial fishing in the Saami homeland is practiced in larger water bodies like Lake Inari, Lokka, and Porttipahta. By the end of 2024, there were 1 commercial fisherman in Enontekiö, 2 in Utsjoki, 32 in Inari, and 29 in Sodankylä, with most Sodankylä fishermen being from outside the Saami homeland. Subsistence fishing is common throughout the Saami homeland. Factors affecting fishing include climate change, economic viability, legislation, and the ability to transfer fishing knowledge across generations. While there is increasing research on the impacts of climate change on fish and their habitats, studies specifically on Saami fishing culture and livelihoods are limited.

Impact of Climate Change

Climate change has altered commercial fishing on Lake Inari, extending the ice-free period and shortening the winter fishing season. These changes complicate fishing and affect fish movements. Traditional knowledge holders report similar difficulties, noting that fishing and movement on Lake Inari have become more challenging, and ice fishing seasons have shortened.

Fish Stocks and Species

Climate change promotes the spread of new fish species to new areas while causing the decline of cold-adapted species, particularly salmonids, and the success of warm-water species. Earlier springs and rising average temperatures benefit spring-spawning fish like perch, roach, and pike. Arctic char, important to the Saami, is expected to disappear from shallow mountain lakes and the southern edge of its range.

Water Temperature and Fish Health

Warming waters increase fish stress, weaken their immunity, and may lead to more fish diseases and bacterial infections. Rising water temperatures in spawning rivers can affect the success of salmon spawning, as salmon fry cannot tolerate temperatures above 20°C for long periods.

Wind and Fishing

Increased windiness complicates net fishing in autumn, affects fish movements, and accelerates fish spoilage. Professional fishermen have adapted by targeting different fish species, changing fishing areas, and developing fishing tourism.

Teno River Salmon

Climate change and fishing have significantly impacted salmon stocks and fishing opportunities in the Teno River system. Despite restrictions on salmon fishing since 2017 and a practical ban since 2021, the salmon population remains weak. Increased salmon mortality and a significant decline in one-year sea salmon in 2024 are attributed to climate change and the introduction of a pink salmon barrier. Changes in river ice conditions and warming water temperatures affect salmon smolt survival and migration timing. Environmental changes due to climate change impact the timing of salmon migration, with young salmon having to travel further for food due to shifts in the capelin population.

Conservation Efforts

Saami and researchers have long called for a halt to marine salmon fishing to restore salmon stocks. Norway's environmental authority proposed banning coastal salmon fishing in Finnmark from 2025 to improve salmon spawning chances. Open sea and fjord salmon farming pose risks to Teno salmon stocks, as escaped farmed salmon can weaken wild salmon genetics, compete for habitat, and spread diseases. Escapes are common, with 1.73 million salmon reported escaped from Norwegian farms between 2011 and 2021. In February 2025, approximately 27,000 farmed salmon escaped from a damaged farm near Tromsø. Climate change increases extreme weather, raising risks for open sea salmon farming.

Cultural Impact

The ban on Teno salmon fishing has generational impacts, particularly on Saami children and youth, who miss learning traditional salmon fishing practices. Other fishing activities, such as removing invasive pink salmon, offer opportunities to transfer and maintain fishing skills. However, single events cannot establish a lasting foundation for knowledge transfer. In 2023, there were 98 children under 18 in Utsjoki. If they do not learn traditional salmon fishing, their descendants will not either.

Overall, climate change poses significant challenges to Saami fishing traditions and livelihoods, requiring adaptations to maintain sustainability and cultural heritage.

Summary of Other Traditional Saami Livelihoods

Duodji (Traditional Saami Handicrafts)

There is no research on the impact of climate change on Saami handicrafts and gathering. Duodji, traditional Saami handicrafts, is a financially viable livelihood. While there are no statistics on handicraft practitioners, many belong to the Saami Duodji association, which has about 300 members. Handicraft traditions, especially among Inari and Skolt Saami, are

endangered. Handicrafts are divided into hard (garraduodji) and soft (dipmaduodji) crafts. Saami handicrafts are part of a network involving nature, people, and traditional livelihoods. The tradition includes craftsmanship, aesthetics, knowledge of natural conditions, growth sites, natural cycles, and raw materials, their acquisition, processing, and preservation. Handicrafts involve cultural values and regional traditions. Many raw materials for Saami handicrafts come from traditional livelihoods: reindeer parts, fish skins and vertebrae, and furs. Handicrafts use various plants for dyeing, burls, wood, and roots for root work and hard crafts, and willows and birches for tanning. Earlier seasons affect plant collection, timing, and utilization. Climate change increases the availability of trees and shrubs but negatively impacts certain raw materials. For example, the growth sites of shoe hay may change, and it can be difficult to find during dry periods.

Climate change indirectly affects handicrafts, their need, and their adaptation to new conditions. Combining traditional handicrafts with commercial products can offer solutions. Nutukkaat (fur boots) are culturally significant and comfortable but less practical in varying winter conditions and snowmobile use. Solutions include synthetic, waterproof, thin protective boots worn over nutukkaat to prevent wetting and facilitate snowmobile use. In Sweden, a "minipeski" vest made from reindeer hide is worn over synthetic jackets, shedding wet snow better and keeping herders warmer.

Gathering

Gathering, especially berry picking, is a common practice among Saami in the homeland. Saami gather plants for medicine, preservation, dyeing, handicrafts, beauty care, and well-being. Gathering traditions involve a relationship with nature, values, outdoor activities, knowledge accumulation, and connection to previous generations.

Climate change impacts gathering by causing unstable conditions. Berry yields are affected by early summer weather, precipitation, drought, wind, and harvest temperature. Early summer drought, frost, or heavy rains can prevent cloudberry flowering and significantly reduce yields. Strong winds hinder pollinator insects and reduce pollination success. The harvest time for plants and berries has advanced due to earlier summers. Cloudberry harvest time has shortened as warm weather causes faster spoilage. Data from the SAAMI project indicates fewer normal cloudberry years and significant variability in yields. Crowberry yields also vary greatly, with some years producing no berries at all.

Overall, climate change poses challenges to traditional Saami handicrafts and gathering practices, requiring adaptations to maintain these cultural traditions.

Hunting

Saami practice hunting as part of their livelihoods, primarily targeting moose and ptarmigan. Climate change affects the availability of food for game animals, predator activity, suitable habitats, and hunting pressure.

- **Moose**: Adapted to cool climates, moose suffer from heat stress at temperatures above 14°C. Moose populations will continue to thrive in the Saami homeland. Traditional knowledge holders have observed that moose population size follows reindeer die-off years; harsh conditions for reindeer are also difficult for moose. For example, in the snowy winter of 2019-2020, moose carcasses were found in the wilderness. Moose have spread to mountain areas, finding suitable food sources like pine. Warmer autumns complicate moose hunting as meat spoils faster. Moose are primarily hunted far from settlements, and carcasses must be transported by off-road vehicles for processing.
- **Ptarmigan**: Ptarmigan are thriving in the Saami homeland, but population size varies due to fox predation, changing weather conditions, and temperature. Locals primarily trap ptarmigan in winter in the three northernmost municipalities, while hunting with firearms is common among tourists. Autumn hunting is mainly tourist hunting. Ptarmigan have moved north to the territory of rock ptarmigan, indicating favorable northern conditions due to higher birch growth.

Climate Change Impacts

- **Seasonal Changes**: Earlier snowmelt in spring exposes ptarmigan to hunting before their summer camouflage changes. Delayed snow cover in autumn exposes ptarmigan to hunting as their camouflage turns white. Increased fox populations in the Saami homeland reduce ptarmigan numbers. Ptarmigan and rock ptarmigan roost in snow burrows in winter for protection from predators and cold. In low-snow winters, they struggle to find suitable burrow sites, increasing predation risk.
- **Vegetation Changes**: Ptarmigan prefer birch forests in winter, while rock ptarmigan prefer higher mountain tundra. Both species benefit from reindeer grazing, which helps control vegetation changes. Other game birds like capercaillie and black grouse have been observed moving higher. Future hunting in the Saami homeland may need to include a more diverse range of game birds.

Hunting Pressure

Climate change and forestry have reduced game bird populations elsewhere in Finland. Hunting pressure for game birds and moose may shift to the Saami homeland, with increased pressure already observed for ptarmigan. Autumn hunting disrupts reindeer

herding and rutting, and hunting dogs scatter reindeer herds. Conflicts between tourism hunting and reindeer herding may increase in the future due to climate change.

Overall, climate change poses challenges to traditional Saami hunting practices, requiring adaptations to maintain sustainability and balance with other livelihoods.

Summary of Current Climate and Conditions in the Saami Homeland

Climate Warming

The climate in the Saami homeland has warmed by 2-3°C compared to pre-industrial times, with Arctic warming occurring up to four times faster than the global average. Saami have observed signs of climate change since the 1960s, with changes accelerating in the 2000s. Adaptation measures in Saami reindeer herding began in the 1990s. The younger Saami generation has only experienced conditions adapted to climate change.

Temperature, Precipitation, and Wind

This report presents past (Chapter 3) and future (Chapter 4) climate data for temperature, precipitation, and wind in the Saami homeland, with time series for three sub-regions: boreal (Sallivaara, Hammastunturi, Ivalo, and Lapland cooperatives), northern boreal (Vätsäri, Paatsjoki, Näätämö, Muddusjärvi, and Muotkatunturi cooperatives), and mountain (Käsivarsi, Näkkälä, Kaldoaivi, and Paistunturi cooperatives). Past climate data for temperature and precipitation are based on ClimGrid data from the Finnish Meteorological Institute, and wind data are calculated from ERA5 reanalysis, combining observations and weather models. Wind data use 925-hPa pressure level winds, typically at 700-800 meters altitude, to better represent general flow, as 10-meter winds are influenced by surface roughness and terrain.

Temperature Trends

The average annual temperature in the Saami homeland increased by 1-1.5°C between the 1961-1990 and 1991-2020 periods. The southern part of Lake Inari saw annual temperatures rise above 0°C in the latest period. Long-term temperature trends from 1960-2023 show rising temperatures in all seasons, with the most significant increase in winter (3-5°C over 60 years). Summer temperatures have risen the least, by less than 2°C, and the trend is not statistically significant in the northernmost areas.

Regional Temperature Changes

Temperature time series from 1961-2022 for the three sub-regions show rising average temperatures annually and seasonally. The boreal region has warmed the most, with

annual temperatures rising by about 2.5°C and winter temperatures by 4°C over 60 years. The northern boreal region has warmed the least, with annual temperatures rising by about 2.1°C and winter temperatures by 2.9°C over 60 years. There is significant year-to-year variability, with the coldest year being 1966 and the warmest summer in 1972 and autumn in 2011.

Long-Term Data

The annual average temperature at Sodankylä Tähtelä weather station from 1901-2023 shows periods of warmer and colder years, with significant variability. A clear warming trend is evident over the past 40 years since the 1980s. Despite this, there are still cold years, such as 1985, the coldest year in the entire series, but warm years are more frequent. The warmest year was 1938, with a record warm autumn.

Previous Research

The CLIMINI project (2020-2023) studied the impacts of climate change and adaptation in reindeer herding. The results indicated that spring and summer will start earlier, and autumn and winter later, in the future. Winter cold spells have moderated, and the number of cold days has decreased. Similarly, the number of frost days in spring has decreased.

Summary of Observations from Traditional Knowledge Holders on Climate

Winter

Traditional knowledge holders have observed significant changes in winter conditions, aligning with meteorological data on warming climate. They note shorter winters and large daily temperature fluctuations, especially in recent years.

- **Shorter Winters**: Long cold spells lasting several weeks were common in the past, but now temperatures can swing from -30°C to thaw conditions within a short time.
- **Extreme Temperature Variations**: Instances of extreme temperature differences within a single day, such as -40°C in the morning and +5°C in the evening, have been noted.
- **Unpredictable Weather**: Winter temperature fluctuations from -25°C to +5°C are frequent, making weather predictions unreliable. Winters are now characterized by wet snow and extended autumn conditions into December.
- **Impact on Reindeer**: Shortened winters may benefit reindeer, but warm spells and rain in winter create hard conditions for reindeer to dig for food.

Summer

Summer conditions have also changed, affecting traditional practices.

- **Earlier Seasons**: Activities like collecting shoe hay now need to be done a month earlier to ensure quality.
- **Snow Melt**: Snow patches that used to last all summer now melt by July, affecting reindeer grazing areas.

Autumn

Autumn conditions have extended into December, often without snow or freezing temperatures.

Overall, traditional knowledge holders' observations highlight significant changes in seasonal conditions, aligning with scientific data on climate warming. These changes impact traditional practices and livelihoods, requiring adaptations to cope with the new normal.

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Summary of Precipitation in the Saami Homeland

Average Annual Precipitation

The average annual precipitation for the periods 1961-1990 and 1991-2020 shows that precipitation distribution is more variable than temperature. During 1961-1990, annual precipitation in the Saami homeland ranged from about 350 to 500 mm, with the highest amounts in the northernmost areas. In the 1991-2020 period, average precipitation increased across the Saami homeland, with more local variation than temperature changes. The northern part of Käsivarsi saw an increase of over 120 mm, while the Lake Inari area saw an increase of less than 20 mm.

Long-Term Trends

From 1960 to 2023, annual precipitation trends show regional and seasonal variation. Annual average precipitation increased throughout the Saami homeland, with the most significant increases in Käsivarsi and Hammastunturi. Some smaller areas did not show statistically significant changes. Seasonally, precipitation increased the most in winter and spring, with up to 60 mm increases, and up to 90 mm in Käsivarsi over 60 years. Summer precipitation changes were small and statistically significant only in Käsivarsi, Hammastunturi, and Ivalo. Autumn precipitation did not show statistically significant changes.

Regional Precipitation Changes

Precipitation time series from 1961-2022 for the three sub-regions show annual increases in all areas. The mountain area saw the most significant increase, about 130 mm over 60 years. Seasonally, precipitation increased significantly in winter and spring, with no clear long-term changes in summer and autumn. The mountain area saw more winter precipitation increases, while the boreal and northern boreal areas saw more spring increases. There is significant year-to-year variability, especially in summer.

Long-Term Data

The annual precipitation at Sodankylä Tähtelä weather station from 1893-2023 shows significant variability over 131 years. While the long-term change is not as clear as temperature, a weaker upward trend is visible since the 1980s. The wet summer of 1992 stands out in the data.

Traditional Knowledge Observations

Traditional knowledge holders' observations align with scientific data, noting shorter snow cover duration and increased winter precipitation. They also observed increased summer drought, despite no statistically significant increase in average summer precipitation. Summer heavy rains are highly localized, and a single heavy rain can account for a month's worth of precipitation, with the rest of the period being dry.

Overall, precipitation in the Saami homeland has increased, with significant regional and seasonal variations, impacting traditional practices and requiring adaptations to cope with these changes.

Winter (Talvi)

- **Increased precipitation**: Snow is wetter and sticks differently to surfaces. Participants noted that snowfall has increased during winter.
- **Changes in snow type**: Snow is not the typical heavy snow but a different kind that blocks gaps in fences and freezes solid.
- **Delayed snowfall**: Compared to the past, autumns are less rainy, and snow arrives later, often suddenly and in large amounts, even in April.

Spring (Kevät)

- **Unpredictable snow**: Snowbanks are eagerly awaited but don't appear every winter, affecting reindeer herding.
- **Rapid melting**: Snow melts quickly, leading to brief periods of muddy conditions. This has been a trend since the 2000s.

- **Sudden snowmelt**: Snow can melt unexpectedly fast, sometimes within a week, even if large amounts fall in April.

Summer (Kesä)

- **Dry and hot summers**: Summers are becoming drier and hotter, with very few rainy days. This affects vegetation and wildlife, such as reindeer, which struggle to find food.
- **Changes in river conditions**: Reduced water levels in rivers like Tenojoki, leading to different plant growth and muddier riverbeds. Leaves fall prematurely due to dry conditions.

Autumn (Syksy)

- **Less rainfall**: Autumns are less rainy compared to the past, impacting reindeer grazing as snow falls on wet ground.
- **Fence damage**: Strong winds and late snowfall cause fences to freeze and collapse, with gaps freezing shut and preventing wind passage.

These observations highlight significant changes in precipitation patterns across the seasons, affecting both the environment and local livelihoods.

Wind Speed and Direction

- **General Trends (1960-2023)**:
    - **Annual Wind Speed**: No significant change in the average annual wind speed across the Saami homeland.
    - **Spring**: Noticeable increase in average wind speed, with the smallest increase in Käsivarsi (0.3-0.6 m/s) and the largest in Näkkälä and Kyrö (up to 1.2 m/s).
    - **Winter**: Slight decrease in wind speed in Kemi-Sompio and Northern Salla, statistically significant.
    - **Summer and Autumn**: No significant changes in wind speed.
- **Seasonal Wind Speed Trends**:
    - **Spring**: Significant increase in average wind speed (0.7-0.8 m/s) across all three areas studied.

        - **Winter**: Strong winds were more common in the 1990s, with record years in 1972 and 1993.
        - **Summer and Autumn**: No significant changes observed.
- **Wind Direction**:
    - **General Patterns**: Predominantly from the southwest and south, with the least common direction being from the north.
    - **Changes Over Time**:
        - **1991-2020 vs. 1961-1990**: Increase in south and east winds, decrease in west and southwest winds.
        - **Seasonal Variations**:
            - **Winter and Summer**: Increase in south, southeast, and east winds; decrease in southwest, west, and northwest winds.
            - **Spring**: Increase in northwest winds; decrease in east-southeast winds.
            - **Autumn**: No significant changes in wind direction.

These observations highlight the changes in wind patterns over the years, with notable seasonal variations and shifts in predominant wind directions.

General Observations

- **Increased Windiness**: Nearly all observations indicate an increase in windiness across different seasons, with a notable rise in south and west winds.
- **Spring**: Significant increase in average wind speed from 1960 to 2023.
- **Other Seasons**: No significant changes in average wind speed, but local environmental factors can cause variations.

Seasonal Observations

Winter

- **Decreased Snowstorms**: Heavy snowstorms that block roads have decreased.
- **Beneficial for Reindeer**: Wind helps break and soften snow for reindeer.
- **Increased South and West Winds**: More frequent winds during traditionally calm, cold months.

- **Dangerous Conditions**: Strong winds combined with snow can create hazardous conditions, making it difficult to move and increasing the cold sensation.

Summer

- **Increased Winds in Spring**: Winds seem to increase towards the evening, contrary to the usual pattern of calming down.

Autumn

- **Increased Winds**: Significant increase in windiness, especially from the west.
- **Impact on Structures**: Strong winds can be damaging to buildings.
- **Beneficial for Reindeer**: Winds help dry the ground, preventing mold.

These observations highlight the perceived increase in windiness and changes in wind patterns, affecting both the environment and daily activities.

the future climate and conditions in the Saami homeland:

Temperature

- **Mid-Century (2040-2069)**:
    - **Winter**: Temperatures are expected to rise by 3-4°C.
    - **Other Seasons**: Increases of 2-3°C.
- **End of Century (2070-2099)**:
    - **Winter**: Temperatures could rise by 4-5°C.
    - **Other Seasons**: Increases of 3-4°C.
- **Monthly Variations**: Winter months will see the most significant warming, with potential increases of over 4°C (up to 7°C under high emissions scenarios).

Precipitation

- **Mid-Century**:
    - **Overall Increase**: 6-12% increase in precipitation, with the highest increases in cold seasons.
    - **Spring**: Significant increase in average precipitation.
    - **Summer**: Smaller increases of 6-9%.

- **End of Century**:
    - **Overall Increase**: 6-18% increase, with the highest increases in spring and winter.
    - **Summer**: Smaller increases of 6-12%.
- **Monthly Variations**: Increases in late autumn, winter, and spring precipitation. Summer increases are less certain.

Wind Speed

- **General Trends**: No significant changes in average wind speed, but local variations due to environmental factors.

These projections indicate significant warming, especially in winter, and increased precipitation, particularly in the colder seasons, which will impact the climate and conditions in the Saami homeland

Wind Speed

- **Mid-Century (2040-2069)**:
    - **Average Wind Speed**: Expected to decrease by 0-4% in the Saami homeland.
    - **Perämeri Region**: Wind speed may increase by 2-6%, particularly in winter, due to reduced ice cover.
- **End of Century (2070-2099)**:
    - **Average Wind Speed**: Expected to decrease by 2-6% in the Saami homeland.
    - **Perämeri Region**: Continued increase in wind speed.

Variability and Uncertainty

- **Model Discrepancies**: Climate models show significant variability and disagreement on the direction and magnitude of wind speed changes.
- **Seasonal Variations**: The most notable decrease in wind speed is projected for early autumn, with a median decrease of 3-5%, but with a wide range of possible outcomes (-18% to +8%).

Local Factors

- **Environmental Influences**: Local terrain and structures significantly affect wind speed and direction, making precise predictions challenging.
- **Need for Regional Models**: More detailed regional climate models are needed to accurately capture local variations, especially in mountainous and lake areas.

These projections indicate a general decrease in wind speed in the Saami homeland, with notable increases in the Perämeri region, but with considerable uncertainty and variability across different models and seasons

summary of the preliminary indicators for monitoring the impacts of climate change on Saami culture:

Overview

The SAAMI project proposes a permanent monitoring system to track the impacts of climate change on Saami culture, homeland, health, and well-being. This system requires measurable indicators to observe changes and support climate policy development and effectiveness.

Indicators

- **Development**: The initial draft includes 59 indicators, some of which can be implemented using existing data, while others require new data collection.
- **Selection**: The most important and effective indicators need to be chosen for further development.
- **Data Integration**: A data interface service is necessary to update information from various sources. Interviews with holders of traditional Saami knowledge are crucial for reliable time series.

Implementation

- **Detailed Planning**: Further projects are needed to define the indicators' content, data description, resources, update cycles, and analysis plans.
- **Collaboration**: The finalization and implementation of indicators require collaboration among various research institutions, traditional knowledge holders, and other stakeholders.

- **Existing Data**: Combining existing data with new data collection is essential. A map-based observation system should be created for direct reporting of observations related to indicators.

Health and Well-being

- **Surveys**: THL's FinHealth and school health surveys can include questions specific to Saami people to compare health and well-being inside and outside the Saami homeland.

Indicator Sectors

The indicators are categorized into sectors:

1. **Population** (3 indicators)
2. **Traditional Saami livelihoods** (9 indicators)
3. **Environment** (8 indicators)
4. **Water bodies** (3 indicators)
5. **Fish stocks** (4 indicators)
6. **Game** (3 indicators)
7. **Temperature** (6 indicators)
8. **Precipitation** (4 indicators)
9. **Snow** (4 indicators)
10. **Wind** (2 indicators)
11. **Saami health and well-being** (9 indicators)
12. **Green transition** (1 composite indicator)
13. **Adaptation and mitigation measures** (3 indicators)

A more detailed description of indicators is following:

1. Saami Population

- **Indicators:**
    - Distribution of the Saami population by age and gender.
    - Development of the number of Saami language speakers.

- Forecasting the Saami population.

2. Traditional Livelihoods

- **Indicators:**
    - Number and age distribution of reindeer owners.
    - Number of reindeer.
    - Forecasting the number of reindeer herders.
    - Preservation and development of reindeer herding models.

3. Environment

- **Indicators:**
    - Tree line and forest density.
    - Tundra habitat.
    - Permafrost and palsa mires, snow patches.
    - Condition of reindeer pastures.
    - Observations of invasive species.

4. Aquatic Environment

- **Indicators:**
    - Water temperature.
    - Blue-green algae and algae.
    - Ice formation, departure, and composition.

5. Fish Stocks

- **Indicators:**
    - Fish stocks.
    - Mass fish deaths.

6. Game and Wildlife

- **Indicators:**
    - Grouse populations.

- Moose population.
- Invasive game species.

7. Temperature

- **Indicators:**
    - Monthly average temperature.
    - Seasonal average temperature.
    - Length of heatwaves.
    - Number of hot days.
    - Number of cold days.
    - Winter temperature extremes.

8. Precipitation

- **Indicators:**
    - Average seasonal precipitation.
    - Length of dry periods in summer and autumn.
    - Number of heavy rainfall days.
    - Winter rainfall.

9. Snow

- **Indicators:**
    - Duration of permanent snow cover.
    - Start date of permanent snow cover.
    - Disappearance date of permanent snow cover.
    - Annual maximum snow depth.

10. Wind

- **Indicators:**
    - Average wind speed by season.
    - Number of windy days.

11. Saami Health and Wellbeing

- **Indicators:**
    - Health impacts of heatwaves.
    - Prevalence of allergies and asthma.
    - Pollen.
    - Air quality.
    - Vector-borne diseases.
    - Accidents due to environmental conditions in reindeer herding.
    - Life satisfaction and well-being.
    - Causes of death.

12. Infrastructure

- **Indicators:**
    - Green transition.
    - Impact areas of wind and solar power plants.
    - Other green transition impact areas (e.g., power lines).

13. Adaptation and Mitigation Measures

- **Indicators:**
    - Resourcing and costs of climate actions and adaptation measures.
    - Climate justice.
    - Climate resilience.

Recommendations

The PRESAAMI2 project recommends that the Saami Climate Council initiate a follow-up project to develop and implement these indicators.

This summary outlines the proposed system for monitoring climate change impacts on Saami culture, emphasizing the need for collaboration, detailed planning, and integration of traditional knowledge.

Future of Saami Culture in a Changing Climate

Influencing Factors

The future of Saami culture is influenced by:

1. Internal factors within the Saami community and population.
2. Climate change.
3. Societal measures.
4. Global climate policy and actions.
5. World political situation.
6. Opportunities for practicing traditional livelihoods.

Key Determinants for Saami Culture's Future

- **Population Stability**: Ensuring the Saami population remains or returns to the homeland.
- **Reindeer Herding**: Preservation and development of reindeer herding.
- **Future Outlook**: Maintaining hope and confidence in the future.
- **Traditional Livelihoods**: Securing conditions for practicing traditional Saami livelihoods.
- **Traditional Knowledge**: Teaching, recording, and transferring traditional Saami knowledge.
- **Global Climate Mitigation**: Effective global climate change mitigation.
- **Local Impact Awareness**: Understanding and anticipating local climate impacts seasonally.
- **Legislation and Support**: Incorporating climate mitigation and adaptation into reindeer herding laws and support systems.
- **Fair Green Transition**: Ensuring the green transition is fair for Saami culture and rights.
- **Lifestyle Preservation**: Maintaining the Saami way of life.
- **Homeland Vitality**: Ensuring the vitality of the Saami homeland.

- **Cultural Transmission**: Supporting natural meeting places and cultural knowledge transfer.
- **Improving Rights**: Enhancing the legal status of Saami people.
- **Ending Discrimination**: Eliminating discrimination against Saami people.
- **Collaborative Knowledge Production**: Systematic climate change monitoring with traditional knowledge holders.

Climate Change Impacts

- **Traditional Livelihoods**: Climate change will increasingly challenge traditional livelihoods due to changing conditions and rising average temperatures, especially in winter.
- **Summer Impacts**: Changes in summer temperatures, precipitation, and drought will affect mountain nature.
- **Policy Success**: Future climate changes depend heavily on the success of climate policies. Current global efforts aim for moderate emissions scenarios.

Critical Thresholds

- **Tipping Points**: Critical thresholds in the climate system can cause significant and irreversible changes. For example, the potential slowing or stopping of the Atlantic Meridional Overturning Circulation could drastically lower winter temperatures in Finland.

Traditional Knowledge Holders' Concerns

- **Environmental Changes**: Concerns about significant environmental changes, such as the potential cessation of the Gulf Stream.
- **Future Scenarios**: Worries about future scenarios and their impacts on younger generations.

Vegetation Changes

- **Mountain Vegetation**: Mountain vegetation types will change, affecting reindeer grazing and berry yields. Boreal species may move northward, leading to vegetation homogenization and reduced food availability for reindeer.

Population Trends

- **Declining Birth Rates**: Saami population may decrease due to declining birth rates, following Finland's overall demographic trends.
- **Urban Saami Culture**: Increasing numbers of Saami people living outside the homeland, leading to the emergence of urban Saami culture.
- **Future Projections**: By 2070, the number of Saami children may significantly decrease, impacting adaptation to climate change.

This summary highlights the multifaceted challenges and considerations for the future of Saami culture in the face of climate change, emphasizing the importance of population stability, traditional livelihoods, and effective climate policies.

Future of Saami Culture in a Changing Climate

Key Factors

The future of Saami culture is influenced by:

1. **Internal Community Factors**: The choices and living locations of Saami children and youth.
2. **Climate Change**: Ongoing changes in climate conditions.
3. **Societal Measures**: Support and opportunities provided by society.
4. **Global Climate Policy**: Effectiveness of global climate actions.
5. **World Political Situation**: Geopolitical stability and its impacts.
6. **Traditional Livelihoods**: Opportunities to practice traditional Saami livelihoods.

Critical Elements for Saami Culture's Future

- **Population Stability**: Ensuring Saami children and youth remain or return to the homeland.
- **Reindeer Herding**: Preservation and development of reindeer herding as it is integral to Saami culture.
- **Positive Outlook**: Breaking the cycle of negativity and fostering hope for the future.
- **Support for Youth**: Providing societal support and opportunities for Saami youth to maintain their culture.

- **Traditional Knowledge**: Teaching, recording, and transferring traditional Saami knowledge.
- **Climate Mitigation**: Effective global climate change mitigation.
- **Local Impact Awareness**: Understanding and anticipating local climate impacts.
- **Legislation and Support**: Incorporating climate adaptation and mitigation into reindeer herding laws and support systems.
- **Fair Green Transition**: Ensuring the green transition is fair for Saami culture and rights.
- **Cultural Transmission**: Supporting natural meeting places and cultural knowledge transfer.
- **Improving Rights**: Enhancing the legal status of Saami people.
- **Ending Discrimination**: Eliminating discrimination against Saami people.
- **Collaborative Knowledge Production**: Systematic climate change monitoring with traditional knowledge holders.

Challenges and Adaptation

- **Climate Change Impacts**: Increasing challenges for traditional livelihoods due to changing conditions and rising temperatures.
- **Vegetation Changes**: Changes in mountain vegetation affecting reindeer grazing and berry yields.
- **Population Trends**: Declining birth rates and the emergence of urban Saami culture.
- **Health and Well-being**: Saami health will align with the general population, but traditional livelihoods are crucial for well-being.
- **Accident Risks**: Traditional livelihoods will continue to have accident risks, but technology can help mitigate these.

Societal and Economic Factors

- **Support for Reindeer Herding**: Ensuring the sustainability and profitability of reindeer herding.
- **Market Dynamics**: The demand for reindeer meat and its market image.

- **Technological Advancements**: Developing environmentally friendly fuels and reducing the carbon footprint of reindeer herding.

Community Perspectives

- **Positive Outlook**: Encouraging a positive outlook and breaking the cycle of negativity.
- **Historical Resilience**: Recognizing past resilience in the face of challenges.
- **Future Generations**: Ensuring that future generations have the opportunity to maintain and develop Saami culture.

This summary highlights the multifaceted challenges and considerations for the future of Saami culture in the face of climate change, emphasizing the importance of population stability, traditional livelihoods, and effective climate policies.

Reindeer Herding Scenarios

The TUNDRA project outlines four future scenarios for reindeer herding:

1. **Traditional Herding**: Maintaining traditional practices.
2. **Variable Herding Methods**: Adapting various herding techniques.
3. **Pasture-Based Livestock Farming**: Integrating reindeer herding with other livestock practices.
4. **Reindeer Farming**: Intensive reindeer farming.

These scenarios consider the impacts of competing land use and climate change. Future reindeer herding models in the Saami homeland will likely include:

- **Merging Herding Cooperatives**: Due to climate mitigation efforts and a declining population, herding cooperatives may merge and boundaries may change.
- **Partial Winter Enclosure**: Sustainable and successful as it is less dependent on natural pastures.
- **Tourism-Oriented Herding**: Expanding due to additional income from tourism services.
- **Supplementary Feeding and Technology**: Adaptable to climate change but costly.
- **Natural Pasture-Based Herding**: Most vulnerable to climate change.

Fishing Culture

- **Sensitive to Environmental Changes**: Fishing will continue but in different forms, focusing on spring-spawning fish.
- **Challenges for Commercial Fishing**: Increasing difficulties, especially for ice fishing.
- **Salmon Fishing**: Dependent on controlling temperature rise to preserve the culture.

Other Traditional Practices

- **Handicrafts**: Not directly threatened by climate change but affected through impacts on traditional livelihoods.
- **Hunting**: Moose and ptarmigan hunting will likely remain possible.

Need for Anticipation and Planning

- **Proactive Measures**: Necessary to ensure the continuity of Saami culture, especially given the low number of children and youth in the homeland.
- **Future Workshops**: Suggested to explore different future scenarios and paths for Saami culture, involving traditional knowledge holders and researchers.

Concerns and Solutions

- **Worries About the Future**: Traditional knowledge holders are concerned but lack resources to find solutions.
- **Support for Traditional Livelihoods**: Essential for maintaining Saami well-being and culture.
- **Climate Council's Role**: Could coordinate efforts to secure a better future for Saami culture.

This summary highlights the various future scenarios for reindeer herding and the broader Saami culture, emphasizing the need for proactive planning and support to adapt to climate change and preserve traditional practices.

Summary

This project compiles key and recent research findings on the living conditions of the Saami people and the impacts of climate change, providing a knowledge base for the Saami Climate Council. The conclusions are based on scientific data, climate models, and traditional Saami knowledge.

Key Findings

- **Climate Change**: The Saami homeland has warmed by 2-3°C over the past 60 years, with winters warming the most. Precipitation has increased, especially in winter and spring, while summer and autumn show no clear changes.
- **Wind Patterns**: No significant annual changes in wind speed, but spring winds have strengthened. Changes in wind direction vary by season.
- **Traditional Knowledge**: Saami knowledge holders have observed increased windiness and changes in temperature and precipitation, aligning with scientific findings.

Research Gaps

- **Extreme Weather**: Further research is needed on the occurrence of extreme winds and storms.
- **Justice and Indigenous Rights**: The project did not address the justice impacts of climate change on Saami indigenous status. Further studies are needed to understand the implications for human rights treaties.

Reindeer Herding

- **Challenges**: Local and regional studies exist, but systematic monitoring is lacking. The decline in reindeer herders and owners, combined with climate change, necessitates a reevaluation of herding boundaries and practices.
- **Future**: Reindeer herding impacts vegetation and climate mitigation. Sustainable grazing practices can help maintain open mountain landscapes and mitigate climate change effects.

Methodology

- **Effective Approach**: The SAAMI project's methodology, involving interviews with Saami knowledge holders, has been effective in gathering new information. This approach should be used in future monitoring studies to create reliable time series and track climate change impacts.

Recommendations

- **Collaborative Efforts**: Cooperation between herders, researchers, and administrators is essential to develop grazing systems that respond to climate-induced vegetation changes.

- **Future Planning**: Proactive measures and planning are needed to ensure the continuity of Saami culture, especially given the low number of children and youth in the homeland.

This summary emphasizes the importance of integrating traditional knowledge with scientific research to understand and address the impacts of climate change on the Saami people and their culture.

Observations and Adaptation

- **Traditional Knowledge**: Saami knowledge holders have observed climate and environmental changes since the 1990s and adapted their livelihoods without societal support.
- **Combining Knowledge**: Integrating traditional Saami observations with scientific research can provide new insights into the cultural and economic impacts of climate change.

Legislative and Structural Challenges

- **Lack of Support**: Current legislation and administration do not adequately support the adaptation and mitigation of climate change impacts on traditional Saami livelihoods.
- **Cultural Threats**: The endangered state of Saami culture hampers their ability to adapt to climate change in a culturally appropriate manner.

Future Research Needs

- **Extreme Weather**: Identifying the occurrence of extreme weather events (heavy rains, storms, wind gusts, extreme temperature fluctuations) reported by Saami knowledge holders.
- **Health and Well-being**: Comprehensive research on Saami health and well-being is lacking.
- **Indicators**: Developing indicators to monitor climate change impacts and update the Saami Climate Council's knowledge base.

Reindeer Herding

- **Pressure to Change**: Climate change is exerting pressure to alter reindeer herding models. Monitoring these changes is crucial for understanding adaptation progress.

- **Economic Viability**: Ensuring the sustainability and profitability of reindeer herding is essential.

Data Integration and Research

- **Effective Research**: Emphasizing impactful research that increases awareness and benefits climate action development.
- **Knowledge Database**: Creating a database for the Saami Climate Council to update research findings and traditional observations, ensuring up-to-date and accessible information.

Recommendations

- **Collaborative Efforts**: Cooperation among various stakeholders, including traditional knowledge holders, is necessary for developing and implementing indicators.
- **Proactive Measures**: Planning and proactive measures are needed to ensure the continuity of Saami culture, especially given the low number of children and youth in the homeland.

This summary highlights the importance of integrating traditional knowledge with scientific research, addressing legislative and structural challenges, and ensuring proactive measures for the future of Saami culture in the face of climate change.