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Exploring the land-use futures related to reindeer herding in Finland through “wild logic” scenarios

Simo Sarkki^{a,b,c}, Sirpa Rasmus^{b,d}, Joachim Otto Habeck^e, Heidrun Matthes^f,
Mia Pihlajamäki^{g,h} and Jussi T. Eronen^{i,j}

^aCultural Anthropology, University of Oulu, Oulu, Finland; ^bArctic Centre, University of Lapland, Rovaniemi, Finland; ^cMax Weber Centre for Advanced Cultural and Social Studies, Erfurt University, Erfurt, Germany; ^dEcosystems and Environment Research Programme, Faculty of Biological and Environmental Sciences, University of Helsinki, Helsinki, Finland; ^eInstitute for Social and Cultural Anthropology, University of Hamburg, Hamburg, Germany; ^fAlfred Wegener Institute Helmholtz Center for Polar and Marine Research, Potsdam, Germany; ^gWater and Development Research Group, Aalto University, Espoo, Finland; ^hNatural Resources Institute Finland, Helsinki, Finland; ⁱEcosystems and Environment Research Programme & Helsinki Institute of Sustainability Science (HELSUS), Faculty of Biological and Environmental Sciences, University of Helsinki, Helsinki, Finland; ^jBIOS Research Unit, Helsinki, Finland

ABSTRACT

Anticipating futures can inform today's decisions. However, existing scenario approaches need systemic methods to diversify the established storylines and to incorporate surprises. We propose a ‘wild logic’ scenario method, which is informed by participatory work and combines logic from exploratory scenarios with assumptions on governance modes. We apply the proposed method to a case of reindeer herding in Finland, building on Shared Socioeconomic Pathway (SSP) storylines and three assumptions on hierarchical, collaborative and affirmative governance. Our main result is an SSP – governance assumption matrix consisting of 10 storylines with divergent implications on land use and social equity for reindeer herders. Our approach was able to produce novel aspects that expand on existing scenario work in the Arctic, especially by addressing affirmative governance. The method is also applicable beyond the Arctic contexts, and can be combined with other than SSP exploratory scenarios, and with other than governance-related assumptions.

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1. Introduction

The future is unknown. However, the better we can anticipate future developments, the more informed decisions we can make today to cope with those futures (Muiderman et al., 2023; Quay, 2010). Scenario methods have been developed to address the challenge of the unknown future (Cordova-Pozo & Rouwette, 2023). Exploratory scenarios are a widely used method to describe how uncertain futures may unfold (Ariza-Álvarez et al., 2023; Avin & Amp,

CONTACT Simo Sarkki  simo.sarkki@oulu.fi  Cultural Anthropology, University of Oulu, Pentti Kaiteran katu 1, Oulu 90570, Finland

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2020; van Vuuren et al., 2012). However, the diversity and innovativeness of existing exploratory scenarios is a challenging topic. This is highlighted by the frequent occurrence of scenarios that fall within so-called scenario archetypes (Harrison et al., 2019; Hunt et al., 2012; Sitas et al., 2019). Examples of commonly used scenario archetypes are: Global and regional sustainability; Economic optimism; Inequality; Regional competition; and Business as usual (e.g. van Vuuren et al., 2012). One way to diversify the scenario field is to develop systemic methods to create variation and divergence within the established narratives (see O'Neill et al., 2020). To add surprising elements, scenario work has come to use concepts such as 'wild cards' representing unlikely but highly influential events (Ebi et al., 2014; Hauptman & Steinmüller, 2018; Mendonça et al., 2004), and 'black swans' conceptualized as high-profile, hard-to-predict, and rare events (Taleb, 2008). Another recent trend has been to use insights from fiction to enhance imaginative aspects of scenarios (Braun et al., 2024; Burnam-Fink, 2015). Both modelling and fiction are practices of telling plausible 'what if' stories of future worlds (van Beek & Versteeg, 2023). Climate fiction could complement or inform the SSPs through the consideration of different human motivations in relation to climate change, the impact of taken-for-granted structural conditions, and the possibility of radically different futures (Nikoleris et al., 2017). In sum, the scenario field is currently seeking ways to diversify the established narratives and to find innovative ways to include an element of surprise in the scenario narratives. To answer these challenges, we propose and illustrate a scenario building method called 'wild logic'.

The focus of wild logic is similar to that of the wild cards concept in that both seek to push the boundaries of conventional thinking and challenge assumptions on established trends. However, by providing plausible boundaries of future worlds within which different kinds of events may occur, wild logic seeks to overcome some of the limitations of wild cards, in particular their focus on single events that can lead to issues about relevance and engagement or overshadow more likely scenarios. Thus, while the wild card refers only to a single event, the wild logic scenarios are about contextual situations, boundaries of future worlds that can lead to unexpected, or even unimaginable surprises. The 'wild' complexifies the logic of exploratory scenarios by bumping the scenarios systematically against the wild assumptions, and by proposing a new matrix logic combining exploratory scenario narratives with wild assumptions that further specify and diversify established future narratives (Figure 1).

Wild logic scenarios can be formulated based on three general components: existing scenario narratives applied to the system under examination, wild assumptions (e.g. on different governance modes, such as hierarchical, collaborative and affirmative governance), and the specific system to be addressed (e.g. the operational environment for reindeer herding). The logic part of our framework derives from the scenario archetypes. The scenario logic seeks to establish internal consistency between the various statements and assumptions that underpin a storyline (Rounsevell & Metzger, 2010). The wild part links to innovative design and use of wild assumptions in specific context that cover uncharted areas left blank by existing exploratory scenarios. Furthermore, the 'wild' implies going beyond the habitual imagination of the participatory future workshop participants: it is a structured way to imagine futures.

We employ the well-known Shared Socioeconomic Pathway (SSP) narratives (Foster, 2020; Riahi et al., 2017) as examples of scenario archetypes (Pedde et al., 2019). The SSP set includes five societal narratives, each of which can be linked to climate pathways: SSP 1:

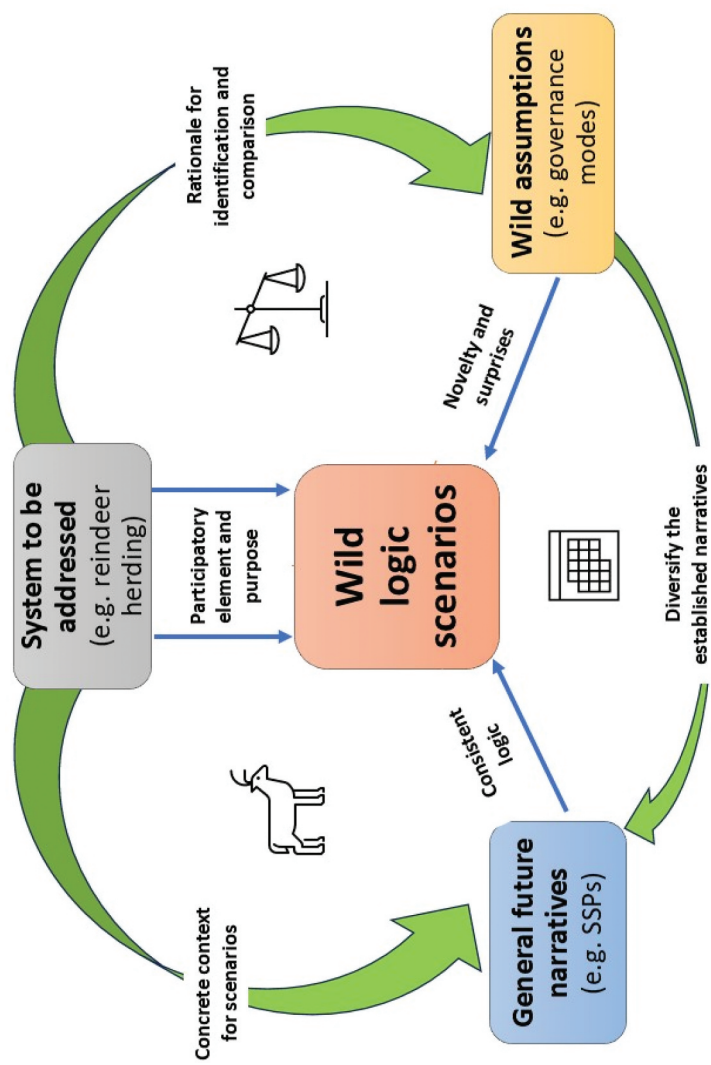


Figure 1. Wild logic scenario framework.

Sustainability (Taking the Green Road); SSP 2: Business-As-Usual (Middle of the Road); SSP 3: Regional Rivalry (A Rocky Road); SSP 4: Inequality (A Road Divided); and SSP 5: Fossil-Fuelled Development (Taking the Highway) (O'Neill et al., 2017; Riahi et al., 2017). The general narrative SSP pathways are developed into scenarios for example by down-scaling or applying the SSPs in a specific context, for example by participatory methods (e.g. Petzold et al., 2024). The SSP narratives offer an established and consistent logic for the more specific wild logic scenarios.

We employ three wild assumptions linked to governance: hierarchical, collaborative and affirmative governance modes. These have been applied to diversify the SSP 1 in the context of reindeer herding (Sarkki et al., 2023), but not in the context of other SSPs. While the wild assumptions may link to the type of future technological development and innovations, politics, demography, cultural change and environmental change, we focus on governance. SSPs include some assumptions on governance-related issues (O'Neill et al., 2017), and governance aspects have also been globally modelled in connection to SSPs (Andrijevic et al., 2020). While such global models are important, they tend to assume a rather unified governance approach within each SSP. For diversifying the SSPs, we propose the wild logic scenario approach, which integrates SSPs with wild assumptions, in our study, specifically those related to land use governance.

Reindeer herding functions here as a case study for building wild logic scenarios. The analysis presented in this paper is largely based on a participatory 'futures' workshop with reindeer herders in Inari 2022 (see Rasmus et al., 2023; Wang et al., 2025). The case of reindeer herding connects to the ways by which land use, nature conservation and climate change and their governance influence Indigenous Peoples' and Local Communities' (IPLC) nature-based livelihoods, which are dependent on seasonal weather conditions and the availability and state of natural environments. Thereby, such livelihoods are affected by governance at various levels, including local, national, regional (e.g. Arctic, European Union), and even global ones. Moreover, participatory approaches are required to elicit the links between the global and the local, thereby acknowledging land users' life-worlds and values (Nilsson et al., 2017). The reindeer herding livelihood acts as a case study to build wild logic scenarios. The case represents a situation where the dynamics of different SSPs come together, and where land use governance functions as a crucial medium in efforts to find ways to reconcile divergent objectives and aspirations connected to land in the north.

The objective of the present article is to introduce and employ the wild logic scenario building approach to obtain insights at the local level through the case of reindeer herding, which can inform wider debates on the ways to anticipate plausible future dynamics applicable also beyond the case study. Our research questions are:

- (1) How can the wild logic scenario framework be applied to the case of reindeer herding? Question 1 is divided into the following four sub-questions:
 - (a) What are the key elements in the operational environment of reindeer herding and their interlinkages?
 - (b) How is such an operational environment changing under different SSPs?
 - (c) What are the relevant wild governance assumptions that can be used in combination with SSPs to explore socially equitable land use for reindeer herding?
 - (d) What kind of wild logic scenarios can be built based on the questions 2a, 2b, & 2c?

- (2) What are the novelties, limitations and plausible future applications for the proposed wild logic scenario framework?

2. Material and methods

2.1. Background for the case study

Reindeer herding provides a case of a livelihood practiced by numerous Indigenous Peoples and Local Communities (IPLC) in the Arctic. The importance of recognizing IPLCs' rights has been stressed in recent discussions on socio-environmental futures (IPBES et al., 2019; Armitage et al., 2020; Schröter et al. 2023). While IPLCs do not automatically and necessarily pursue livelihoods in a sustainable way and are not necessarily in harmony with nature, their mode of resource use implies a high degree of dependence on sustainability – and simultaneously a high degree of awareness of sustainability (e.g. Nitah, 2021).

Specifically, our case is reindeer herding in Finland, where both Indigenous Sámi people and ethnic Finns practice herding as a culturally and economically important livelihood (Sarkki et al., 2021). Herding is part of Sámi ethnic identity and way of life across northern Finland, Sweden and Norway (Horstkotte et al., 2022), and the Kola Peninsula of Russia. The reindeer management area in Finland is divided into 54 Reindeer Herding Cooperatives (RHCs), making up one-third of Finland's territory. The livelihood is practiced also in more than 40 RHCs south of what in Finland is administratively designated as the Sámi Homeland Area (Figure 2).

Land use competition is challenging the continuity of reindeer herding, which has traditionally relied on natural pastures in large geographic areas (Horstkotte et al., 2022). As Stoessel et al. (2022) have shown, 85% of the Fennoscandian reindeer herding area is affected by at least one land-use pressure and 60% is affected by multiple land-use pressures (e.g. mining, forestry, wind energy, nature conservation, tourism). Land use change co-occurs with challenges such as increasing predator presence and climate change, which is faster in the Arctic than the global average (Rantanen et al., 2022). Climate, land-use pressures and herding practices vary between the RHCs. However, in the present article we consider the reindeer management area as a whole.

2.2. 'Futures' workshop with reindeer herders and analysis

We arranged a participatory 'futures' workshop with reindeer herders in Inari, northern Finland, in 2022 (Figure 2). The workshop was attended by 27 herders and other actors linked to reindeer herding (for a summary, see Rasmus et al., 2023; for an outline of the workshop method, see; Wang et al., 2025). The groups were formed by the organizers to increase the diversity of the participants' backgrounds in each group. A total of 36 people, of which 9 were organizers, participated in the workshop. The proper participants represented seven reindeer herding cooperatives and the Municipality of Inari, the Regional State Administrative Agency for Lapland, the Lapland University of Applied Sciences, the Natural Resources Centre (LUKE), the Central Union of Agricultural Producers and Forest Owners (MTK), Reindeer Herders' Association, the Sámi Parliament (Sámediggi), the Sámi Reindeer Herding Cooperatives (Sámi bálgosat rs) and Suoma Boazosámit rs. The



Figure 2. The reindeer management area and the relevant administrative borders in Finland, and Inari, the location of the workshop. Map: Philip Burgess.

participants were divided into groups and seated at four tables. The workshop included three sessions conducted in four breakout groups and the scenario analysis was conducted in four steps (Table 1).

The workshop results were documented by 1) participants' direct inputs in the form of prioritized elements of the operational environment of reindeer herding, 2) cognitive maps drawn by participants, 3) post-it notes that participants wrote in the workshop, and 4) notes taken in each breakout group by a dedicated secretary.

Table 1. Three workshop sessions and four analytical steps.

Session and step	Description
Session 1	<p>Prioritizing elements and building cognitive maps on the operational environment of reindeer herding</p> <p>In Session 1, the participants identified the operational environment of herding (i.e. the conditions and dynamics that shape the activities of the reindeer herding system) by prioritizing predefined elements ($N=50$). Based on our previous extensive research and literature on the reindeer herding livelihood, we selected 50 predefined elements from a longer list to keep the number of variables manageable and presented them to the participants on cards. The elements related to 1) Pastures and land use, 2) Reindeer herding and reindeer herders, 3) Climate, the environment, reindeer, and 4) Economy, market, society and governance. Participants also made use of the possibility of proposing new elements relevant for reindeer herding from their perspectives, adding them on provided blank cards. Each group prioritized around 20 elements that were linked to each other in a cognitive mapping exercise including arranging, grouping and linking the elements on a large sheet of paper.</p>
Analysis Step 1 (section 4.1)	<p>Identification of the operational environment of reindeer herding</p> <p>Analysis step 1 seeks to understand the system addressed by the scenario exercise. This is facilitated by cognitive mapping using a set of predefined elements, derived from literature reviews and explorative interviews. In our futures workshop with reindeer herders, of the 50 available elements, 10 were prioritised by all four breakout groups. In addition to the 10 priority elements, we then added eight elements, which were discussed in the workshop, but not prioritized by all groups. This was done with the explicit purpose of strengthening the connection to the SSPs. Cumulative land use impacts were discussed frequently in the workshop (Sessions 1 and 2), and land use governance was identified by several participants as the most critical element in the operational environment of reindeer herding for enhancing the continuity of the livelihood for future generations (Session 3). Hence, the eight additional elements included different land uses and actors influencing the land use. Together these 18 elements captured key pressures for change emerging externally and behaving differently across the SSP narratives. In addition, the priority element of well-being of herders was narrowed down to well-being resulting from opportunities of herders to influence (land-use) decisions concerning their livelihood. The interrelations and dynamics between the 10 priority elements are outlined also in a cognitive map produced by the authors (more details, see Rasmus et al., 2023, submitted) presenting a synthesis of the relationships between the elements based on the four cognitive maps constructed by the breakout groups, each with a distinct focus. The synthesis map combined these four focuses and included the aspect of cumulative land use impacts as a driver that influences the operational environment of reindeer herding in complex ways. The synthesis map also contains the most frequently identified livelihood-related dream – notably, the continuity of the livelihood, including the related identity and culture, to future generations. Whether and to what extent this dream can be realized, is a general outcome resulting from the dynamics in the operational environment of reindeer herding.</p>
Session 2	<p>Assessing how the operational environment changes with SSP-related “what if” questions</p> <p>In Session 2, each breakout group was assigned one ‘what if’ question. We asked the workshop participants to discuss: “what if” the green transition intensifies (linking to SSP 1); “what if” costs of feed and gasoline continue to rise because of the Russian war of aggression in Ukraine (SSP 3), and “what if” climate change will accelerate (SSP 5). The SSP 2 on business as usual was not discussed as it is considered that the current situation consists of a combination of all the other SSPs (Eronen et al., 2025). The SSP 4 on inequality was not explicitly discussed because it was considered to be included in the three abovementioned SSPs selected for discussion, and we used “what if” the COVID pandemic continues as the question for the fourth breakout group. The task of the groups was to discuss how these developments impact the dynamics of the operational environment, utilizing and modifying the cognitive maps they had constructed during the first session. Thus, in the second session, participants considered how the operational environment of reindeer herding is changing when following the “what if” questions linking to certain SSPs.</p>

(Continued)

Table 1. (Continued).

Session and step	Description
Analysis step 2 (section 4.2)	<p>Assessing how the operational environment of reindeer herding changes across SSPs</p> <p>In the workshop, SSP narratives were compressed into simple and manageable, yet extensive “what if” questions. The content of relevant workshop discussions was thematically analyzed to come up with descriptions of how the SSPs may play out in the North and how various developments may affect reindeer herding.</p>
Session 3	<p>Livelihood-related dreams and critical points in the operational environment</p> <p>In Session 3, the participants identified their individual dreams and aims related to reindeer herding and the most critical elements in the operational environment for the realization of these. This was done by asking each participant to identify a livelihood-related aim or dream and write it on a post-it note. After all participants had placed their dream descriptions on the cognitive map with an explanation, they marked the most critical point for the concretization of their dream on the cognitive map with a sticker. As a result, the cognitive maps showed interpretations of the operational environment of the livelihood, with impacts of pressures typical for each SSP considered, as well as the critical points for the realization of livelihood-related aims and dreams.</p>
Analysis Step 3 (Section 4.3)	<p>Identifying three wild governance assumptions</p> <p>Step 3 seeks to identify wild assumptions that are critical for the system to be addressed. In a participatory workshop format, this can be done by introducing individual dreams and aims related to the system addressed, and then asking the participants to identify the most critical variables in the system for the realization of their dreams. The wild assumptions are then built to reflect the critical points.</p> <p>In our reindeer herding example, land use governance was identified as the most critical aspect regarding the realization of the livelihood-relevant aims and dreams. To explore the land use governance further through the scenarios, we designed three wild governance assumptions, which diverge quite substantially from each other regarding how the reindeer herders’ rights are considered, and who are the key actors driving the land-use developments. The three governance assumptions consider hierarchical, collaborative and affirmative governance, which we presumed to reflect negative, middle-ground and positive options for social equity of land use for reindeer herders (Rasmus et al., submitted; Sarkki et al., 2023). The designation of these governance assumptions reflects the long-standing focus of reindeer research on participatory land use planning, or lack of it (see Raitio, 2008), and the idea that several small compromises with diverse land users gradually lead to significant cumulative impacts (Horstkotte et al., 2022), and that herders could be recognized as rights-holders instead of stakeholders (Sarkki et al., 2021).</p> <ul style="list-style-type: none">– Under the <i>hierarchical governance</i> assumption, herders’ opportunities to participate in land-use decisions is generally low.– In <i>collaborative governance</i>, herders are considered as stakeholders similar to other land users, such as forestry companies and organizations, tourism entrepreneurs, mining and wind power companies, and nature conservation agencies. Challenges relate to the need for herders to legally defend their interests among other land users, which requires a lot of resources – including time and expertise – but these resources are limited and not paid for. In addition, collaborative governance forces herders to make small compromises with several land users, gradually leading to significant cumulative land-use impacts on pastures.– <i>Affirmative governance</i> would recognize herders as rights-holders by arrangements that are targeted specifically to them (e.g. compensations, requirements for other land users to negotiate specifically with herders, identification of priority areas, etc).
Analysis step 4 (reported in section 3.4)	<p>Constructing the wild logic scenarios</p> <p>Step 4 seeks to build wild logic scenarios based on the above three steps. The skeletons for wild logic scenarios can then be built by developing a two-dimensional scenario matrix including using the chosen SSP narratives and the identified wild assumptions. For our reindeer herding example, we used 1) the four SSP scenario narratives enriched in the workshop, and 2) the three wild governance assumptions, resulting in 12 cells, each providing skeletons for individual wild logic scenarios. In the resulting matrix, two cells remained empty due to the incompatibility of the given governance assumption with the overall SSP logic of the respective SSP. Each wild logic scenario has distinct implications for reindeer herders and herding as a livelihood. The scenario contents were gained by considering how each scenario logic impacts the 18 key elements in the operational environment of reindeer herding that were identified in Step 1. The scenario dynamics were also informed by key relationships between land-use governance and the operational environment of reindeer herding identified in the first workshop session. As a result, we constructed 10 wild logic scenarios that are outlined in full in Appendix (A1-A10).</p>

Each breakout group was facilitated by a researcher, and there was also a secretary taking notes in each group. Detailed notes were analyzed after the workshop using applied thematic analysis (Creswell & Creswell, 2018); this included systematic reading, organizing the notes according to the main themes, and summarizing.

The divergence in workshop participants' perspectives was handled by ensuring individual inputs in each session and by encouraging respectful dialogue among participants. The individual inputs were discussed collectively in the groups. In general, our results do not require looking for consensus, but rather open up views that are based on the plurality of the workshop participants' perspectives.

3. Results

3.1. *The system: operational environment of reindeer herding*

Ten key elements for the operational environment of reindeer herding were prioritized in all groups in the workshop session 1, and these were complemented by eight elements to strengthen the focus on land-use governance and the connection to SSPs. The added elements are also based on the workshop discussions and are supported by some key references on the reindeer herding livelihood (Table 2). The relationships of the elements are synthesized in a cognitive map (Figure 3; see also Annex A0).

3.2. *The SSP scenario logics regarding reindeer herding*

Here we outline four scenario logics based on the workshop discussions on relevance of SSP narratives for reindeer herding.

Regarding SSP 1 (Sustainability: Taking the Green Road), it was recognized that the emphasis on moving away from fossil fuels with the green transition will create pressures for land use in the form of mining minerals needed for batteries, and in the form of renewable energy projects. It was also considered that in order to increase trust between herders and wind power companies, clear rules and regulations are needed that clarify and ensure herders' opportunities to get their voice heard in the planning of wind power parks. While it was recognized that protected areas usually benefit herding, it could also be possible that 'green thinking' would lead to calls to reduce reindeer numbers and establish protected areas which do not allow reindeer grazing. International tourism based on aviation could decrease with increasing pressures to mitigate climate change. This would negatively affect the markets for reindeer meat, where tourists play a significant role. SSP 1 could be beneficial for herders, if 'done right', including forest management and nature conservation in ways that would also be beneficial for reindeer herding.

Regarding SSP 3 (Regional Rivalry: A Rocky Road), the first finding was that the prices of gasoline and reindeer feed have grown due to the Russian war in Ukraine starting in 2022. This has caused additional costs for reindeer herders, thereby challenging the profitability of herding. On the one hand, it was also considered possible that the well-being of reindeer may be compromised (less money for supplementary feed, more expensive use of motorized vehicles). On the other hand, the war and its aftermath may increase the need for national self-sufficiency in food production and thereby increase the demand

Table 2. Eighteen key elements in the operational environment of reindeer herding with emphasis on land use and land-use governance. The 10 elements prioritized in the workshop exercise are marked in bold. The remaining eight elements were added to capture cumulative land use impacts, diverging across SSPs, by specific land uses and related actors (see analysis step 1).

Key elements in the reindeer herding system	Brief description	Supporting references
National legislation and reindeer herding	Legislation links to Indigenous Sámi rights, regulating reindeer numbers, and also providing a frame of reference for interactions and regulations targeting various land users in the North.	Kirchner and Frese (2016)
Forestry and reindeer herding	The majority of forests in the reindeer herding area are logged and managed by the state forestry enterprise Metsähallitus. Forestry often has negative impacts on reindeer pastures, but those can be at least partly mitigated through applying softer forestry methods.	Turunen et al. (2020)
Mining and reindeer herding	Mining has negative impacts on pastures, but those are often compensated for and can be mitigated by mining companies seeking social licence to operate. However, herders often remain marginalized when decisions about land use and mining are made.	H. Heikkinen et al. (2016)
Wind power and reindeer herding	Wind power is increasing in the North, and herders' possibilities to influence the situation or get compensation are often unclear even in Environmental Impact Assessment processes.	Nysten-Haarala et al. (2021)
Protected areas and reindeer herding	Protected areas offer good pastures for reindeer, unless they restrict reindeer grazing within the strictly protected areas. Predator-caused losses may also grow within and close to the protected areas.	Markkula et al. (2019)
Predators (wolf, lynx, wolverine, bear, golden eagle) and reindeer herding	Large carnivores eat and kill reindeer causing losses to reindeer herders. Predator problems are severe, especially in the eastern and southern reindeer herding area. Compensations are paid, but it is debated whether they are adequate to cover losses for herders	Rasmus, Kojola, et al. (2020)
Missing collaboration between land users	Land use conflicts and lack of collaboration have been part of land use governance in Finnish Lapland, and they have taken place especially between 1) herders, forestry and ENGOs, 2) mining companies, herders, and tourism entrepreneurs.	Sarkki et al. (2022); Komu (2020)
Well-being: (Ability of herders to make decisions concerning their lives)	In connection to land use, we employ the idea of herders' well-being as being connected to their ability to take part in land-use decisions affecting their livelihood.	H. I. Heikkinen et al. (2012)
Traditional knowledge; know-how and land use	Reindeer herders, especially Sámi, hold traditional knowledge and know-how on reindeer herding and northern nature. Yet, this knowledge has only recently started to be considered in land use decision-making, and is still not mainstreamed as part of the land use governance.	Markkula et al. (2019)
Communality among herders	Herding work includes communal activities related for example to collecting reindeer, slaughtering, and earmarking. There are 54 Reindeer Herding Cooperatives (RHC) in Finland, which arrange the herding work within the area of the RHC.	Kietäväinen and Tuulentie (2018)
Reindeer stock	The size and the welfare of reindeer stock forms the core of reindeer herders' income, and hence links to profitability. State regulates the maximum allowed number of reindeer.	Pekkarinen et al. (2020)
Profitability and costs of reindeer herding	Profitability of reindeer herding depends traditionally on selling meat. However, compensation and subsidies are currently also an important part of the herders' incomes. Supplementary feeding has been growing since the 1970s leading to additional costs, the necessity mainly caused by competing land use in the reindeer herding area.	Pekkarinen et al. (2020)

(Continued)

Table 2. (Continued).

Key elements in the reindeer herding system	Brief description	Supporting references
Winter pastures	The Finnish Reindeer Husbandry Act (848/1990) seeks to ensure that reindeer grazing does not exceed the carrying capacity of winter pastures. However, other land uses have significantly decreased winter pastures and thus grazing pressure focuses on fewer remaining pasture areas.	Turunen et al. (2020); Stoessel et al. (2022)
Pasture rotation	In Finland, reindeer use different summer and winter pastures, but within an area of single Reindeer Herding Cooperatives. Recently, Pasture Management Planning has been introduced as a tool to enhance pasture rotation.	Horstkotte et al. (2022)
Severe winter weather and snow conditions	Unusual winters (e.g. icing events, rain on snow, frozen or mouldy ground surface, very deep snow) affect the ability of reindeer to find forage on natural pastures. In 2019–2020 and 2021–2022, winter conditions were particularly difficult in Finland, causing significant losses.	Rasmus et al. 2020
Herders' resources for adaptation to climate change	Resources for adaptation to climate change is a key issue for the ability of herders to cope with future climate change and changing weather.	Laptander et al. (2024)
Civil society (ENGOS) and reindeer herding	The relationship between herders and Environmental Non-Governmental Organizations (ENGO) is ambiguous. On the one hand, herders may form coalitions with ENGOS to get more power in land-use discussions – even through conflict. On the other hand, ENGOS have argued against herding based on alleged overgrazing, negative impacts of herding on predator populations, and even by proposing to decrease the size of the reindeer herding area by moving its southern border northwards.	Sarkki et al. (2022)
Science and reindeer herding	State-funded natural science has often, especially in the past, considered reindeer as a threat to the fragile northern nature. Social science-oriented researchers address reindeer herding as keystone cultural and economically important northern livelihood, and as part of biocultural diversity in the Arctic.	Nyyssönen (2022)

for and the price of reindeer meat. The participants also referred to the nuclear accident in Chernobyl in 1986, which also impacted reindeer herding through the radioactive fallout on pastures and decreased the demand for reindeer meat.

Regarding SSP 4 (Inequality: A Road Divided), it was recognized from Indigenous Sámi perspectives that past centuries entailed a history of colonization of Sápmi (the homeland of Sámi), with one land-use project after another. Moreover, nature conservation, especially regarding large carnivores, was considered as unjust, even with existing compensation practices. The opportunities for local herders to participate in land-use related decisions was also discussed and considered as an important factor to increase trust and enhance co-existence of reindeer herding with other land uses.

Regarding SSP 5 (Fossil-Fuelled Development: Taking the Highway), the key threats were linked to extreme weather events, including icing of the snow cover, which makes it impossible for reindeer to access ground lichen during winter. Also, hot and dry summers as well as the increase of parasites and animal diseases were considered as potential future challenges. However, the key critical uncertainty of the future linked to climate change was the condition of pastures, which is likely to change most strongly under SSP 5

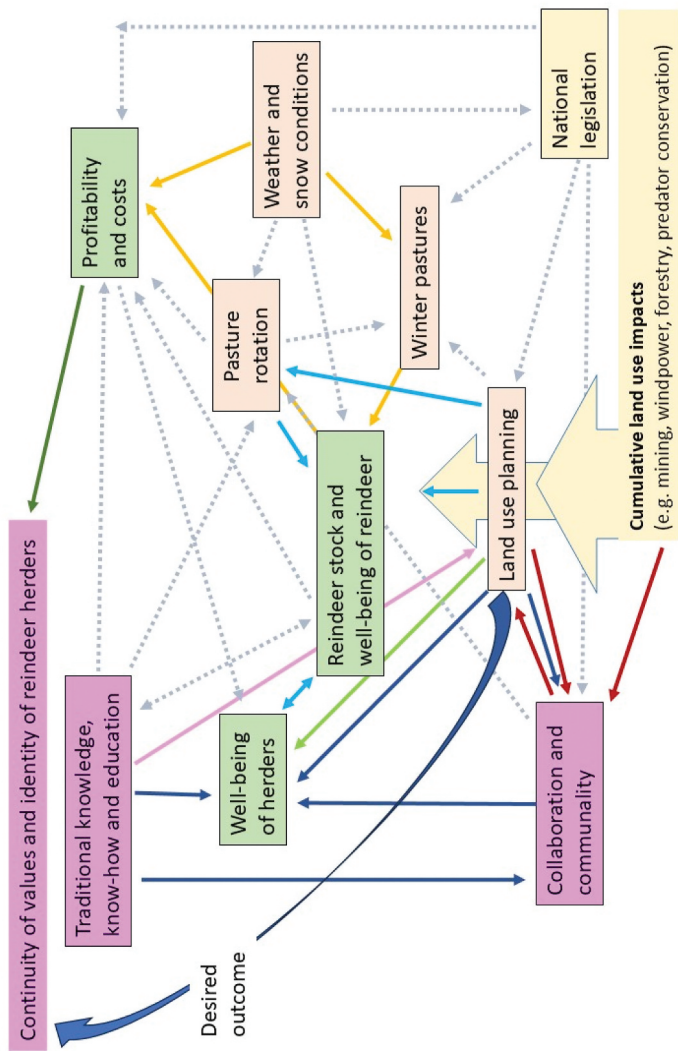


Figure 3. Synthesis of the four cognitive maps which were built during the ‘futures’ workshop with reindeer herders in Inari in 2022. The colour coding distinguishes between the elements representing the main focuses of the four breakout group discussions. Group 1 considered that the ‘soul of reindeer herding’ consists of values and identity, traditional knowledge, and communality among herders (purple boxes). Group 2 focused on interconnected well-being of reindeer and herders, and the link to profitability of the livelihood (green boxes). Group 3 targeted especially winter pastures, weather and snow conditions, pasture rotation, and land use planning (light orange boxes). Group 4 highlighted the importance of other competing land uses as a key challenge for reindeer herding (yellow boxes). The coloured feedbacks are reflecting key dynamics discussed in the workshop (see box 1); light grey dashed arrows are other important feedbacks, but not part of the key dynamics. Details: Rasmus et al. (2023).

in particular. Establishment of a catastrophe fund was discussed as one instrument to enhance adaptation to climate change. It was also considered that reindeer behaviour may change due to climate change and make it difficult for herders to anticipate the needed herding activities (e.g. natural pasture rotation; reproductive behaviour).

One of the major findings of the workshop was that the current situation includes aspects of all the SSPs, which may also produce cumulative impacts. For example, it was considered that the high price of supplementary feed and gasoline together with impacts of climate change – increasing the need for supplementary feeding – may lead to a vicious cycle whereby profitability of reindeer herding will be severely compromised. Moreover, the Russian aggression in Ukraine may lead to further needs in Finland to enhance national self-sufficiency in material and energy production, increasing land-use pressures also in the reindeer herding area. Furthermore, the increase of other land uses was considered to make adaptation to climate change more difficult, for it reduces herders' flexibility to use available natural pastures needed during adverse weather and snow conditions.

3.3. *Three wild governance assumptions*

The key finding from the workshop was that land use and related decision-making were the most often mentioned critical issue for the realization of various reindeer-herding related dreams and aims. Hence, we geared our scenario exercise around land-use governance. The livelihood- related dreams voiced by workshop participants were clustered into abstract long-term objectives and more concrete desirable futures. Long-term objectives were 'life without crises', and 'continuity of life with reindeer for future generations'. More concrete aims were 'importance of mitigating climate change', 'good condition of winter and summer pastures in the future', 'continuity of profitable reindeer herding for future generations', 'continuity of Sámi reindeer herding and traditions', and 'collaboration and good relationship between diverse land users'. Because of the critical role land-use related decision-making is playing in realization of these dreams and aims, we explore here the three governance assumptions especially from a land-use perspective (Box 1; Table 3).

Box 1. Three wild governance assumptions

- *Hierarchical governance* was reflected in the workshop as reindeer herders' considerations on difficulties to influence the decisions on other land uses, such as mining, forestry, and wind power, and also as concerns about 'green colonialism'. This compromises the social equity of land-use governance for herders. Thus, we considered the hierarchical governance as a negative option for herders – yet possibly not in every single regard, as will be explained below.
- *Collaborative governance* was brought up and reflected on in the workshop through the frustrating perception that it is always the reindeer herders who end up compromising their interests in negotiations with administration and other stakeholders, which leads to cumulative impacts emerging from several small compromises. In addition, concerns were raised about limited resources to participate in all the land-use planning meetings and environmental assessment procedures. We considered the collaborative governance mode as a middle option: notwithstanding the challenges mentioned, it includes possibilities for herders to influence the land-use governance.
- *Affirmative governance* was reflected in the workshop as hopes that reindeer herders' rights would not only be better recognized by administrations and other land users, but also implemented in concrete land-use practices. For example, it was considered that being granted the status as a rights-holder could enhance the leverage of herders in land-use negotiations. We considered the affirmative governance as a positive option as it seemed to respond to many concerns related to the need for additional respect towards herders and their way of life by land use governance decisions and actors (Table 2).

Table 3. Key aspects of three governance modes, detailing governance assumptions with examples from land-use governance.

Governance assumptions	Hierarchical governance	Collaborative governance	Affirmative governance
Definition	Hierarchical governance is characterized by the flow of decisions in a top-down manner, where the grassroots-level actors do not have much possibility to influence decisions. This can be manifested for example in policy (e.g. EU – national – subnational scale) relations, or within organizational structures used in businesses (Primmer et al., 2015).	Collaborative governance is based on consensus-seeking negotiations leading to compromises. These negotiations seek to include a wide array of diverse stakeholders. The problem in such collaborative arrangements is that they give more power to economic and big interest groups than to marginal actors (e.g. as is usually the case with IPLCs) (see Raitio, 2008).	Affirmative governance is characterized by decision-making which utilizes targeted approaches to alter power dynamics that have previously marginalized, excluded and even discriminated against certain actors, like IPLCs. Affirmative governance improves IPLCs' access to land and livelihood assets and enables previously excluded groups to participate in (land-use) decision-making concerning their lives (see Ribot & Larson, 2012).
Linkage to sustainable development	To enforce sustainable development	To leave no one behind from sustainable development	To reach first those furthest behind from current socio-economic development
How governance understands reindeer herders	As subjects to be governed	As stakeholders with whom to negotiate	As rights-holders whose rights need to be secured

3.4. The wild logic scenarios

Based on the previous steps, we constructed 10 wild logic scenarios for land use governance and reindeer herding in SSP – wild governance assumptions matrix (Table 4). There are two empty cells in the scenario matrix, because affirmative governance is not possible under SSP 4 (Inequality) due a marginal position of the herders in this SSP scenario. We also assume that in the SSP 5 scenario, hierarchical governance is not possible due to weak policy regulation assumed in this SSP.

Our scenario exercise shows that from among the three key governance assumptions, *affirmative governance* often seems to be the most favorable option across the SSPs for the reindeer herders. This is not very surprising since the affirmative governance mode explicitly considers IPLCs' and reindeer herders' rights. However, this finding can be complexified by some details of the scenarios. First, reindeer herders are not a homogenous group, and some scenarios are better for some herders than for others in scenarios under SSP 4 (Inequality), as illustrated by the narratives 'Policy for Elites' (Appendix A7) and 'Markets and Authenticity' (Appendix A8). Furthermore, divergences may also relate to owners of big reindeer herds in comparison to those with smaller herds. In the 'Fortress Europe' (Appendix A5) scenario EU agricultural policies would drive 'rationalization' of herding and subsidize only owners of a large number of reindeer, thus forcing small-scale herders to withdraw. An emphasis on big herds may also happen in the 'Engineering for Sustainability' (Appendix A9), where market competition and lack of regulation may eventually mean that large herds remain the only option for an economically viable livelihood. The reliance of RHCs on natural pastures in the northern

Table 4. Shared socioeconomic pathways (SSPs) (Riahi et al., 2017) and three wild governance assumptions (GAs) to explore the implications of scenarios for socially equitable land use for reindeer herders. The 10 scenario logics described in the table are outlined in more detail in appendix A1–A10, which also portrays relevant dynamics around the land-use governance (as identified by workshop participants).

	Governance Assumption 1: Hierarchical governance enforcing environmental goals	Governance Assumption 2: Collaborative governance to achieve intertwined environmental and equality goals	Governance Assumption 3: Affirmative governance to ensure IPLCs' rights
Shared Socio-economic Pathway (SSP)			
SSP 1: Sustainability: Taking the Green Road The world shifts toward a more sustainable path, emphasizing more inclusive development that respects perceived environmental boundaries.	'Half Earth': Global policy community agrees on the urgency of environmental problems and implements effectively hierarchical policies. Green colonialism overrides herders' perspectives. (Dynamics 11; 13)	'Sharing the Planet': It is considered that environmental goals cannot be achieved by top-down regulations and in isolation from social objectives. Reindeer herders are considered as stakeholders among other actors. (Dynamics 2; 6; 8; 9).	'Rights for Life': Rights of reindeer herders are considered to be best secured by affirmative governance arrangements, aiming at inclusion and endorsement of resource use in a renewable way. (Dynamics 2; 3; 14).
SSP 3: Regional Rivalry: A Rocky Road A resurgent nationalism, concerns about competitiveness and security, and regional conflicts push countries to increasingly focus on domestic or, at most, regional issues.	'Iron Hand for the Nation': EU weakens and strong national policies emerge to ensure self-sufficiency in energy, raw materials, and food. Concerns over geopolitical security are prioritized over environment and equity. Nation states support intensification of industrial land use leading to negative impacts on reindeer herding. (Dynamics 1; 5; 7; 9; 11).	'Fortress Europe': European self-sufficiency in energy, raw materials and food is secured. Strong EU and its Common Agricultural Policy lead to 'rationalisation' of agriculture and also reindeer herding, so that only owners of big herds remain and owners of smaller herds drop out. Herders' possibilities to influence decisions remain marginal. (Dynamics 4; 7; 12).	'Security by Social Equity': EU is guided by the principle of social equity, which is used as a tool to ensure cohesion, and as means to keep remote areas inhabited for geopolitical security. Reindeer herders are targeted by affirmative governance and reindeer are recognized as an important part of national food security. (Dynamics 1; 6; 12).
SSP 4: Inequality: A Road Divided Highly unequal investments in human capital, combined with increasing disparities in economic opportunity and political power, lead to increasing social stratification both across and within countries.	'Policies for Elites': Urban – rural divide deepens, and rural areas are used mainly as resource storages, and also as sites for nature conservation and tourism. Those rural actors engaged with industrialized land use (e.g. forestry, mining) or tourism are well-off, while other rural actors, like reindeer herders, are further marginalized. (Dynamics 4; 5; 11; 13).	'Markets and Authenticity': International 'elites' collaborate, and those worse off are left further behind. Reindeer herding is considered as a traditional Indigenous activity. However, only those Indigenous people practicing traditional livelihoods are properly recognized. (Dynamics 4; 9; 12).	Not considered (in this scenario IPLCs are in a marginal position)
SSP 5: Fossil-Fuelled Development: Taking the Highway Increasing faith in competitive markets, innovation and participatory societies to produce rapid technological progress and development of human capital as the path to sustainable development.	Not considered (this scenario suggests that economy is only weakly regulated)	'Engineering for Sustainability' Economic growth is highly fuelled by technological innovations, global markets, fossil fuels, and participatory society. There is a high interest in engineering ecological processes for the future. Whether reindeer herding will be part of those engineering solutions is a contested issue. (Dynamics 1; 7; 10).	'Compensations for Moral Relief' Policy makers decide to reserve significant funds for those suffering from climate change. Herders receive plenty of resources to adapt to the impacts of climate change and compensations from land users in the reindeer herding area. The key question for herders is if cultural change can be compensated for. (Dynamics 6; 8; 10; 12).

parts of reindeer herding area, and the widespread reliance of southern RHCs on supplementary feeding were envisaged as reflecting deepening divergences between the northern and the southern RHCs in the 'Markets for Authenticity' (Appendix A8) scenario.

Second, SSP 1 (Sustainability) and SSP 3 (Regional Rivalry) show very polarized outcomes for the social equity objectives between hierarchical and affirmative governance modes. If SSP 1 (Sustainability) is reached through top-down hierarchical governance, it may include some very negative elements for herders, but if sustainability is sought by affirmative governance, it would be a very good scenario for herders. Incidentally, the hierarchical 'Half Earth' (Appendix A1) scenario could have some positive outcomes for herders, but only if reindeer herding were to be considered as an integral part of northern nature and its biocultural diversity, instead of a threat to natural integrity (H. I. Heikkinen et al., 2012). In earlier scenario work considering Arctic IPLCs, reindeer grazing as a part of northern nature was recognized for example in the scenario called "Romanticism" (Lazariva et al., 2021). This scenario describes a future in which IPLC livelihoods and ecotourism flourish while other activities in the Arctic are banned. Reindeer herding as a human activity threatening the northern nature is a narrative strongly voiced in the 'Antarctic' scenario, envisioning the Arctic empty of all human activities, including reindeer herding (Haavisto et al., 2016).

The third finding is linked to collaborative governance, which can be regarded as generally positive for social equity objectives. Perhaps surprisingly, collaborative governance can also imply that when top-down regulation is missing, and affirmative governance is non-existent, the powerful players will overrun economically less privileged interest groups, like reindeer herders (Sarkki et al., 2021). Currently, there are some affirmative governance arrangements in place targeting herders (e.g. compensations; special negotiation practices between RHCs and the state forestry enterprise). Collaborative governance scenarios could result in downgrading those affirmative privileges that reindeer herders have already gained.

The fourth finding is related to controversial developments in SSP 5 (Fossil-Fuelled Development) accompanied by affirmative governance in the scenario of 'Compensations for Moral Relief' (Appendix A10). While continuity of traditional herding practices is likely to decline, the economy of herders may be improved. This is because it is assumed that SSP 5 includes market-based thinking, and the affirmative governance mode guarantees a widespread use of compensation for lost opportunities. Furthermore, the number of reindeer would not be limited by the government. This could lead to an increase in reindeer numbers and, thus, to improved profitability. Yet, this could also imply an increasing competition between herders and a decrease of communality and solidarity among herders. Furthermore, in the 'Compensations for Moral Relief' scenario, compensations would account for the majority of the herders' income instead of an income from selling meat. This would pose the question of whether cultural change (or loss) can be compensated for. In addition, in longer time scales, climate change would lead to increasing negative impacts, also on herders (Appendix A4).

Finally, Regional Rivalry (SSP 3) – although often considered as highly negative due to the geopolitical tensions and increasing competition associated with it – could have positive impacts on social equity of land use from the herders' perspective, but only if it

is accompanied by affirmative governance (e.g. the scenario of ‘Security by Social Equity’, Appendix A6). This is due to the emphasis on domestic food security and the aim of keeping remote areas inhabited for geopolitical reasons in SSP 3.

4. Discussion

4.1. Novelty of the scenarios on the Arctic

We formulated the wild logic approach and constructed 10 scenarios across four SSPs (1, 3, 4, 5). The key question is, are these scenarios describing novel future trajectories as a result of using the wild logic approach? To answer this question, we compare the 10 scenarios to previously published scenarios on the Arctic. We rely on A. Nilsson and Sarkki (2022), who typologized existing Arctic scenarios (Brigham, 2007; Burkhart et al., 2016; Erokhin & Rovenskaya, 2020; Haavisto et al., 2016; Lazariva et al., 2021; Loe et al., 2014), across the exploratory scenario archetypes. Nilsson & Sarkki (2022) also identified one additional archetypical scenario distinct for the Arctic: ‘the Frozen Development’, encompassing full protection of the Arctic, where Indigenous and local communities could thrive through their traditional nature-based livelihoods (‘Romanticism’, Lazariva et al., 2021), or could be totally excluded from using the Arctic lands and waters (‘Antarctic’, Haavisto et al., 2016). In addition, previous research has identified the ‘Half Earth’ and ‘Sharing the Planet’ scenarios (Immovilli & Kok, 2020), and the ‘Rights for Life’ scenario (Sarkki et al., 2023) in the nature conservation context.

Figure 4 situates the Arctic scenarios under the six archetypes, excluding the Business-As-Usual. In addition, our 10 scenarios built by the wild logic approach can be situated in relation to these scenario archetypes. This indicates that our analysis did not reveal fundamentally novel scenario archetypes. This can be explained by the use of SSP narratives as the underpinning scenario logics. However, our wild logic approach produced scenarios that expanded the existing scenarios within the archetypes. The following three findings were made (Figure 4): First, even though SSPs did not include the ‘Frozen Development’ scenario archetype, our scenario set also covered the ‘Frozen Development’ trajectory by the ‘Half Earth’ scenario. This further justifies the use of the ‘Frozen Development’ as a new scenario archetype specific for the Arctic.

Second, Figure 4 shows that the scenarios with the most novel aspects were based on the affirmative governance assumption (scenarios ‘Rights for Life’, ‘Security by Social Equity’, and ‘Compensations for Moral Relief’). This finding can be explained by the use of hierarchical and collaborative governance logics in previous scenario works. However, use of hierarchical and collaborative governance assumptions together with the affirmative governance assumption create interesting divergences between the built scenarios. This is especially relevant, when indigenous Sámi people and reindeer herders are increasingly arguing for better recognition of their rights, especially connected to land. Thus, using novel and even surprising wild assumptions (i.e. affirmative governance) together with more established assumptions on governance (i.e. hierarchical, collaborative) can help to build contrasting and imaginative scenario set on boundaries and dynamics of different types of future worlds. Hence, we consider that while our wild logic scenario building method is a new one, key emphasis in future work should be paid on the actual wild assumptions underpinning the scenarios. Elements of surprise can be

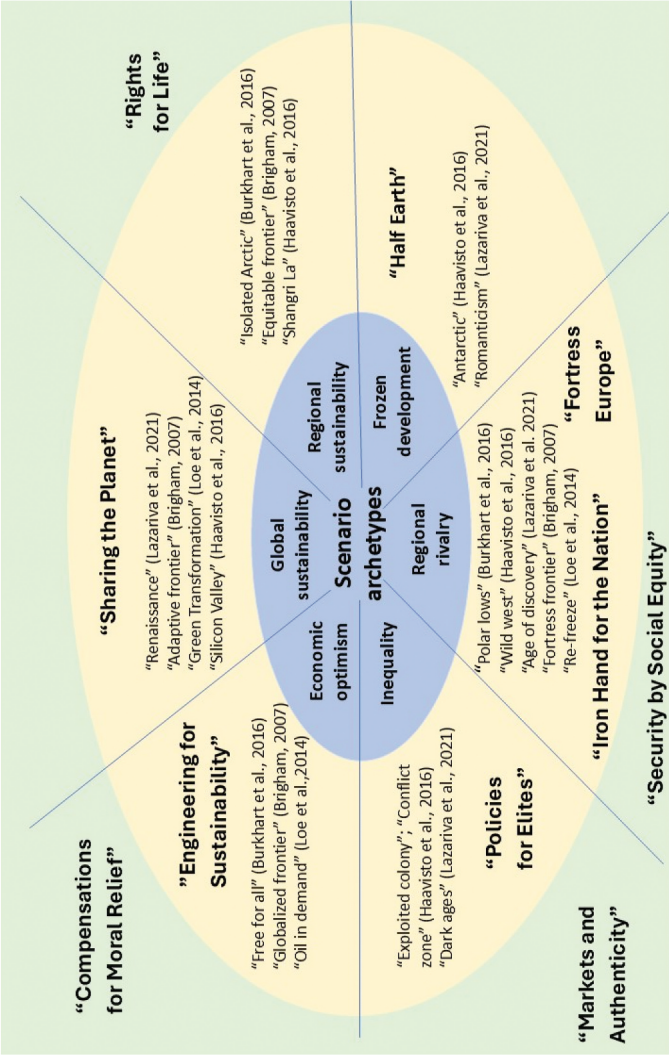


Figure 4. Arctic scenario archetypes with examples from previous scenario work on the Arctic. The blue circle includes the six scenario archetypes, with the archetype of 'frozen development' being specific for the Arctic (Nilsson & Sarkki, 2022). The yellow circle includes examples of Arctic scenarios clustered under the six archetypes. The green area represents novelty in comparison to previously published Arctic scenarios. Some of the 10 scenarios developed in the present article are located in the green area, especially those three using the affirmative governance as the key assumption. Also 'markets for authenticity' considers that some herders may gain advantages even in an unequal world (SSP 4), but may simultaneously result in a deepening divide between northern and southern RHCs. The other six scenarios built can be considered as variants of the previous scenario work on the Arctic.

designed into the scenario set by using imaginative and non-conventional assumptions on issues shaping future development trajectories, for example linked to governance. We consider that our comparative assessment on the plausible future implications based on hierarchical, collaborative and affirmative governance assumptions is powerful in that it can reveal major differences in existing common governance approaches and less used but robustly justifiable governance approaches (e.g. affirmative land use governance targeting indigenous peoples and local communities).

Third, 'Markets and Authenticity' was also considered as extending previous Arctic scenarios within the 'Inequality' (SSP 4) narrative. It reveals internal divergences within the reindeer herding livelihood. The divergence relates to what kind of reindeer herding is considered as 'authentic' by external actors (e.g. tourism actors; policy makers). Therefore, the inequality considered by SSP 4 links not only to regional inequality (and inequality between different types of stakeholders), but the 'Markets & Authenticity' scenario envisages inequality also within reindeer herding livelihood and its practitioners.

4.2. Limitations

We acknowledge three limitations in our approach: one is conceptual and the other is methodological, and third one relates to the diversity of participants at the workshop. The conceptual limitation derives from the use of SSP narratives as a basis for identifying scenario logics. The SSP narratives offer well-defined and widely accepted future logics, but the use of SSPs may also narrow the 'wildness' of the resulting scenarios. Alternative options include use of local or regional scenarios as a starting point, for example regarding the Arctic (Brigham, 2007; Burkhart et al., 2016; Erokhin & Rovenskaya, 2020; Haavisto et al., 2016; Lazariva et al., 2021; Loe et al., 2014). Yet, it has been found that many Arctic scenarios fall under existing scenario archetypes (Nilsson & Sarkki 2022), like the SSPs also (Pedde et al., 2019). This shows that identifying fundamentally new scenario archetypes is generally challenging.

The methodological limitation in our article is linked to lack of participatory validation of the final scenarios. Our four methodological steps to build wild logic scenarios utilized a participatory approach especially in the two first steps, based on which the wild governance assumptions were defined, and the systemic creation of the scenarios were conducted. Scenario work, and analysis on how the system works, often relies on empirical and participatory material, but also on extensive interpretation of the results after the participatory events (Edwards & Kok, 2021). The robustness of final scenarios is enhanced by participatory validation notably as part of step 4. Our wild governance assumptions were designed to address the identified critical issue of land use governance for herders, and use of SSPs as providing underpinning logics for scenarios proved to be relevant for herders in the workshop.

Third reflection relates to the diversity of workshop participants. The participants were mostly herders themselves or working in organizations connected to reindeer herding. If there had been only herders present, the discussions could have been even more practical concerning the everyday practice of the livelihood. However, after workshop the organizers have had discussions with herders, who generally thought that these kind of future workshops are very nice, but as a next step, they suggested to have workshops with stronger participation by policy actors to discuss the challenges and futures of reindeer herding with those who have actually power to make decisions.

4.3. Expanding the wild logic by further research

Further research is needed on the applicability of the wild logic scenario approach. Our application integrated SSPs logics with three wild governance assumptions. We can note that there are at least 10 more governance modes that could be used as a basis for governance assumptions (Sarkki et al., [submitted](#)). The use of governance assumptions in connection to SSPs was inspired by the recognized need to capture policy aspects that are not covered by the SSPs in scenario work, as done with the concept of Shared Policy Assumptions (Kriegler et al., 2014). For example, the SSPs cover well the climate-related policies, so making more assumptions related to the governance of climate may duplicate the focus and may lead to complications when constructing the scenario logic – wild assumption matrix. Even more importantly, the key assumptions need to be relevant to the empirical context that is addressed. For example, our use of wild governance assumptions derived from the major finding in the participatory ‘futures’ workshop with reindeer herders that land use governance is among the most crucial issues that may facilitate or hinder the realization of reindeer herders’ livelihood-related dreams and aims.

The wild assumptions can work individually, but also as a coherent set of assumptions that deliver divergent outcomes regarding the target of the scenario exercise. For example, in our case, we showed that the affirmative governance is likely to deliver better outcomes for herders than the hierarchical and collaborative governance. While this seems self-evident, the approach made it possible to see that even seemingly negative future worlds, like the one depicted by SSP 3 (Regional Rivalry), surprisingly appeared to include many positive elements for herders if combined with affirmative governance. Future studies using wild logic can benefit from using a set of wild assumptions that offer contrasting approaches to the examined topic, and can be used to illuminate meaningful differences between the assumptions. In such case, connection of the assumption to existing normative policy goals, such as the UN Sustainable Development Goals, makes the scenario exercise more policy-relevant. In our case, we considered the social equity of land use for reindeer herders. Social equity is addressed by SDG 10, and IPLCs’ rights in several ongoing discussions, such as in the Convention on Biological Diversity’s decision in 2024 to enhance the Indigenous representation in the biodiversity-related discussions.

Governance assumptions are only one way of constructing wild assumptions to create diversity and novelty within an established exploratory scenario set. Other possibilities regarding the commonly used drivers of change in scenario literature include, for example, assumptions on the type of technological development and innovation, cultural change, environmental changes, demographic changes, and economic developments. We consider that wild logic may be applicable also in the field of business and organizational studies, military and defence planning, urban and spatial planning, and policy studies.

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References

- Andrijevic, M., Crespo Cuaresma, J., Muttarak, R., & Schleussner, C.-F. (2020). Governance in socio-economic pathways and its role for future adaptive capacity. *Nature Sustainability*, 3(1), 35–41. <https://doi.org/10.1038/s41893-019-0405-0>
- Ariza-Álvarez, A., Soria-Lara, J.A., & Aguilera-Benavente, F. (2023). Re-thinking the role of exploratory scenarios for adaptive policymaking: An application for land use and transport planning. *Futures*, 149, 103139. <https://doi.org/10.1016/j.futures.2023.103139>
- Armitage, D., Mbatha, P., Muhl, E.-K., Rice, W., & Sowman, M. (2020). Governance principles for community-centered conservation in the post-2020 global biodiversity framework. *Conservation Science and Practice*, 2(2), e160. <https://doi.org/10.1111/csp2.160>
- Avin, U., & Amp, R.G. (2020). Using exploratory scenarios in planning practice. *Journal of the American Planning Association*, 86(4), 403–416. <https://doi.org/10.1080/01944363.2020.1746688>
- Braun, R., Lehane, O., & Lizarazu, M.R. (2024). Literary futures: Harnessing fiction for futures work. *Futures*, 158, 103348. <https://doi.org/10.1016/j.futures.2024.103348>
- Brigham, L.W. (2007). Thinking about the arctic's future. *The Futurist*, 41(5), 27–34. https://www.aspeninstitute.org/wp-content/uploads/files/content/docs/ee/Arctic_WSI_Thinking_About_Arctics_Future_Scenarios.pdf
- Burkhart, K., Seadas, T., & Wichmann, C. (2016). *Arctic, 2030: Planning for an uncertain future* (no. M-RCBG associate working paper series No. 57). Harvard Kennedy School. https://www.hks.harvard.edu/sites/default/files/centers/mrcbg/files/57_final.pdf
- Burnam-Fink, M. (2015). Creating narrative scenarios: Science fiction prototyping at emerge. *Futures*, 70, 48–55. <https://doi.org/10.1016/j.futures.2014.12.005>
- Cordova-Pozo, K., & Rouwette, E.A.J.A. (2023). Types of scenario planning and their effectiveness: A review of reviews. *Futures*, 149, 103153. <https://doi.org/10.1016/j.futures.2023.103153>
- Creswell, J.W., & Creswell, J.D. (2018). *Research design: Qualitative, quantitative, and mixed methods approaches* (5th ed.). SAGE Publications Inc.
- Ebi, K.L., Hallegatte, S., Kram, T., Arnell, N.W., Carter, T.R., Edmonds, J., Kriegler, E., Mathur, R., O'Neill, B.C., Riahi, K., Winkler, H., Van Vuuren, D.P., & Zwicker, T. (2014). A new scenario framework for climate change research: Background, process, and future directions. *Climatic Change*, 122(3), 363–372. <https://doi.org/10.1007/s10584-013-0912-3>
- Edwards, G.I., & Kok, K. (2021). Building a fuzzy cognitive map from stakeholder knowledge: An episodic, asynchronous approach. *Current Research in Environmental Sustainability*, 3, 100053. <https://doi.org/10.1016/j.crsust.2021.100053>
- Erokhin, D., & Rovenskaya, E. (2020). *Regional scenarios of the arctic futures: A review* (working paper No. WP-20-013). IIASA. <http://pure.iiasa.ac.at/id/eprint/16648/1/WP-20-013%20a.pdf>
- Eronen, J., Rasmus, S., & Sarkki, S. (2025). Tensional dreams - Policy option for a sustainable arctic. *CHARTER working paper 4* (backgrounder for the policy brief). https://www.charter-arctic.org/wp-content/uploads/2024/11/CHARTER_working_paper_4_tensional_dreams.pdf

- Foster, G. (2020). Concrete utopianism in integrated assessment models: Discovering the philosophy of the shared socioeconomic pathways. *Energy Research & Social Science*, 68, 101533. <https://doi.org/10.1016/j.erss.2020.101533>
- Haavisto, R., Pilli-Sihvola, K., Harjanne, A., & Perrels, A. (2016). *Socio-economic scenarios for the Eurasian arctic by 2040*. Ilmatieteen laitoks. <https://helda.helsinki.fi/handle/10138/160254>
- Harrison, P.A., Harmáčková, Z.V., Karabulut, A.A., Brotons, L., Cantele, M., Claudet, J., Dunford, R.W., Guisan, A., Holman, I.P., Jacobs, S., Kok, K., Lobanova, A., Morán-Ordóñez, A., Pedde, S., Rixen, C., Santos-Martín, F., Schlaepfer, M.A., Solidoro, C., Sonrel, A., & Hauck, J. (2019). Synthesizing plausible futures for biodiversity and ecosystem services in Europe and Central Asia using scenario archetypes. *Ecology and Society*, 24(2), 27. <https://doi.org/10.5751/ES-10818-240227>
- Hauptman, A., & Steinmüller, K. (2018). Surprising scenarios. Imagination as a dimension of foresight. In R. Peperhove, K. Steinmüller, & H. Dienel (Eds.), *Envisioning uncertain futures. Zukunft und Forschung*. Springer VS, Wiesbaden. https://doi.org/10.1007/978-3-658-25074-4_4
- Heikkinen, H.I., Sarkki, S., & Nuttall, M. (2012). Users or producers of ecosystem services? A scenario exercise for integrating conservation and reindeer herding in northeast Finland. *Pastoralism: Research, Policy and Practice*, 2(1), 11. <https://doi.org/10.1186/2041-7136-2-11>
- Heikkinen, H., Lépy, É., Sarkki, S., & Komu, T. (2016). Challenges in acquiring a social licence to mine in the globalising arctic. *Polar Record*, 52(4), 399–411. <https://doi.org/10.1017/S0032247413000843>
- Horstkotte, T., Holand, Ø., Kumpula, J., & Moen, J. (Eds.). (2022). *Reindeer husbandry and global environmental change: Pastoralism in fennoscandia*. Routledge. <https://doi.org/10.4324/9781003118565>
- Hunt, D.V.L., Lombardi, D.R., Atkinson, S., Barber, A.R.G., Barnes, M., Boyko, C.T., Brown, J., Bryson, J., Butler, D., Caputo, S., Caserio, M., Coles, R., Cooper, R.F.D., Farmani, R., Gaterell, M., Hale, J., Hales, C., Nicholas Hewitt, C. . . Christopher, D.F. (2012). Scenario archetypes: Converging rather than diverging themes. *Sustainability*, 4(4), 740–772. <https://doi.org/10.3390/su4040740>
- Immovilli, M., & Kok, M. (2020). Narratives for the “half earth” and “sharing the planet” scenarios: A literature review. PBL Netherlands Environmental Assessment Agency. <https://www.pbl.nl/sites/default/files/downloads/pbl-2020-narratives-for-half-earth-and-sharing-the-planet-scenarios-4226.pdf>
- IPBES. E. S. Brondizio, J. Settele, S. Díaz, and H. T. Ngo (editors). (2019). *Global assessment report on biodiversity and ecosystem services of the intergovernmental science-policy platform on biodiversity and ecosystem services*. IPBES secretariat. <https://doi.org/10.5281/zenodo.3831673>
- Kietäväinen, A., & Tuulentie, S. (2018). Trust matters – Social capital in herding cooperation in Finland. *Society & Natural Resources*, 31(9), 1064–1079. <https://doi.org/10.1080/08941920.2018.1463421>
- Kirchner, S., & Frese, V.M. (2016). Sustainable indigenous reindeer herding as a human right. *Laws*, 5(2), 24. <https://doi.org/10.3390/laws5020024>
- Komu, T. (2020). Manoeuvring conflict: Industrial land use projects and ‘refusal to resist’ among reindeer herding communities in Northern Fennoscandia. *Ethnos*, 85(3), 532–549. <https://doi.org/10.1080/00141844.2019.1580304>
- Kriegler, E., Edmonds, J., Hallegatte, S., Ebi, K.L., Kram, T., Riahi, K., Winkler, H., & van Vuuren, D.P. (2014). A new scenario framework for climate change research: The concept of shared climate policy assumptions. *Climatic Change*, 122(3), 401–414. <https://doi.org/10.1007/s10584-013-0971-5>
- Laptander, R., Horstkotte, T., Habeck, J.O., Rasmus, S., Komu, T., Matthes, H., Tømmervik, H., Istomin, K., Eronen, J.T., & Forbes, B.C. (2024). Critical seasonal conditions in the reindeer-herding year: A synopsis of factors and events in Fennoscandia and northwestern Russia. *Polar Science*, 39, 101016. <https://doi.org/10.1016/j.polar.2023.101016>
- Lazariva, A., Kalinin, A., Middleton, A., Nilssen, F., & Belostotskaya, A. (2021). *Arctic, 2050: Mapping the future of the arctic*. SKOLKOVO Institute for Emerging Market Studies. Available at SSRN. Retrieved January 27, 2021, from <https://ssrn.com/abstract=3784762>
- Loe, J.S., Jakobsen, E.W., & Swanson, P. (2014). *Arctic business scenarios 2020*. Menon Economics. <https://www.menon.no/publication/arctic-business-scenarios-2020/>

- Markkula, I., Turunen, M., & Kantola, S. (2019). Traditional and local knowledge in land use planning: Insights into the use of the akwé: Kon guidelines in eanodat, Finnish sápmi. *Ecology and Society*, 24(1). Artikkel 20. <https://doi.org/10.5751/ES-10735-240120>
- Mendonça, S., Pina, M., Kaivo-Oja, J.-K.-O., & Ruff, F. (2004). Wild cards, weak signals and organisational improvisation. *Futures*, 36(2), 201–218. [https://doi.org/10.1016/S0016-3287\(03\)00148-4](https://doi.org/10.1016/S0016-3287(03)00148-4)
- Muiderman, K., Vervoort, J., Gupta, A., Norbert-Munns, R.P., Veeger, M., Muzammil, M., & Driessen, P. (2023). Is anticipatory governance opening up or closing down future possibilities? Findings from diverse contexts in the global south. *Findings from Diverse Contexts in the Global South Global Environmental Change*, 81, 102694. <https://doi.org/10.1016/j.gloenvcha.2023.102694>
- Nikoleris, A., Strippel, J., & Tenngart, P. (2017). Narrating climate futures: Shared socioeconomic pathways and literary fiction. *Climatic Change*, 143(3–4), 307–319. <https://doi.org/10.1007/s10584-017-2020-2>
- Nilsson, A.E., Bay-Larsen, I., Carlsen, H., van Oort, B., Björkan, M., Jylhä, K., Klyuchnikova, E., Masloboev, V., & van der Watt, L.M. (2017). Towards extended shared socioeconomic pathways: A combined participatory bottom-up and top-down methodology with results from the Barents region. *Global Environmental Change*, 45, 124–132. <https://doi.org/10.1016/j.gloenvcha.2017.06.001>
- Nilsson, A., & Sarkki, S. (2022). Scenarios and surprises: When change is the only given. In S. Sörlin (Ed.), *Resource extraction and arctic communities: The new extractivist paradigm* (pp. 89–108). Cambridge University Press. <https://doi.org/10.1017/9781009110044.008>
- Nitah, S. (2021). Indigenous peoples proven to sustain biodiversity and address climate change: Now it's time to recognize and support this leadership. *One Earth*, 4(7), 907–909. <https://doi.org/10.1016/j.oneear.2021.06.015>
- Nysten-Haarala, S., Joona, T., & Hovila, I. (2021). Wind energy projects and reindeer herders' rights in Finnish Lapland: A legal framework. *Elementa: Science of the Anthropocene*, 9(1), 00037. Retrieved January 21, 2021, from <https://doi.org/10.1525/elementa.2020.00037>
- Nyysönen, J. (2022). A competing harvester, stakeholder, and environmental threat: Positioning reindeer in metla forestry research, society & animals (published online ahead of print 2022). *Society & Animals*, 31(5–6), 689–706. <https://doi.org/10.1163/15685306-bja10076>
- O'Neill, B.C., Carter, T.R., Ebi, K., Harrison, P.A., Kemp-Benedict, E., Kok, K., Kriegler, E., Preston, B.L., Riahi, K., Sillmann, J., van Ruijven, B.J., van Vuuren, D., Carlisle, D., Conde, C., Fuglestedt, J., Green, C., Hasegawa, T., Leininger, J., Monteith, S., & Pichs-Madruga, R. (2020). Achievements and needs for the climate change scenario framework. *Nature Climate Change*, 10(12), 1074–1084. <https://doi.org/10.1038/s41558-020-00952-0>
- O'Neill, B.C., Kriegler, E., Ebi, K.L., Kemp-Benedict, E., Riahi, K., Rothman, D.S., van Ruijven, B.J., van Vuuren, D.P., Birkmann, J., Kok, K., Levy, M., & Solecki, W. (2017). The roads ahead: Narratives for shared socioeconomic pathways describing world futures in the 21st century. *Global Environmental Change*, 42(2017), 169–180. <https://doi.org/10.1016/j.gloenvcha.2015.01.004>
- Pedde, S., Kok, K., Hölscher, K., Oberlack, C., Harrison, P.A., & Leemans, R. (2019). Archetyping shared socioeconomic pathways across scales: An application to central Asia and European case studies. *Ecology and Society*, 24(4), 30. <https://doi.org/10.5751/ES-11241-240430>
- Pekkarinen, A., Kumpula, J., & Tahvonen, O. (2020). What drives the number of semi-domesticated Reindeer? Pasture dynamics and economic incentives in fennoscandian reindeer husbandry. In *Nordic perspectives on the responsible development of the arctic: Pathways to action* (pp. 249–270). Springer Polar Sciences. https://doi.org/10.1007/978-3-030-52324-4_12
- Petzold, J., Garschagen, M., Deshpande, S., Dhiman, R., Doshi, D., Katzschner, A., Santos, A.P., & Parthasarathy, D. (2024). Identifying future challenges for climate change adaptation through insights from participatory scenario-downscaling in Mumbai. *NPJ Climate Action*, 3(1), 111. <https://doi.org/10.1038/s44168-024-00197-z>
- Primmer, E., Jokinen, P., Blicharska, M., Barton, D.N., Bugter, R., & Potschin, M. (2015). Governance of ecosystem services: A framework for empirical analysis. *Ecosystem Services*, 16, 158–166. <https://doi.org/10.1016/j.ecoser.2015.05.002>
- Quay, R. (2010). Anticipatory governance: A tool for climate change adaptation. *Journal of the American Planning Association*, 76(4), 496–511. <https://doi.org/10.1080/01944363.2010.508428>

- Raitio, K. (2008). *You can't please everyone - Conflict management practices, frames and institutions in Finnish state forests* [PhD thesis]. University of Joensuu. Social sciences. N: 86.
- Rantanen, M., Karpechko, A.Y., Lipponen, A., Nordling, K., Hyvärinen, O., Ruosteenoja, K., Vihma, T., & Laaksonen, A. (2022). The arctic has warmed nearly four times faster than the globe since 1979. *Communications Earth & Environment*, 3(1), 1–10. <https://doi.org/10.1038/s43247-022-00498-3>
- Rasmus, S., Kojola, I., Turunen, M., Norberg, H., Kumpula, J., & Ollila, T. (2020). Mission impossible? Pursuing the co-existence of viable predator populations and sustainable reindeer husbandry in Finland. *Journal of Rural Studies*, 80, 135–148. <https://doi.org/10.1016/j.jrurstud.2020.08.017>
- Rasmus, S., Sarkki, S., Pekkarinen, A.-J., Jokinen, M., Mettiäinen, I., Post, L., Rikkinen, T., Sorvali, J., & Väärälä, T. (2023). The future of reindeer husbandry. Surprises and dreams. A workshop summary report. *CHARTER working paper # 3*. <https://www.charter-arctic.org/wp-content/uploads/2023/02/Reindeer-husbandry-dreams-and-surprises-report.pdf>
- Rasmus, S., Sarkki, S., Wang, I., Burgess, P., Habeck, J.O., Horstkotte, T., Jokinen, M., Matthes, H., Mettiäinen, I., Parviainen, T., Pekkarinen, A., Post, L., Rikkinen, T., Sorvali, J., Turunen, M., Väärälä, T., & Eronen, J.T. (submitted). Playing with dreams: Workshop tool to support future-oriented work in communities and livelihoods.
- Rasmus, S., Turunen, M., Luomaranta, A., Kivinen, S., Jylhä, K., & Räihä, J. (2020). Climate change and reindeer management in Finland: Co-analysis of practitioner knowledge and meteorological data for better adaptation. *Science of the Total Environment*, 710, 136229. <https://doi.org/10.1016/j.scitotenv.2019.136229>
- Riahi, K., van Vuuren, D.P., Kriegler, E., Edmonds, J., O'Neill, B.C., Fujimori, S., Bauer, N., Calvin, K., Dellink, R., Fricko, O., Lutz, W., Popp, A., Cuaresma, J.C., Kc, S., Leimbach, M., Jiang, L., Kram, T., Rao, S. . . . Tavoni, M. (2017). The shared socioeconomic pathways and their energy, land use, and greenhouse gas emissions implications: An overview. *Global Environmental Change*, 42, 153–168. <https://doi.org/10.1016/j.gloenvcha.2016.05.009>
- Ribot, J., & Larson, A.M. (2012). Reducing REDD risks: Affirmative policy on an uneven playing field. *International Journal of the Commons*, 6(2), 233–254. <https://doi.org/10.18352/ijc.322>
- Rounsevell, M.D.A., & Metzger, M.J. (2010). Developing qualitative scenario storylines for environmental change assessment. *WIREs Climate Change*, 1(4), 606–619. <https://doi.org/10.1002/wcc.63>
- Sarkki, S., Heikkinen, H.I., & Löf, A. (2021). Reindeer herders as stakeholders or right-holders? Introducing a social equity-based conceptualization relevant for indigenous and local communities. In D.C. Nord (Ed.), *Nordic perspectives on the responsible development of the arctic: Pathways to action* (pp. 271–292). Springer Polar Sciences. https://doi.org/10.1007/978-3-030-52324-4_13
- Sarkki, S., Jokinen, M., Heikkinen, H.I., Nijnik, M., Melnykovich, M., & Kluvankova, T. (2022). “Going out to get in”—roles of forest conflicts in bottom-linked environmental governance progressing toward socio-political innovations. *Environmental Policy and Governance*, 32(6), 478–491. <https://doi.org/10.1002/eet.2020>
- Sarkki, S., Pihlajamäki, M., Rasmus, S., & Eronen, J.T. (2023). “Rights for life” scenario to reach biodiversity targets and social equity for indigenous peoples and local communities. *Biological Conservation*, 280, 109958. <https://doi.org/10.1016/j.biocon.2023.109958>
- Sarkki, S., Rasmus, S., Habeck, J.O., Matthes, H., Pihlajamäki, M., & Eronen, J. (submitted). Elaborating the SSP-based scenario architecture by concept of governance assumptions.
- Schröter, M., Barbés-Blázquez, M., Albert, C., Hill, R., Krause, T., Loos, J., Mannetti, L.M., Martín-López, B., Neelakantan, A., Parrotta, J.A., Quintas-Soriano, C., Abson, D.J., Alkemade, R., Amelung, B., Baptiste, B., Barrios, E., Djoudi, H., Drakou, E.G. . . . Villasante, S. (2023). Science on ecosystems and people to support the Kunming-Montreal global biodiversity framework. *Ecosystems & People*, 19(1). <https://doi.org/10.1080/26395916.2023.2220913>
- Sitas, N., Harmáčková, Z.V., Anticamara, J.A., Arneth, A., Badola, R., Biggs, R., Blanchard, R., Brotons, L., Cantele, M., Coetzer, K., DasGupta, R., Den Belder, E., Ghosh, S., Guisan, A., Gundimeda, H., Hamann, M., Harrison, P.A., Hashimoto, S. . . . Valle Tobar, M. (2019). Exploring the usefulness of scenario archetypes in science-policy processes: Experience across IPBES assessments. *Ecology and Society*, 24(3), 35. <https://doi.org/10.5751/ES-11039-240335>

- Stoessel, M., Moen, J., & Lindborg, R. (2022). Mapping cumulative pressures on the grazing lands of northern fennoscandia. *Scientific Reports*, 12(1), 16044. <https://doi.org/10.1038/s41598-022-20095-w>
- Taleb, N.N. (2008). *The Black Swan*. Penguin Books.
- Turunen, M.T., Rasmus, S., Järvenpää, J., & Kivinen, S. (2020). Relations between forestry and reindeer husbandry in northern Finland – Perspectives of science and practice. *Forest Ecology and Management*, 457, 117677. <https://doi.org/10.1016/j.foreco.2019.117677>
- van Beek, L., & Versteeg, W. (2023). Plausibility in models and fiction: What integrated assessment modellers can learn from an interaction with climate fiction. *Futures*, 151, 103195. <https://doi.org/10.1016/j.futures.2023.103195>
- van Vuuren, D., Kok, M., Girod, B., Lucas, P., & Vries, B. (2012). Scenarios in global environmental assessments: Key characteristics and lessons for future use. *Global Environmental Change*, 22(4), 884–895. <https://doi.org/10.1016/j.gloenvcha.2012.06.001>
- Wang, I., Rasmus, S., Sarkki, S., Habeck, O., Burgess, P., Pekkarinen, A.-J., & Eronen, J. (2025). *Playing with dreams - workshop playing cards*. Zenodo. <https://doi.org/10.5281/zenodo.14843107>