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Between the local and the global? - reindeer herders' perspectives on land use challenges and conflicts in the Sámi homeland, Finland

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ABSTRACT

Rapid increase in new land uses is one of the biggest threats to reindeer husbandry in Fennoscandia. We conducted a partly facilitated online Public Participation GIS survey to study reindeer herders' perspectives on the impacts of land uses on reindeer herding in Inari, in the Sámi Homeland, Finland. The herders found that predators, husky safaris, hunting, mineral prospecting, gold mining, and forestry have had the most negative influence on reindeer herding, but they were most concerned about the cumulative effects of multiple land uses. Nature conservation was reported as having the most positive impact on reindeer herding. Map markings of the herders indicated that new land uses should not be directed to grazing areas but to population centers with existing infrastructure. The facilitated PPGIS survey encompassing interviews was found to be time-consuming, but trust-inspiring and interactive in that it enabled detailed discussions with the herders.

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1. Introduction

Global population growth and rising living standards drive economic activity related to increased food production, construction and technological development, energy production, and more people travelling (Beck, 2000; Olafsdottir et al., 2020; Suopajärvi et al., 2022). Urbanization, digitalization, climate change and environmental concern are central drivers influencing societies and economic activities. Intensification of economic activities is anticipated in all sectors in the Global North (Suopajärvi et al., 2022). For example, in forestry, increased demand for timber entails the intensification of silviculture and harvesting operations. Mining of critical raw materials is needed for the green transition (Suopajärvi et al., 2022). The Arctic nature and its assets are at risk of overexploitation, and the Sámi and other local communities are exposed to the cumulative effects of land uses.

Rapid increase in new land uses is one of the biggest threats to reindeer husbandry in Fennoscandia. Both Indigenous Sámi and Finns practice reindeer husbandry in Finland, unlike in Sweden and Norway where it is mainly an exclusive right of the Sámi (Holand et al., 2022). The reindeer management area (RMA) covers 36% of Finland's total area. In this area, semi-domesticated reindeer (*Rangifer tarandus tarandus*) have a free grazing right which is not dependent on land ownership (Reindeer Husbandry Act 848/1990, 1990). Reindeer husbandry is considered important as it employs people, keeps remote areas inhabited, and provides economic benefits. It also represents

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cultural continuity and a way of life connected to traditions, indigenous rights, and *trans*-generational values (Helle & Jaakkola, 2008; Vuojala-Magga et al., 2011).

Traditionally, Sámi reindeer herding has been nomadic, and herders moved with their herds between summer and winter pastures, moving distances being up to 400 kilometers even beyond the current state borders (Dana & Riseth, 2011; Seitsonen & Viljanmaa, 2021). The reindeer herding Sámi lived in *siidas*, reindeer herding communities. Since then, Sámi reindeer herding has undergone considerable changes brought about by practices and policies of the Nordic states that have been described as 'colonial' (Kuokkanen, 2020). In Finland the state obligated reindeer owners to establish geographically defined herding districts (HDs) in 1898. This stopped the nomadic lifestyle and reduced the usable area for reindeer herding. Furthermore, modernization and the demand to adapt to technological, economic and political changes has posed challenges to the livelihood. Despite this, reindeer herding is still dependent on the traditional knowledge (TK) and skills, which are passed on from generation to generation (Magga et al., 2009).

In a globalizing north, reindeer husbandry shares the same operational space with multiple other land users; it has had conflicting interests mainly with forestry, agriculture, exploration and extraction of natural resources, energy production, outdoor recreation and tourism as well as with predators (AMAP, 2017). In a few cases, the disputes between reindeer herding and other land uses have escalated into serious conflicts (e.g. Saarikoski & Raitio, 2013). Economic development, such as industrial infrastructure projects and tourism activities, is growing rapidly in the Arctic. Tourism has positive impacts on the income for the local economy, networks, and co-operation. In addition to its positive effects, nature-based tourism greatly affects land use on wide areas, causing conflicts with other livelihoods (Olafsdottir et al., 2020).

Intensifying land use can lead to loss, fragmentation, or degradation of reindeer pastures, or result in disturbance affecting reindeer behaviour, and weaken reindeer health and wellbeing. In addition to shrinking available pasture area, land use also threatens the traditional practices of utilizing natural grazing resources (Horskotte et al., 2022; Rasmus et al., 2021; Skarin & Åhman, 2014). Climate change poses additional challenges to reindeer husbandry: A warmer climate and more extreme weather events result in deep and/or hard snow cover or ice crusts, which makes reindeer foraging through the snowpack energy-demanding or impossible. During summer, heat periods and increased insect harassment can cause stress to reindeer (Jaakkola et al., 2018; Ruosteenoja & Jylhä, 2023; M. T. Turunen et al., 2016).

Several acts, agreements, and guidelines direct land use planning in the Sámi homeland. The Reindeer Husbandry Act (848/1990), 1990 regulates land use by obliging the State authorities to consult the representatives of reindeer husbandry when planning measures concerning State lands have a substantial effect on reindeer husbandry. The Act on the Sámi Parliament (974/1995), 1995 requires that the authorities shall negotiate with the Sámi Parliament in all far-reaching and important measures which may directly affect the status of the Sámi as an indigenous people. In addition, the The Act on Metsähallitus (234/2016), 2016 obligates the authorities to secure the prerequisites for practicing the Sámi culture. Furthermore, the Akwé: Kon Voluntary Guidelines, which partly fulfill the requirements of the Article 8(j) of the Convention on Biological Diversity (CBD, 1992), were first applied in 2013 in Hammastunturi Wilderness Area in Inari (Juntunen & Stolt, 2013; Markkula, Turunen, & Kantola, 2019; Secretariat of the CBD, 2004).

Citizen participation as part of land use planning and decision making has been implemented in varying ways during the past decades (e.g. Arnstein, 1969; Ramasubramanian, 2011). The need for the development of participatory mapping methods based on Geographic Information Systems (GIS) was derived from the critique that the perspectives of local people are not considered adequately in decision-making (National Center for Geographic Information and Analysis, 1996). PPGIS methods have improved the collection and utilization of locally relevant knowledge in planning and decision making (Fagerholm et al., 2022; Kantola et al., 2023; Nikula et al., 2020; Sandsröm et al., 2020). Tools like this enable the collection of localized information from stakeholders regardless of their physical presence in a certain place at a certain time (Brown & Kyttä, 2018). While there are several terms for

participatory mapping methods with slightly different connotations, for example, public participation GIS (PPGIS), participation GIS (PGIS) and volunteered geographic information (VGI, VGIS) (Brown et al., 2014; Sandsröm et al., 2020; Verplanke et al., 2016) in general, map-based tools enable the collection of root-level information about citizens' cultural and social views of their environments and important places, and its incorporation into decision-making (Nikula et al., 2020; Sieber, 2006).

This study is part of the ArcticHubs project (2020–2024), which studies the consequences of global drivers at the local level. Inari was chosen as one of the 'Indigenous hubs' in Finland, because it is located in the Sámi Homeland and has multiple land uses and the related problems and conflicts are common. The goal of the present study is, first, to address the perspectives of reindeer herders in Inari, Finland on the impacts of different land uses and related challenges and conflicts on their livelihood and, second, to test the applicability of the facilitated online PPGIS method to enhancing participation of local reindeer herders in discussions of land use in relation to other livelihoods.

2. Materials and methods

2.1. Study site

The study site is the Inari Municipality (Fig. 1a) that, with an area of about 17 000 km², is the largest municipality in Finland. The location of Inari in northern Finland is characterized by boreal forests in the south, and the landscape changes gradually to tundra towards the north. The region is characterized by water areas such as Lake Inari (1080 km²), forests, swamps, and fells. Nature conservation areas cover about 72% of the land area (Figure 1b). State owns around 91% of the forests in Inari (LUKE, 2021); the forests and conservation areas are managed by Metsähallitus (Finnish Forestry Ltd.). The Inari Municipality belongs to the Indigenous Sámi homeland in Finland (Sápmi). In the end of 2022, there were 7,047 residents of which 31% were Sámi (STATFIN, 2024). The most populated villages of the municipality are Ivalo (3,000 residents), Inari (640 residents), and Saariselkä, which is mainly a touristic resort (280 residents). The population density in Inari is 0,5 inhabitants/km².

The biggest employers are the Inari Municipality, the Finnish Border Guard, and Metsähallitus. There are almost 800 enterprises in Inari. One of the major sources of income in Inari is nature-based tourism, which has a long tradition in the area. In the Inari-Saariselkä tourism resort, the number of overnight stays was 533,800 in 2022 of which about 57% were by foreign tourists (Tourism and Accommodation statistics, 2024). Traditional Sámi livelihoods reindeer herding, fishing, hunting, and handicrafts, are important both economically and culturally (Markkula, Turunen, & Kantola, 2019). In addition to traditional, meat-based reindeer husbandry, reindeer-based tourism is an important source of income. The reindeer management area (RMA) is divided into 54 herding districts (HDs). Of these, Hammastunturi, Ivalo, Sallivaara, Muotkatunturi, Muddusjärvi, Näätämo, Paatsjoki, and Vätsäri are located in the Inari Municipality (Figure 1a). In Inari there were 524 reindeer owners in the reindeer herding year 2021–2022; the numbers ranged from five in Paatsjoki HD to 126 in Sallivaara HD (RHA, 2023). The number of reindeer in winter stock was 33,344 and the number of slaughtered reindeer was 13,484 (RHA, 2023).

2.2. PPGIS survey

A PPGIS survey of the effects of different land uses on reindeer husbandry in the Inari Municipality was conducted between March and November 2022. The relevance of the survey questions was tested by Sámi actors and reindeer herders before publishing the survey. The survey was conducted using the Maptionnaire platform, a map-based online survey tool (new.maptionnaire.com). Information on and link to the PPGIS survey were distributed three times via email to the herders in Inari by the Reindeer Herders' Association (RHA), two times in the local newspaper, and a couple of times in social media (Facebook groups). Herders were contacted by phone, and special events were organized to reach

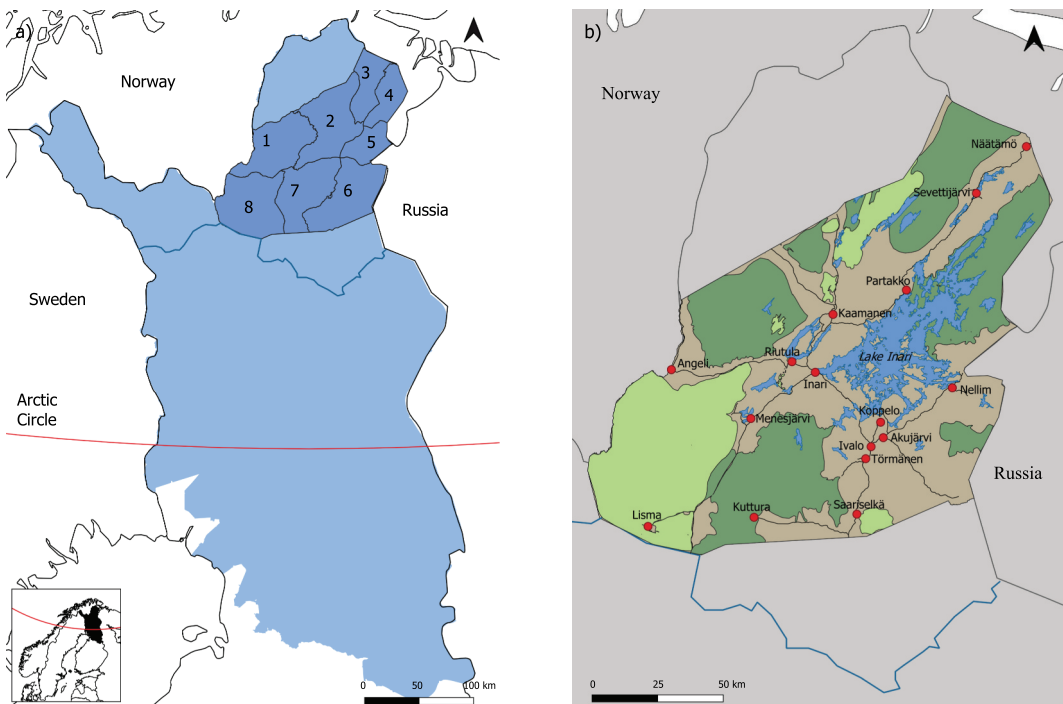


Figure 1. The study site is Inari municipality (a; dark blue), which includes eight herding districts (HDs): 1 Muotkatunturi, 2 Muddusjärvi, 3 Näätämö, 4 Vätsäri, 5 Paatsjoki, 6 Ivalo, 7 Hammastunturi, and 8 Sallivaara within the reindeer management area (RMA) (light blue). The southern border of the Sámi homeland is indicated by a dark blue line (a and b). The study site is characterized by several villages (red dots), water areas (blue), and nature conservation areas such as national parks (dark green) and wilderness areas (light green) (b). Data: RHA (2024), Finnish environment institute, National land survey, Finland.

herders for participation in the Inari and Ivalo villages for the purpose of facilitating the survey. Only three herders attended these ‘PPGIS events’. All eight HD managers in the Inari Municipality were contacted and invited to participate in the facilitated PPGIS, and four of them participated.

Reindeer herders could participate in the PPGIS survey either independently by responding to the questions via an online link or participating in a facilitated PPGIS survey with an interview. In the facilitated PPGIS survey, one of the researchers (TR) who originates from the Inari region, went through the PPGIS survey with the herders ($n = 10$) onsite or via Microsoft Teams, and interviewed them for more detailed information, and provided technical support with completing the questionnaire if needed. We have followed the ethical principles of research with human participants and ethical review in the human sciences in Finland (Kohonen et al., 2019). Prior to the interviews, we informed the participants about the purpose of the study and how the interviews were going to be used. Participants were provided with an information sheet about the study, and informed written consent (in Finnish) was sent to all participants. The interviews were coded, taped and transcribed (Tutkimustie Ltd), and the data were handled according to the General Data Protection Regulation (Directive 95/46/EC 2016).

The PPGIS online survey (Appendix 1) consisted of traditional survey and map-based questions. The participants were asked to give background information (sex, age, ethnicity etc.), and to respond to the questions about land use conflicts and solutions. They were asked to evaluate what kind of impact the different land uses and issues have had on their reindeer herding. The impact could be evaluated on a Likert scale with the options: ‘very negative’, ‘negative’, ‘both negative and positive’, ‘no influence’, ‘positive’, and ‘very positive’. In addition, the participants were asked to evaluate how the different

land uses have influenced their reindeer herding-related issues in the past 20 years. With both questions, the participants were able to freely add other land uses or issues if they were not listed.

In the map-based questions, the participants were asked to mark on a map places and areas (1) where they have observed problems or conflicts between reindeer herding and other land uses; (2) where they have observed changes in the environment; and (3) where new land uses should be preferably located in Inari and where they by no means should be located (Appendix 1). Some of the marked areas seemed problematic in the analysis, since it was possible to mark extensive areas, such as a whole HD or a big wilderness area. This can be a sign of 'counter-mapping' (Peluso, 1995), by which locals express their claims to their traditional territories or protest against technological ways (PPGIS) of presenting local or traditional information consisting of larger entities and landscapes which cannot be divided into single locations. Fortunately, we were able to specify some of these markings in the facilitated interviews, by asking for additional information, which improved the quality of the data. The areas indicated on the maps by the herders were converted into points for clarity of the visual presentation. From here on, we use 'locations' when we refer to places and areas marked onto maps by herders. The participants were also asked to provide additional information regarding the marked points. Then the participants were asked questions about their life and future. They were, for example, asked to describe the changes they have had to make in their life or reindeer herding due to the changed circumstances. In addition, the participants were asked to evaluate how they see their chances to influence land use related changes (Likert scale: 'very poorly'; 'poorly'; 'neither poorly nor well'; 'well'; 'very well' or 'I don't know'). In this survey, the number of responses to each question varied, and decreased towards the end of the questionnaire, because the participants were not required to respond to all questions. We also report the responses from partially completed questionnaires.

In the Results section we focus on reporting the responses of reindeer herders to the land use-related questions. First, we report the data collected from the responses to the traditional questions and the interview sessions (Chapter 3.1 and 3.2), and second, the data from the map-based questions (Chapter 3.3). Quotes from the interviews are presented in Appendix 2.

2.3. Background of the participants

A total of 58 sessions were started to answer the survey. Of those who indicated their sex, 25 were male, 29 were female, and three persons did not want to disclose their sex. Of the participants, 26% reported belonging to the age class of 21–30 years, and 19% were in each of the age classes of 31–40, 41–50 and 51–60 years ($n = 58$). Considerably less participants reported belonging to the age classes over 70 (2%), 61–70 (7%), and under 20 years (9%) compared to the other classes.

Almost all participants (95%) lived in the Inari Municipality. The highest number of responses was received from Muotkatunturi and Hammastunturi, which are the biggest HDs in the Inari Municipality, and no responses at all were received from the two smallest HDs, Paatsjoki and Vätsäri. Out of 49 participants 82% identified themselves as Sámi, or both Finnish and Sámi. Reindeer herding was a full-time job for 62%, and a part-time job for 38% of the participants ($n = 55$). Eighty-eight percent of the participants' households had practiced reindeer herding for over two generations, and 62% for over 20 years. The income sources outside reindeer herding included customer service, financial management, construction and earth moving, teaching, research, fishing, gathering berries and mushrooms, and pension. Fifty-nine percent of the participants informed that they own forest ($n = 54$).

3. Results

3.1. What kind of influence do the different land use activities have on your reindeer herding?

Reindeer herders were most concerned about the cumulative effects of multiple land use activities in the Inari region. One of the herders crystallized the view of all participants: *The combined impacts of*

all these land uses, and you never know what the consequences will be and what the effects that are already [felt] now are' (see Appendix 2 for other quotes from the interviews).

The influence of different land uses on reindeer herding is presented in Figure 2. Most of the herders agreed that **predators** are the most problematic issue for reindeer herding. In Inari, the main predators of reindeer are wolverine (*Gulo gulo*), bear (*Ursus arctos*), golden eagle (*Aquila chrysaetos*), and wolf (*Canis lupus*). Of the participants 73% viewed predators as having had a very negative, and 22% a negative influence on reindeer herding (Figure 2). Concerning land use, predators limit the usability of pastures and cause damage to reindeer, which can greatly decrease herders' income (Figure 3).

Tourism has had both negative and positive impacts on reindeer herding (Figure 2). Positive impact is caused by the income from reindeer-based activities and products. Herders emphasized that rapidly increasing tourism, which is expanding into wilderness, is the most problematic, because it increases uncontrollable traffic on pasture land, disturbs reindeer, and causes conflicts with reindeer herding. For example, when taking photographs, tourists may go directly into the herd, which disturbs reindeer and disperses the herd. This can cause serious problems and more work particularly in the spring, when pregnant hinds are disturbed. **Touristic routes** (e.g. for snowmobiling, hiking, mountain biking, and husky safaris) guide tourists to designated areas, but they can also have negative impacts such as loss of pasture area, and disturbance of the reindeer.

Eighty-eight percent of the herders viewed that the influence of **husky safaris** on reindeer herding is either very negative or negative (Figure 2). Herders were worried about "wild" tourism enterprises with no permission for their activities or knowledge on how to operate in the RMA. The number of husky safari businesses has exploded during recent years. Herders pointed out that the dogs used in husky safaris are big, noisy, smelly, and continuously unleashed. The dogs disturb reindeer and drive them away from their winter pasture or calving area. Only part of the damage caused by sled dogs can be verified. In some HDs the routes of

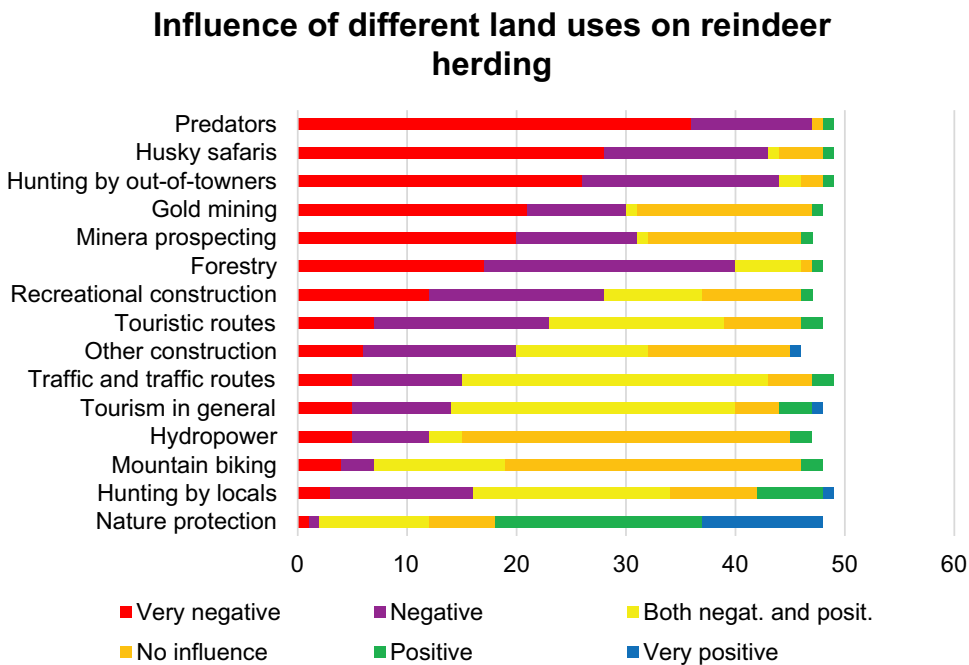


Figure 2. Number of responses of reindeer herders to the question: What kind of influence have the following land uses had on your reindeer herding during the past 20 years? The scale: 'very negative'; 'negative'; 'both negative and positive'; 'no influence'; 'positive'; 'very positive' (n = 46–49).

Influence of different land uses on reindeer herding related issues

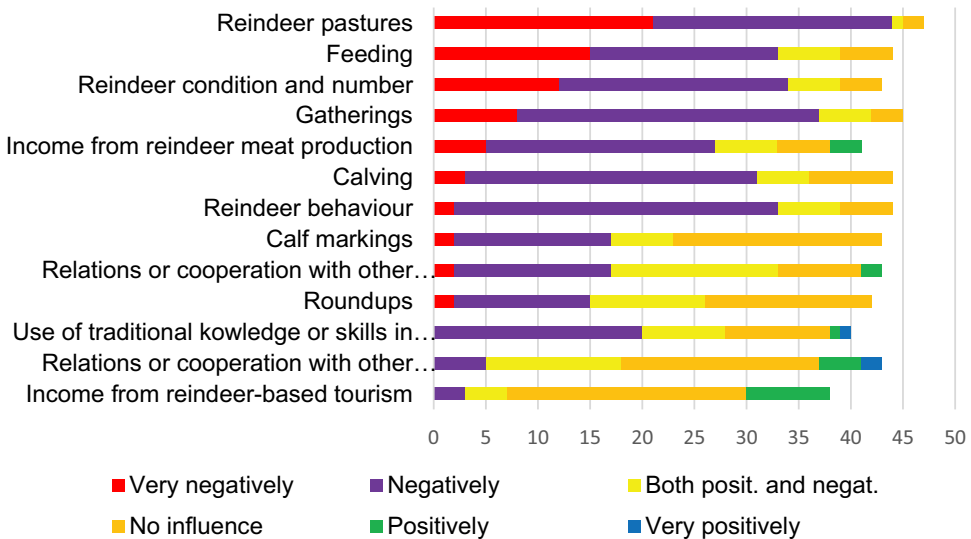


Figure 3. Number of responses of reindeer herders to the question: How have different land uses influenced your reindeer herding-related issues in the past 20 years? The scale was the following: 'very negatively', 'negatively', 'both negatively and positively', 'no influence', 'positively', 'very positively' ($n = 38-47$).

reindeer have had to be changed, and using a helicopter for gathering the animals has been necessary due to husky farms. Herders agreed that husky farms would be more acceptable if the number of farms was smaller, only small-scale guided safaris were conducted, and if the location of the routes as well the timing of their use could be negotiated with herders to minimize disturbance.

Reindeer herders agreed that **hunting by out-of-towners** is more negative for reindeer herding than **hunting by locals**. One-third of herders considered also hunting by locals either negative or very negative (Figure 2). The participants found that the attitude of the non-local hunters towards reindeer herding was the most ignorant and careless. The herders were concerned about several hunting groups with multiple dogs operating in the grazing area at the same time. Out-of-towners use dogs not trained to behave in a reindeer herding environment. A dog that is not used to reindeer can disturb the herd, and dogs can even kill reindeer. In the herders' view, hunting for moose (*Alces alces*) in autumn, and for willow grouse in spring were the most problematic hunting forms. A great number of moose hunters, traffic by ATVs, and hunting dogs disturb reindeer and make their gathering for round-ups difficult. The herders also criticized the extension of the moose hunting season into January, which should not have been allowed, because reindeer settled down on their winter pastures get easily disturbed by hunters.

Herders informed that hunting for willow grouse on the fells disturbs the herds taken there, and can be destructive for escaping pregnant hinds in spring; even the presence of dogs makes reindeer frightened. Hunters may drive a snowmobile, unleash their dogs, and follow grouse tracks on skis. Good willow grouse years can be catastrophic, because hunters may come even by airplanes or helicopters and land in the middle of a herd. Herders criticized the decisions regarding the willow grouse and rock ptarmigan hunting season, because it is scheduled two months before the start of the Sámi traditional [grouse and ptarmigan] trapping season. Some of the herders stated that less hunting permissions should be sold for hunters, hunting regulations should be made clearer, and that only dog-free hunting should be allowed.

Sixty-six percent of the participants agreed that the influence of **mineral prospecting** is very negative or negative on reindeer herding (Figure 2). Mineral exploration has not resulted in large-scale mining industry in the Inari region, but herders informed that earlier explorations are still causing concern among the herders for their future. In **gold mining**, which is practiced in a few HDs, gold panning claims are being converted into larger-scale mechanical gold mining, which has a very negative influence on reindeer herding due to losses of pasture areas, and due to the influence on the water quality (Figure 2). The trend continues in some of the HDs even though in the Lemmenjoki National Park mechanical gold mining was prohibited in 2020. Staking a new claim always means building a new road and removing the area from the use of reindeer herding, and due to this, reindeer have to be fed and their moving routes have to be changed. Herders proposed that The Mining Act (10.6.2011/621) (2011), be reformed so that the HDs would have more authority in decision making.

Eighty-three percent of the participants agreed that **forestry** has had either a negative or very negative impact on reindeer herding: Winter pastures have decreased and become fragmented due to cuttings and soil preparation (Figure 2). The herders informed that the pastures removed from the use of reindeer herding have increased the grazing pressure on the remaining areas, and herders have been forced to feed their reindeer, which has greatly increased the expenses. In addition, forestry roads have increased traffic and disturbance to reindeer herding. The participants (of which 59% were forest owners) viewed that forestry has also had some positive impacts on reindeer herding. For example, thinning of dense seedling stands increases the amount of light within the forest, which improves the growth of lichens. The herders stated that, in recent years, instead of conflicts with Metsähallitus, there have been more conflicts with private and joint forest owners who have restricted reindeer herding on their land by requiring the round-up site to be removed and by prohibiting winter feeding of reindeer, for example.

Sixty-three percent of the herders viewed the influence of **nature protection** on reindeer herding as either very positive or positive; 21% viewed it as both positive and negative (Figure 2). The herders found that conservation areas (Figure 1b) have a positive impact on reindeer herding due to old-growth forests, which have been valuable winter pastures of reindeer especially during winters with difficult snow conditions, since cuttings and other major land use are not allowed in the conservation areas. However, the protection of wildlife, including predators of reindeer, poses a considerable challenge to reindeer herding in the Inari region (Figure 2).

3.2. How have different land uses influenced your reindeer herding-related issues in the past 20 years?

A high proportion of the herders agreed that reindeer pastures, feeding, reindeer condition and the number as well as gatherings of reindeer to round-ups have been influenced very negatively or negatively by different land uses (Figure 3). Income from meat production has been affected mainly negatively, whereas income from reindeer-based tourism has mainly not been affected, or has experienced even positive impacts (Figure 3) mainly due to the increased number of customers.

More than half of the participants found that TK and skills related to reindeer herding have been influenced negatively by competing land uses (Figure 3). Herders stated that loss of TK is in many cases related to the loss of traditional pastureland. For example, the emergence of new roads has forced herders with their herds to give up their traditional lands, paths and herding structures (e.g. old round-up sites), which have carried TK over several generations, and start using new ones. The loss of land may also have forced herders to give up their traditional practices and methods and replace them with new ones. Forty-four percent of the participants reported that land use has not had any influence, and nine percent found that it has even had a positive or very positive influence on the relations or co-operation with other herders or HDs (Figure 3). For example, during times of 'forest conflicts' herders from different HDs have used "joint power" against the joint enemy, such as Metsähallitus. Some herders emphasized, however, that there is an ongoing dispute among the HDs

due to their contrasting attitudes towards the state forestry practiced by Metsähallitus; not all HDs in the Inari Municipality belong to the advocacy group of Sámi HDs ("Saamelaispaliskunnat ry"). Repeated disputes among herders have occurred also due to reindeer lost in neighboring HDs. Reindeer herders' views on the relations or co-operation with other stakeholders were divided: 40% of the herders informed that land use has had either a negative or very negative influence, while 37% reported either positive and negative influence, 19% no influence, and 5% even positive influence on relations with stakeholders (Figure 3). Herders found rather unanimously that the Inari Municipality does not stand for reindeer herding, and that the development of tourism and forestry are much more important interests to the municipality. In many cases, however, e.g. Greenpeace or the Sámi Parliament, have advocated reindeer herders in land use questions.

The participants found their chances of influencing land use-related issues rather poor: 63% saw their chances either as 'very poor' or 'poor', and eight percent saw their chances as 'good', and none as 'very good' ($n = 24$). One of the herders emphasized that influencing land use issues is difficult, but it can work out through co-operation with the HDs and the partners outside the livelihood, and through more effective information flow and negotiations: *'we have been forced to search for partners from outside to help us'*. For example, some HDs have co-operated with Greenpeace in the most difficult issues such as plans for cutting the old-growth forests, because the resources of the HDs are limited. Another herder pointed out the importance of co-operation with the Sámi Parliament, which is more powerful than an individual HD in writing statements regarding new mineral prospecting claims to the Finnish Safety and Chemicals Agency (TUKES), for example.

3.3. PPGIS map markings by reindeer herders

The herders made a total of 151 markings on the PPGIS maps about the conflict or problem locations (Figure 4), and the locations where new land use should or should not be directed (Figure 5) in the Inari Municipality. The herders marked a total of 111 locations, which have land use conflicts or problems. These locations are mainly situated in the Saariselkä tourist resort, the Inari village, and conservation areas (Figure 4). The most commonly marked problem or conflict locations were related to tourism (tourism and touristic routes 21 times, husky farms 21 times), hunting (hunting by out-of-towners 26 times, by locals 17 times) and forestry (29 times).

A total of 40 locations on which new land use should not or should be directed were marked by herders on PPGIS maps (Figure 5). Herders marked 15 locations where new land use should not be directed. These locations included important reindeer herding and grazing areas and places, wilderness areas, and other extensive areas such as whole HDs or Lake Inari. The herders marked 25 locations where new land use should be directed; the majority of these locations included existing population centers such as Ivalo, Inari, and the Saariselkä tourist resort as well as smaller villages, such as Nellim, Kaamanen, and Sevettijärvi (Figure 5). Herders stated that in these centers the noise from tourism activities, like husky dogs, would be mixed with the existing noise from other infrastructure, and the tourist accommodations would also be located in the same place.

4. Discussion

Our study showed that the reindeer herders in the Inari Municipality, within the Sámi homeland in Finland, were most worried about the cumulative effects of rapidly increasing multiple land use activities on reindeer husbandry. Spatial data marked on the maps by the herders made cumulative land use visible as the 'hots spots' of multiple land use in the same locations. The herders stated that it is not always only one particular land use, but all the different land uses combined, which fragment and degrade valuable pasture areas; they also believed that not all consequences of the cumulative land use are yet known. Cumulative impacts of multiple land uses accumulate not only over time, but also in space; they can greatly reduce the diversity of pastures, which has been identified as one of the most important factors for adaptation in Sámi reindeer herding (Horskotte et al., 2022).

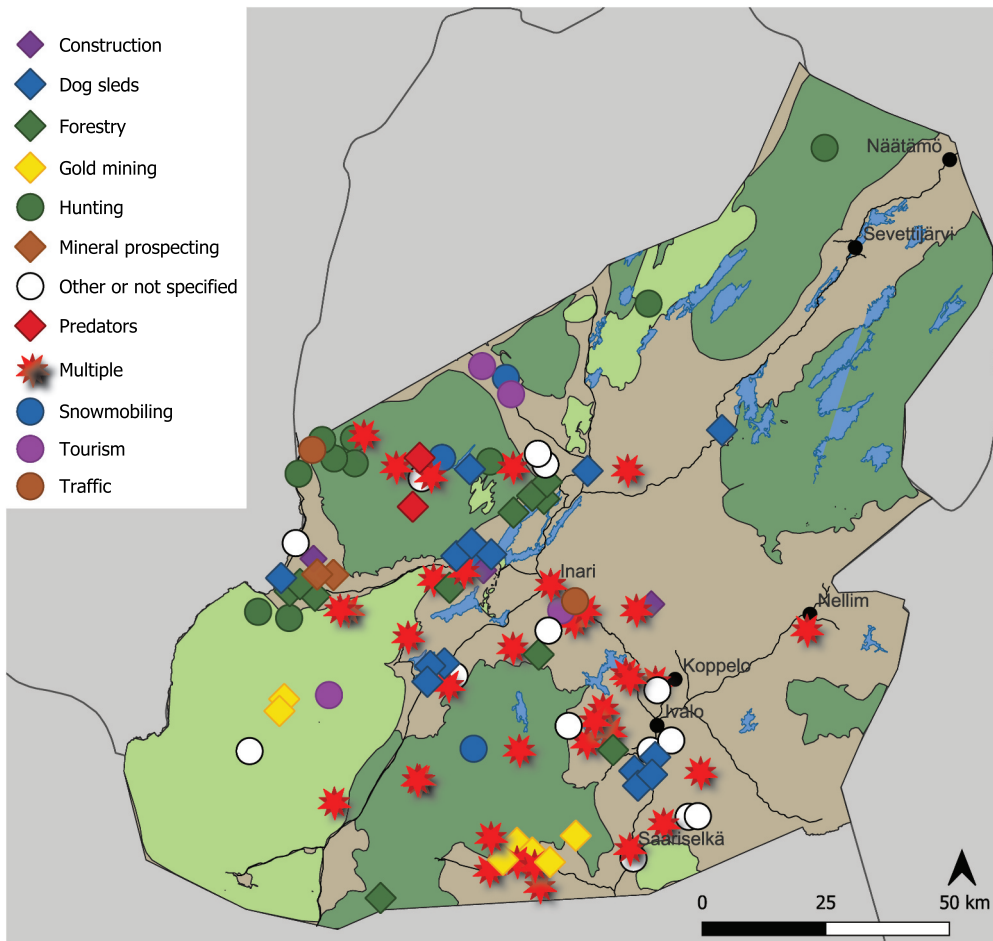


Figure 4. Conflict or problem locations between reindeer herding and other land uses in the Inari municipality marked by reindeer herders. Red stars denote that 2–12 markings of different land uses were marked into the same location by the same participant. The majority of the multiple conflict or problem locations are situated in Saanselkä tourist resort, the Inari village, and national parks. ‘Tourism’ includes both tourism activities and touristic routes (e.g. For snowmobiling, hiking, mountain biking and husky safaris). No responses were received from the smallest HDs, Paatsjoki and Vätsäri. The map also includes water areas (blue), and nature conservation areas such as national parks (dark green) and wilderness areas (light green). Data: RHA (2024), Finnish environment institute, national land survey of Finland.

Cumulative impacts of land use also interact with climatic drivers, since weather and snow conditions greatly govern the access of reindeer to forage resources. For example, ice formation on fragmented and degraded winter pastures can dramatically reduce the availability of lichens for reindeer. All these impacts together with higher grazing pressure in the remaining areas may be crucial for traditional Sámi reindeer herding, which is used to operating in extensive grazing areas (Dana & Riseth, 2011; Magga et al., 2009; Seitsonen & Viljanmaa, 2021). The situation in reindeer herding may be aggravated in future, if continuing decline and fragmentation of pastures strongly limit the adaptive capacity of reindeer herders to respond to the climatic drivers (Horskotte et al., 2022; M. T. Turunen et al., 2016).

Reindeer herding in the Inari region has had to adapt to the cumulative effects of multiple land uses for several decades. Our results showed that the most negative effects of land use were targeted to reindeer pastures and the condition and number of reindeer. Due to lost and weakened quality of pastureland and disturbance to reindeer, herders have had to adapt to these changes by winter

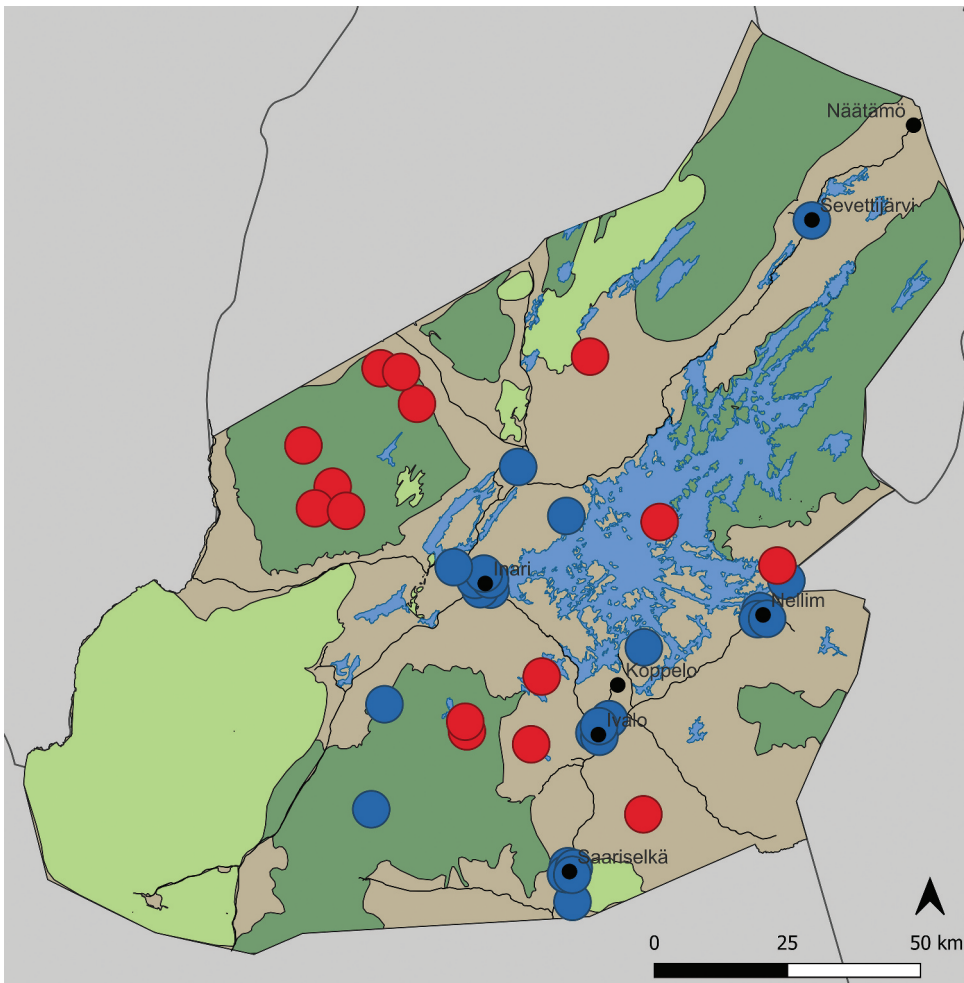


Figure 5. Locations on which new land use should not (red dots) and should (blue dots) be directed as marked by reindeer herders in Inari. The majority of the markings on which new land use could be directed were located in the villages, such as Ivalo, Inari, and the Saariselkä tourist resort. Locations where new land use should not be directed included important reindeer herding and grazing locations, wilderness areas and other extensive areas, such as whole HDs or lake Inari. The map also includes water areas (light blue), and nature conservation areas such as national parks (dark green), and wilderness areas (light green). Data: RHA (2024), Finnish environment institute, national land survey of Finland.

feeding and more effective gathering work. In addition, herders have had to move traditional pastures, routes of the herds, round-up sites, cabins etc. to other locations due to new land uses and/or disturbance of reindeer and herding work. Loss of valuable pastures and related structures have often also meant gradual erosion of the cultural meanings, stories, memories, and TK attached to them (Berkes, 1993). Influences by other land uses increase expenses of the livelihood (e.g. feeds, gasoline). This is why gaining extra income both inside and outside reindeer herding has been crucial for many herding families for decades. Diversification of the livelihood by refinement, supporting operations such as reindeer-based tourism, Sámi handicraft and development of new innovations has opened new possibilities for many herding families in the Sámi homeland.

The herders found their chances to influence land use planning rather poor, and thus an improvement is needed. In our view, the only constructive way to reconcile different land use activities in the Inari Municipality is a strongly participatory and equal planning process, with engagement between herders, representatives of different land users and the authorities. Mere

planning tools such as PPGIS cannot replace a proper planning of the participatory process, however. Earlier studies have also indicated that participants often feel that they do not have a real influence on the outputs and final land use plans. In addition, authorities may regard participatory mapping as an extra effort on top of more traditional ways of engaging people (Kantola et al., 2023; Nikula et al., 2020). In Inari, the most urgent problem is to reconcile nature-based tourism, primarily husky safaris and hunting by out-of-towners, with reindeer herding. This will not be an easy task and it might need new regulations especially regarding the location of husky farms. At present, husky farms can be established rather freely. Also, forbidding 'wild husky safaris' is not possible due to Everyone's Rights (Tuunanen et al., 2012). The main way forward are negotiations between planners, decision-makers, tourism entrepreneurs, RHA and other land users, and in those negotiations, PPGIS can be one tool for herders to show the exact locations of problematic areas.

Herders found that co-operation with Metsähallitus has improved, because in its current practice, a more interactive planning is applied than earlier to ensure an improved prevention and governance of conflicts between state forestry and reindeer herding (M. Turunen et al., 2020). A large part of the state-owned lands in Inari are no longer exposed to extensive forestry due to the Co-operation agreement between RHA and Metsähallitus (2013). In addition, research on new forestry methods is advancing, and some continuous cover forestry methods, for example, could be one of the options to preserve the lichen in the commercial forests better than in the even-aged forestry (Rikkonen et al., 2023). Few private and joint forest owners in Inari are cutting old-growth forests, but they have difficulties selling the timber to the forest enterprises, which often require that the timber they buy is from a forest owner who follows the criteria of the FSC (Forest Stewardship Council) certification system. When FSC certification is applied, the perspectives of the HDs are better considered due to the consultation procedure it requires (FSC standard for Finland, 2010).

In the present PPGIS survey targeted to herders, the participation rate was 11% of all reindeer owners in the Inari Municipality. Direct contacts by phone, email and social media were the most effective means of recruiting participants for this study. Social media enables contact with a large number of potential participants; and repeating the promotion of the survey is also easy and cost-effective (Markkula et al., 2020; Nikula et al., 2020).

Being overwhelmed with different projects in the area, and experiencing lack of time, interest, motivation or trust may have reduced herders' participation rate. The managers, as key informants of their HDs, are often overburdened with requests to participate in interviews, surveys, and project workshops alongside herding work and related office work. Lack of motivation to participate in research may be common in cases where a herder experiences that research does not support solving the land use problems in their own HD, or it just takes too long time to get feedback, if any, from the research. Offering incentives to participants usually improves the participation rate, but not all projects can afford it. The participation rate of herders has also been weak in the PPGIS surveys conducted previously. For example, in a survey targeted to all land user groups in Enontekiö (another municipality in Finnish Lapland) the proportion of herders was only 2,5% of all participants, although 19% of the residents in the municipality are herders (Markkula et al., 2020; Nikula et al., 2020).

Both contacting herders directly by phone and organizing facilitation either face-to-face or virtually play a crucial role in achieving an adequate number of participants for the PPGIS surveys. The facilitation of the PPGIS survey by assisting participants with filling in the questionnaire and interviewing them was time-consuming. One of the pros of facilitation is that it made it possible to control the representativeness and data quality (Fagerholm et al., 2022). Facilitation secured the participation of key informants, such as HD managers in our survey; we were also able to control the gender and age balance of the data as well as the balance between the HDs. Facilitation also improved data quality: The facilitator was able to ensure that all questions were responded to and understood correctly. The interaction between the participant and the researcher during facilitation also helped build trust, which was essential for having detailed discussions on land use questions. We also experience that the possibility to participate in a facilitated survey lowered the threshold for participation of some herders.

5. Conclusion

The biggest concerns of reindeer herders in Inari within the Sámi Homeland are the cumulative land use impacts: predators, hunting, forestry and rapidly increasing tourism. No new land use should be directed to the pastureland including wilderness areas. If new land use is necessary, it should be strongly targeted to the existing population centers. Most of the participants supported centralized building of tourism infrastructure in existing tourism areas. Our methodological point of view is that the facilitated online PPGIS method is a promising tool for land use planning. The method made it possible to mark on the map the locations of conflicts and places where new land use should or should not be targeted; this is assumed to be helpful e.g. in land use negotiations. The outcomes of the PPGIS survey included statistics and interview data on land use perspectives of herders, as well as condensed, visual, easy-to-read presentations on land use issues. The interviews conducted during the facilitation were an essential part of the survey for achieving a deep understanding of the herders' perspectives on land use questions.

PPGIS has been widely applied in developing countries in the Global South, mostly in rural areas, and the focus has been on community engagement to planning, encouraging community identity and empowerment of local communities (Brown & Kytä, 2014). Participatory mapping has also been used in Nordic indigenous communities in several contexts such as forestry (Sandström et al., 2012), mining (Herrmann et al., 2014) and cultural heritage (Barlindhaug, 2013). In Sweden, researchers developed in cooperation with Sámi RenGIS, a geographic information system for the purpose of collecting information on different land uses and reindeer herding (Sandström, 2015).

Our experience of the facilitated PPGIS study conducted in the Sámi Homeland in Finland, which included interviews, is also applicable to other contexts where Indigenous people are dependent on pastoralism and land use conflicts are common. Facilitated PPGIS together with other community-based participatory methods (Sandström, 2015) could potentially provide benefits for better-informed policies, which could lead to enhanced community empowerment, innovation and social change (Diop et al., 2022). Community-based mapping of resources also helps to identify and prioritize social, ecological and economic problems of rural communities and to find sustainable solutions to natural resource management-related problems (Cho & Mutanga, 2021).

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Abbreviations

HD herding district
 PPGIS Public Participation Geographic Information System
 RHA Reindeer Herders' Association
 RMA reindeer management area
 TK traditional knowledge

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