

Adapting together in times of climate change

The potential of adaptive governance for improving the cooperation between reindeer herders and forest owners in northern Sweden

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Abstract: 400 words

Reindeer husbandry has long been a central element of the traditional livelihood and culture of indigenous Sami people in northern Sweden. However, it faces several challenges from competing land uses, primarily forestry. Different forest conditions are desired by forestry and reindeer husbandry to accommodate each sector's distinct interests, promoting high timber and pulp production or improved pasture conditions respectively. As the property right of forest owners and the right of customary longtime use of reindeer herders causes an overlap regarding the use rights to the same land, a cooperative forest management to take the activities of both sectors into account is needed. As the effects of climate change in Sweden increase, conditions in the social-ecological system (SES) of northern Sweden's forests change. Forestry needs to accommodate for increasing risks of forest damage from storms, droughts, pests and fires. Shifting forestry strategies and altered snow conditions that hinder foraging will change the pasture quality for reindeer herding. Adaptive governance has emerged as a concept to deal with uncertainty and changing SES conditions such as resulting from climate change.

To consider the potential of adaptive governance as an alternative to regulate the shared land use for reindeer husbandry and forestry, this study uses policy documents from governmental and non-governmental organisations as well as academic literature, supplemented by two semi-structured interviews with stakeholders from both reindeer husbandry and forestry. First, a system analysis is conducted utilizing Ostrom's SES framework to describe the factors influencing the current system. Building on this analysis, the social context is evaluated regarding its capacity for adaptive governance based on factors outlined by Folke, Hahn, Olsson and Norberg (2005) that promote the implementation of adaptive governance: knowledge, collaboration and decision-making. The findings illustrate that the collection and exchange of knowledge and information has been central to past efforts for improving the dialogue and have increased the understanding between the groups for each others activities. Several projects were based on collaboration involving both groups. However, the relationship between forest owners and reindeer herders varies throughout the reindeer herding area, as some reindeer herders feel a lack of influence on decision-making and experience low levels of trust and respect. Therefore, to expand the capacity for adaptive governance, the social context needs to be developed further by focusing on collaboration and trust between these groups, for example through the establishment of bridging organisations.

Keywords: social-ecological system; land use; reindeer husbandry; forestry; climate change; sustainability science

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1 Introduction

The presence of reindeer constitutes an important influence for arctic-alpine ecosystems, as the reindeer's grazing behaviour affects ecosystem structures and processes (Pape & Löffler, 2012). Reindeer herding of semi-domesticated reindeer has been practiced in Fennoscandia for centuries by the indigenous Sami people and as such has become central to their culture and traditions (Danell, 2005; Pape & Löffler, 2012) as well as economically for their livelihood (Tyler et al., 2007). Nowadays, reindeer husbandry faces several challenges such as climate change and land use conflicts (Pape & Löffler, 2012; Pape & Löffler, 2016). In the areas of Sweden where reindeer husbandry is practiced, other interests are pursued as well, such as mining, tourism and forestry. Reindeer husbandry and forestry, both requiring large areas of forest land, have long been at odds regarding their shared use of those forest lands, thus drawing attention from the government (Brännström, 2017).

Forests cover large areas of Sweden and are of great importance, especially economically (Lindahl et al., 2017; Forbes, 2006). While providing habitat for animals and vegetation, they also serve the interests of forestry, reindeer husbandry, hunting, gathering of mushrooms and berries as well as for recreational purposes (Carlsson & Boström, 2014). As these activities are mainly occurring parallel to each other in the same places, they influence each other in many ways and lead to conflicting ideas of how to manage forests best (Brännström, 2017). As forest owners and reindeer herders both have the legal right to the same forest lands to use for their activities (Brännström, 2017) and both sectors shape life and society in northern Sweden (Skogsstyrelsen, 2013), the dialogue between these two interest groups and their negotiation about forest management is relevant when considering the future development of the forests in northern Sweden.

The effects of climate change in Sweden alter the conditions under which both reindeer husbandry (Pape & Löffler, 2012) and forestry operate (Eriksson et al., 2016). Arctic regions and their ecosystems, such as found in the northernmost areas of Sweden, are at higher than average risk from the impacts of a changing climate (Furberg, Evengård & Nilsson, 2011; IPCC, 2018). In order to cope with impacts which are already occurring now as well as to anticipate future changes to the system, there is a need for forestry and reindeer husbandry to modify and adapt their practices, which complicates their cooperation and puts more pressure on the dialogue between these groups.

Adaptive governance has emerged as a concept in the context of social-ecological systems (SES), that are shaped by the complex interactions and feedbacks between ecological and social factors. Adaptive governance intends to address the challenges for the management and governance of SES,

posed by high levels of complexity, uncertainty and risk such as involved with climate change (Chaffin, Gosnell & Cosens, 2014). The aim of this study is therefore to answer the following question: In the case of the shared land use by reindeer husbandry and forestry in northern Sweden, could adaptive governance be a potential alternative to facilitate the response to future impacts from climate change? Further, the following sub-questions are addressed: a) What are the circumstances and factors within the SES that currently influence the cooperation between reindeer herders and forest owners? b) Which aspects of the social context facilitate and promote adaptive governance and to what degree? c) How could the prospects for adaptive governance be improved? In order to answer these questions, first supplemental information is going to be given on the background of reindeer husbandry, forestry, and climate change in Sweden. Then, the relevant theories and how they guide the methodology are going to be explained. Following this, the SES and the social context for adaptive governance is analysed and discussed. At the end, the conclusions of this study are going to be summarised and presented.

2 Background

In this chapter, the aim is to give more information about the background of the shared land use in northern Sweden. In order to do so, the two land uses of reindeer husbandry and forestry are examined in the Swedish context. This is followed by the consideration of the impacts from climate change on these land uses.

2.1 Reindeer husbandry and Sami in Sweden

Sami are the indigenous people that live throughout the northern areas of Sweden, Norway and Finland as well as the north-western parts of Russia, and who have their own cultural identity shaped by their history, traditions and language with varying dialects (Henriksen, 2008; SSR, 2018). The association of people and land as well as their reindeer husbandry is a central element to the Sami culture, tradition and identity (Danell, 2005; Pape & Löffler, 2012). As an important part of their livelihood, reindeer husbandry is also of economic significance to the Sami people (Tyler et al., 2007). To recognize the importance of reindeer husbandry to the Sami, the Swedish government has determined that Sami have the exclusive right to herd reindeer (Danell, 2005; Pape & Löffler, 2012). Historically, during the 19th and in the 20th century, Sweden has followed assimilation policies (Mulk, 2009) that, for example, discouraged their traditional faith and names (Müller & Pettersson, 2001).

Although initially, the north of Sweden and further areas of Fennoscandia were inhabited and used mainly by the Sami, from the 17th century onwards, the Swedish crown encouraged an increasing colonisation towards the north (Brännström, 2017). Through a process of continuous and increasing demarcation, the forested lands became private property of people from the south, leading to the parallel use of the forests for forestry by the private owners and for reindeer herding by the Sami, whereas the degree of legal recognition of the rights for reindeer herding varied over time (Brännström, 2017).

Reindeer husbandry depends on the availability and accessibility of a variety of natural pastures to meet seasonally different needs (Pape & Löffler, 2012). During the 19th century, due to the establishment of national borders, patterns of seasonal migration was disrupted and thus the access to pastures for the reindeer was restricted (Pape & Löffler, 2012). Further pasture restrictions resulted from the division into 51 separate management districts (Pape & Löffler, 2012), or samebyar (singular: sameby), which are the geographic, economic, and administrative unions that regulate and

organise the reindeer herding within their district (Carlsson & Boström, 2014). The availability of forest areas as pastures has further decreased and become more fragmented due to several other land uses which inhibit the lands usability for reindeer grazing such as forestry, mining, power stations using wind or water, infrastructure and further other human activities (Carlsson & Boström, 2014; Eftestøl, Tsegaye, Flydal & Colman, 2016; Skarin & Åhman, 2014; Skarin, Nellemann, Rönnegård, Sandström & Lundqvist, 2015). Today, reindeer herding is allowed on around half of Sweden's land area (fig. 1), however, the area that can and is effectively used for reindeer herding is considerably smaller due to the land use for other purposes (Carlsson & Boström, 2014).

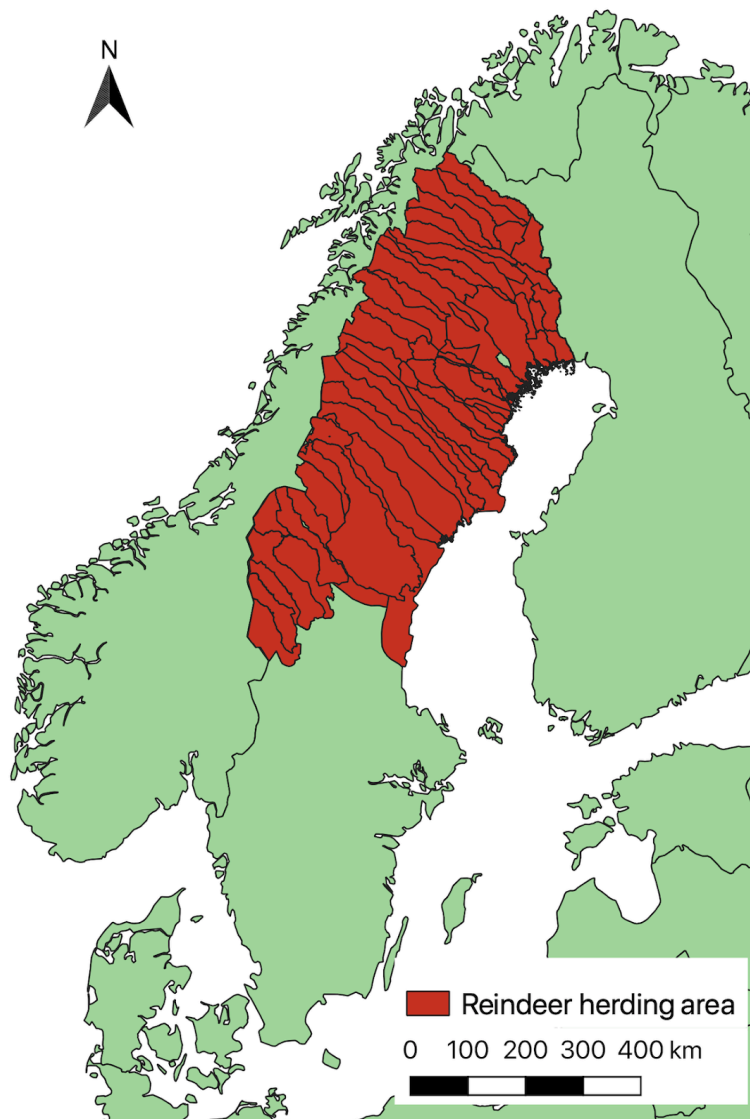


Figure 1. The extent of the potential reindeer herding area (red) in Sweden with delineation of samebyar. (Data from Rennäringens markanvändningsdatabas, IRENMARK, 2017)

2.2 Forestry in Sweden

Forestry is of very high importance for the Swedish economy and accounts for large parts of the country's exports (Lindahl et al., 2017). Due to rise of industrialisation, demand for forest products from Sweden increased since the 19th century (Lindahl & Westholm, 2011). This motivated the increasing expansion of productive forests in the north of the country (Lindahl & Westholm, 2011; KSLA, 2015). This increasing forestry sector became an important source of wealth for Sweden (KSLA, 2015; Lindahl et al., 2017; Lindahl & Westholm, 2011), supporting the development of the country as a welfare state (Lindahl et al., 2017; Lindahl & Westholm, 2011).

The sharp increase of the production of forest products and the associated loss of forest lands motivated the development of a national forest policy and the formulation of the Swedish Forestry Act in 1903 (Lindahl et al., 2017; KSLA, 2015). Since then, legislation about forest and forestry has been modified several times (KSLA, 2015). During the 20th century, the development of the forestry sector continued to focus on high production, however, now coupled with a consideration of forest regrowth to sustain forest production in the future (KSLA, 2015). In the middle of the 20th century, such concerns were reinforced with regulations to promote afforestation and increasingly evenly aged tree stands with single species to ensure high yield (Lindahl et al., 2017; KSLA, 2015). As environmental concerns gained more attention during the 1970s and 1980s, the forest legislation from 1979 was revised, resulting in a major change of Swedish forest policy in 1993 as ecological considerations were added to those aimed at production in the Swedish Forestry Act (Lindahl et al., 2017; KSLA, 2015). Since then, further social considerations have also been added (KSLA, 2015). The Swedish model for forestry has been described as 'freedom with responsibility', giving landowners much power over decision-making with the expectation that they would make the investments and efforts necessary to improve environmental conditions and production (Lindahl et al., 2017; KSLA, 2015). Yet, this model has been criticised as failing to meet sustainability and environmental goals, instead focusing on production (Lindahl et al., 2017).

Half of the productive forest lands in Sweden are owned by individual private owners (KSLA, 2015). Further 25% of productive forest lands are owned by private sector companies and 14% by state owned companies, while the remaining 11% of productive forest lands are owned by either the state directly or other public or private owners (KSLA, 2015). Around half of the individual private owners have joint together to form various forest owner associations with the goals of strengthening their position on the market, representing forest owners politically and advising forest owners on forest management (KSLA, 2015).

The focus of the Swedish forestry sector lies mainly on the production of timber and pulp for paper production (Lindahl et al., 2017). Although the forestry industry in Sweden is doing relatively well economically, it is experiencing difficulties such as diminishing consumption of paper as well as climate change (Nilsson, 2019). Nevertheless, Swedish forests generally have gained higher relevance in the context of climate change mitigation as forest biomass can serve as carbon stocks (KSLA, 2015).

2.3 Influence of climate change on reindeer husbandry and forestry

Even if international goals to limit the increase of global temperatures will be achieved, predictions show that Sweden will likely experience higher than average warming, especially in the north of the country (Naturvårdsverket, 2020; Eriksson et al., 2016). Additionally, Sweden is expected to experience both increases in precipitation as well as an increasing risk for droughts (Eriksson et al., 2016). Although regional and seasonal variations occur, a trend of increasing temperatures has been detected in arctic regions (Pape & Löffler, 2012; IPCC, 2019).

Warmer winters can increase in freeze-thaw-cycles and rain on existing snow cover, both of which causes harder snow layers, although snow cover overall is decreasing (Pape & Löffler, 2012). Such harder snow layers and ice crusts impact reindeer since much of the ground lichen that are essential for the reindeer's winter diet become difficult to reach or completely inaccessible to them (Pape & Löffler, 2012). The herders' knowledge about effective herd management (Pape & Löffler, 2012; SSR, 2019a) as well as the reindeer's physiology and behaviour which allows them to survive shorter periods with less favourable conditions has supported the capacity to cope with changes in the past (Pape & Löffler, 2012). In general, pressures from climate change and competing land uses are expected to aggravate the situation, requiring alternative courses of action from the herders (SSR, 2019a).

With the temperatures increasing, the vegetation period in Sweden is also expected to increase about 1-2 months which could benefit the regrowth of forests (Eriksson et al., 2016). Climate related stress such as from extreme temperatures and droughts is expected to increase the risk of damage to the trees, resulting in more damage from storms or creating conditions that favour fungi or insects that are regarded as pests (Eriksson et al., 2016; Skogsstyrelsen, 2020). The drought in 2018 created favourable conditions for the bark beetle, causing higher damage to the trees than in previous years (Skogsstyrelsen, 2020). Similarly, many forest fires happened during the drought in Sweden in 2018, as the risk of forest fires is increased by drought conditions (Skogsstyrelsen, 2020). The damage to

trees caused by such factors can decrease the quality of wood and as a result, also reduce profits for the forestry industry (Eriksson et al., 2016).

3 Theoretical frameworks

In the following subchapters, the theoretical framework of this thesis is considered. For this, first sustainability science as a field and how this thesis contributes to it, are going to be considered, followed by the examination of the concept of adaptive governance.

3.1 Contribution to sustainability science

Sustainability science as a field has emerged since the beginning of the 21st century in order to “understand the fundamental character of interactions between nature and society” (Kates et al., 2001, p. 641) and considers both present and future needs (Kates, 2011). This understanding of the dynamics can support sustainable transitions (Kates, 2011; Kates et al., 2001). Sustainability science is a multi-, inter- and transdisciplinary field and combines knowledge from natural, social, technological sciences as well as several other disciplines (Clark & Dickson, 2003; Kates, 2011). Furthermore, as sustainability science is problem-driven and action oriented and therefore aims to generate knowledge to inform and support decision-making (Clark & Dickson, 2003; Kates, 2011).

This thesis concerns the complex interactions of the SES in northern Sweden and therefore aims to understand the dynamics between nature and society, especially under the pressures of climate change, and how both present and future needs of forest owners and reindeer herders can be met. The SES framework that was first proposed by Ostrom (2009) is a major framework used within sustainability science and guides the analysis of this thesis about the interactions between natural and social factors. For the purpose of increasing this understanding of the SES, knowledge from several disciplines is combined with insights from stakeholders outside of academia. Furthermore, the analysis of the potential for adaptive governance as an alternative can be used to inform and support policy and decision-making in northern Sweden. Based on these considerations, this master thesis contributes to sustainability science research.

3.2 Adaptive governance

SES with their complex interactions and connections between social and ecological factors are influenced by the governance systems in place. This system of institutions and organisations, policies, laws and regulatory processes and social norms involved in governing environmental actions and resource use is considered as environmental governance (Chaffin et al., 2014). Adaptive governance has emerged as a concept for environmental governance (Chaffin et al., 2014) with the goal of

dealing with complexity, uncertainty and risk in SES (DeCaro et al., 2017; Chaffin et al., 2014) and is strongly influenced by systems thinking, complexity theory and resilience theory (Cosens, Ruhl & Soinenen, 2019; Hurlbert & Gupta, 2016).

Cosens et al. (2019) have defined adaptive governance as the governance which allows for the implementation of adaptive management. Adaptive management has emerged out of ecology as a new approach to natural resource management of ecosystems in order to account for nonlinear behaviour by learning from management actions and consequently adjusting policies (Cosens et al., 2019; Folke, Hahn, Olsson & Norberg, 2005). As the idea of this approach was then extended to SES, the need for a governance framework which supports and legitimises such management was recognised (Cosens et al., 2019). In the context of these developments, the term 'adaptive co-management' became used to recognise the necessity for more political and collaborative actions (Cosens et al., 2019).

Several features have been identified that enable a transformation to adaptive governance. Typically, adaptive governance emerges in a relatively self-organised process that may make use of windows of opportunity caused by crises or gaps of the previous governance system (DeCaro et al., 2017). However, this autonomous process can also result in uncoordinated and fragmented adaptation efforts (DeCaro et al., 2017). Based on empirical evidence, Folke et al. (2005) explored in their influential work the social conditions that promote the emergence of adaptive governance.

They identified knowledge generation and collection as an important factor supporting adaptive governance. For this, learning should not be aimed at discerning the details of parts of the system, but instead at increasing the overall understanding of the whole system (Folke et al., 2005). Further, adaptive governance can be supported by combining different knowledge systems (Folke et al., 2005). Local people, who interact closely with the ecosystem over long time periods, will gather much experience and knowledge that can add to the capacity of managing complex systems and the associated uncertainties (Folke et al., 2005). Thus, such insights from local communities as well as traditional knowledge can be integrated with information from scientific research to better cope with changes in the SES (Folke et al., 2005). This can be aided through the mobilisation of social memory as diverse experiences about past management and adaptation practices in the SES are gathered and shared, to inform the development of future practices (Folke et al., 2005).

Collaboration as another important requirement for adaptive governance depends greatly on social links and networks (Folke et al., 2005). These networks can help to connect local and internal actors and resources with external ones, thus facilitating the process of mobilisation and self-organisation

(Folke et al., 2005). Bridging organisations, in some literature also called boundary organisations (Olsson, 2007), across sectors and levels can encourage the development of social networks, trust as well as shared visions and as a result promote collaboration (Folke et al., 2005). For this collaboration to effectively transfer to management decisions in the form of adaptive co-management, the power over and responsibility for management decisions needs to be shared between the actor groups (Folke et al., 2005). This distribution of decision-making power also leads to the presence of multiple centres of agency (Folke et al., 2005). As such, power dynamics as well as enabling legislation and economic incentives can influence the potential for emergence of adaptive governance (Folke, 2007; Cleaver & Whaley, 2018).

Expanding on the ideas of adaptive governance, the development of the concept of adaptive governance brought additional perspectives on the processes of governance in the context of change, complexity and uncertainty (Cosens et al., 2019). One such example is anticipatory governance which emphasised the development of multiple scenarios to anticipate future changes to be used as the basis for management strategies (Hurlbert & Gupta, 2016; Boyd et al., 2015).

4 Methodology

This study incorporates several types of information for its analysis and is based on two frameworks to address the research question and sub-questions. The analysis is going to be based predominantly on secondary data in the form of scientific research as well as policy documents from governmental and non-governmental organisations. Further, this is supplemented by two semi-structured interviews that were conducted over telephone with actors within the SES to gain additional insights into the social context and the cooperation between reindeer herders and forest owners. The first interview was conducted with a reindeer herder (in the following referred to as RH) from the Norrbotten region of Sweden, while the second interview was conducted with a representative from a forest owner association (in the following referred to as FOA representative), which mainly operates further south in the regions of Västerbotten, Jämtland and Västernorrland. While it needs to be considered that the two interview partners act and operate in different regions of the reindeer husbandry area of Sweden, their input serves to gain insights from both a forestry as well as a reindeer husbandry perspective. Although Swedish is not my first language, the interviews were conducted in Swedish to support the respondents in expressing themselves and thus increase their comfort in the interview setting. However, this also has the potential of mistranslation or miscommunication. Following the interviews, the conversations were transcribed using the data analysis software MaxQDA.

In order to address the specific sub-questions guiding this research and to organise, structure, and analyse the data, two different analytical frameworks were used. First, to examine the factors and conditions currently influencing the SES, Ostrom's SES framework was used. This framework was initially proposed by Ostrom in 2007 to provide common vocabulary to describe and analyse SES (Ostrom, 2009) and was subsequently and in cooperation with scholars from other fields developed further to make it more applicable to a wider spectrum of SES (McGinnis & Ostrom, 2014). As a more general framework for SES (Binder, Hinkel, Bots & Pahl-Wostl, 2013), Ostrom's SES framework was designed to allow for the integration and organisation of information from different fields and disciplines (McGinnis & Ostrom, 2014). In the SES framework, multiple components and their interactions and feedbacks are considered. The first-tier variables consist of 'governance systems' (GS), 'actors' (A), 'resource systems' (RS) and 'resource units' (RU) as well as the 'interactions' (I) between them and the 'outcomes' of those interactions (O) (McGinnis & Ostrom, 2014). Additionally, the 'social, economic, and political settings' (S) and 'related ecosystems' (ECO) are taken into account as variables that influence the SES (McGinnis & Ostrom, 2014). The relationships between these first-

tier variables are shown in figure 2. These first-tier variables are made up of further variables and a table of second-tier variables suggested by McGinnis and Ostrom (2014) can be found in Appendix B. The relevance of each of these second-tier variables depends on the specific SES and the aim of the study and consequently the second-tier and further variables can be adjusted to suit the particular needs and purposes (Ostrom, 2009; McGinnis & Ostrom, 2014). Therefore, although the analysis of the SES relevant for this thesis is based on the second-tier variables of the SES framework as suggested by McGinnis & Ostrom (2014), not all of these variables are equally appropriate in this case. The relevant variables used for this thesis are found in table 1. Although less relevant second-tier variables have been omitted, the codes used for the remaining second-tier variables stay the same as the codes in the full list of variables suggested by McGinnis & Ostrom (2014) (Appendix B).

The analysis using the SES framework is further helpful for a first consideration of the potential for adaptive governance. Ostrom (2009) noted, based on previous studies, that several of these second-tier variables are associated with self-organisation, such as i.a. the ‘size of the resource system’ or the ‘number of users’ (updated in the revised SES framework to ‘number of relevant actors’ (McGinnis & Ostrom, 2014). This association with self-organisation is relevant because self-organisation can support the emergence of adaptive governance as mentioned in chapter 3.2.

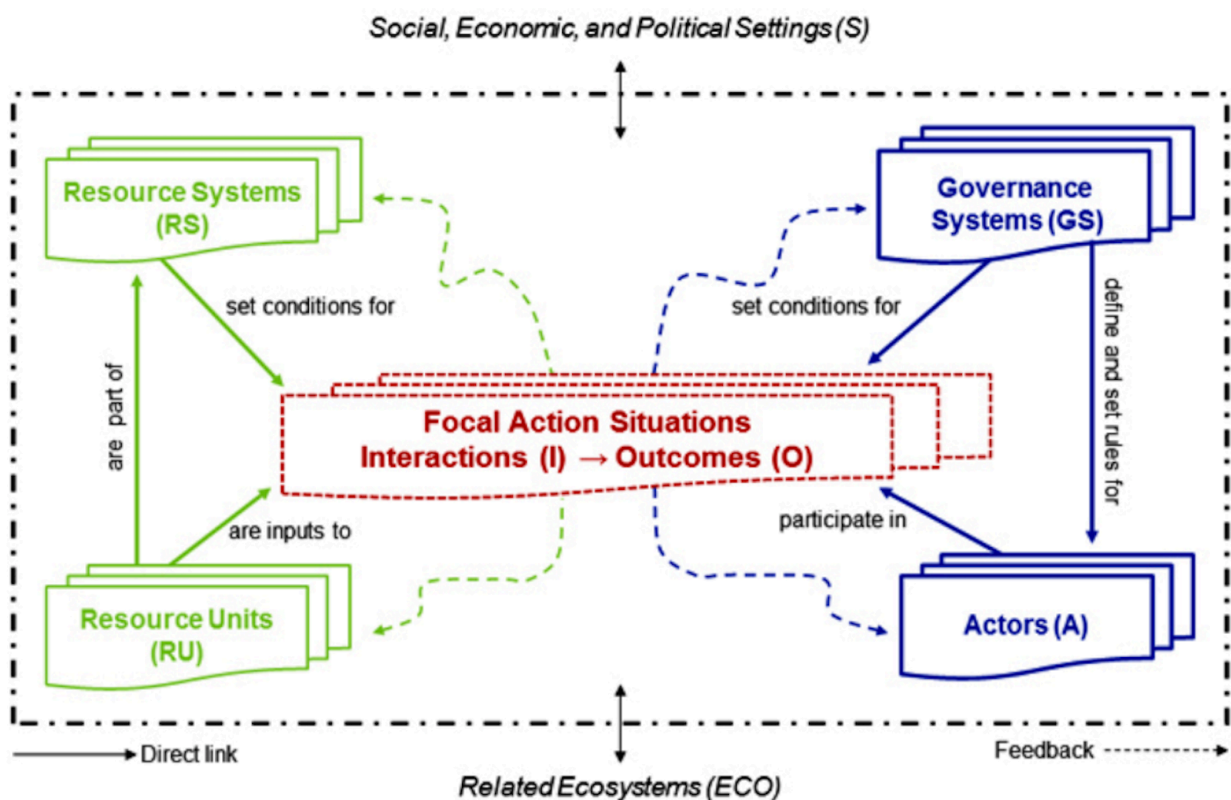


Figure 2. Revised SES framework with first-tier variables and their relationships (McGinnis & Ostrom, 2014)

Following the analysis based on the SES framework, the social context is examined closer to determine the potential for adaptive governance and which conditions that support adaptive governance are already present. With this aim, a framework was developed based on the influential article by Folke et al. (2005) which explores the social context necessary for the development of adaptive governance in a SES. These conditions have been outlined previously in detail in chapter 3.2. The framework considers the factors of ‘knowledge’, ‘collaboration’, and ‘agency and decision-making’ as first tier categories. The examination of these categories is guided and structured by supporting questions, found in table 2.

Table 1. The first-tier and second-tier variables of the SES framework which are used for the analysis of this thesis with their associated codes. (Adapted from McGinnis & Ostrom, 2014).

First-tier variable	Second-tier variable	Code
Social, economic and political settings	Economic development	S1
	Demographic trends	S2
	Other governance systems	S4
	Markets	S5
	Climate patterns	ECO1
Related ecosystems	Government organisations	GS1
	Nongovernmental organisations	GS2
	Property-rights systems	GS4
	Operational-choice rules	GS5
	Constitutional-choice rules	GS7
Governance systems	Number of relevant actors	A1
	Socioeconomic attributes	A2
	History or past experiences	A3
	Location	A4
	Norms (trust-reciprocity)/social capital	A6
	Knowledge of SES/mental models	A7
	Importance of resource (dependence)	A8
	Technologies available	A9
	Actors	Sector
Clarity of system boundaries		RS2
Size of resource system		RS3
Predictability of system dynamics		RS7
Location		RS9

Resource units	Resource unit mobility	RU1
	Growth or replacement rate	RU2
	Interaction among resource units	RU3
	Economic value	RU4
	Distinctive characteristics	RU6
Interactions	Information sharing	I2
	Deliberation processes	I3
	Conflicts	I4
	Lobbying activities	I6
	Self-organising activities	I7
	Networking activities	I8
Outcomes	Social performance measures	O1
	Ecological performance measures	O2

Table 2. First-tier and second-tier variables of the framework for the social context of adaptive governance (Based on Folke et al., 2005).

First-tier categories	Guiding questions
Knowledge	Is the knowledge production aimed at improving the understanding of the whole system?
	Are different knowledge systems, such as scientific research and traditional knowledge, being integrated?
	Are experiences, knowledge and information collected and shared among the actors?
Collaboration	How developed is the social network, especially between both actors within the SES as well as external actors?
	Do the relevant actors share a clear and compelling vision that strengthens their collaboration?
	Do the relevant actors have trust in each other?
	Is collaboration supported by bridging organisations or structures?
Agency and Decision-making	Is the power over and responsibility for management shared among actors, among them users, communities, and organisations?
	Are there multiple centres of agency which act side by side?

5 Analysis

The results of the analysis using both the SES framework as well as the framework for the social context of adaptive governance, are presented in the following section. First, the information from the analysis of the SES regarding reindeer husbandry and forestry in northern Sweden is examined. Following this, the social context and its implications for adaptive governance are considered.

5.1 The social-ecological system

The SES framework allows for a detailed examination of SES through its numerous variables. While the analysis was guided by first-tier as well as second-tier variables, the following results are presented according to the first-tier variables. In-text, relevant second-tier variables are marked with the codes given in table 1.

5.1.1 *Social, economic and political settings*

The social, economic and political settings make up the wider context of society which influences, but also impacts the SES in question. In this context, it is important to consider that with an average population density of 25 people per km² (SCB, 2019) Sweden is more sparsely populated than other European countries. In the northern regions of Sweden, the population density can decrease even further down to 2,6 people per km² (SCB, 2019) (S2). In these rural regions, both forestry and reindeer husbandry represent important fields of employment (Skogsstyrelsen, 2013), although as mentioned in previous chapters forestry has developed to be a very important economic sector in Sweden (Forbes, 2006; Lindahl et al., 2017) (S1; S5). Due to this importance of forests for Sweden, it is considered a national asset which needs to be managed sustainably for production with consideration of biodiversity and other public interests (Swedish Forestry Act, 1979:429) (S4). In addition, Swedish national policies are influenced by international policies such as EU forest regulations (KSLA, 2015).

5.1.2 *Related ecosystems*

While the social, economic and political settings give more information about the wider social context of the SES, this section concerns factors of the wider ecosystem context, such as climatic conditions. The climate in Sweden is mainly cold-temperate with some warm-temperate areas in the southern coastal regions (*Sveriges klimat*, 2020) (ECO1). However, records show that the temperatures have been steadily increasing, leading already to temperature increases of over 2°C in

northern Sweden (*Sveriges klimat*, 2020). As the global climate continues to change, this trend will continue, as it is expected that even if international agreements to limit the increase of global temperatures, this will cause a higher than average increase of temperatures in Sweden (Naturvårdsverket, 2020; Eriksson et al., 2016). As previously mentioned in chapter 2.3, this will have significant impacts on the SES in northern Sweden.

5.1.3 Governance systems

Two influential governmental organisations that affect the SES are, on the one hand, the Swedish Forest Agency, which is the national authority about forest related issues with regional offices, and, on the other hand, Sametinget, which has the function of a parliament representing the Sami people as well as the function of a state authority under the Swedish government and aims to promote Sami interests and culture (*Folkvalt organ och myndighet*, 2019) (GS1). Further, there are a variety of non-governmental organisations (GS2). Previously mentioned were samebyar, the geographic, economic and administrative districts for the management of reindeer herding (Carlsson & Boström, 2014), which thus form local groups of reindeer herders. These samebyar and additional Sami associations together comprise the association for Swedish Sami (Svenska Samernas Riksförbund), which aims to work for Sami self-determination and sustainable reindeer husbandry with a long-term perspective (SSR, 2018). Similar associations also exist for forestry, as there are several regionally active forest owner associations (*Skogsägarföreningarna*, 2014). Additionally, international NGOs like the Programme for the Endorsement of Forest Certification or the Forest Stewardship Council influence the interactions within the SES, as these NGOs offer forest certifications which require certain ecological and social standards that include the consideration of reindeer husbandry within the forest management (Skogsstyrelsen, 2013).

The property-rights system (GS4) in northern Sweden is complex with several different rights pertaining the same land. Out of the colonisation of northern Sweden and the later recognition of the indigenous people's rights, a system of dual property rights has emerged (Brännström, 2017). An underlying principle in Sweden is that land ownership is the basic right to land (Brännström, 2017). As such, forest owners may decide about the management of the land and use it to their economic benefit by pursuing forestry and using the trees and other vegetation produced on this land to sell timber, pulp or other wood products (Brännström, 2017). At the same time, the needs of other right holders to this land must be respected to certain degrees (Brännström, 2017). The rights of Sami to use public and private land for reindeer grazing was first formalized in the Reindeer Grazing Act in 1886, which also specified that these rights cannot be bought by other land users or owners

(Sandström, 2015). Therefore, based on customary right and their longtime use of the land, Sami reindeer herders, holding the right to use these forests for reindeer herding, may graze their herds in these forests, move their animals over these lands and build some necessary structures (Brännström, 2017). As such, the reindeer herders may also make decisions about how to manage and use the forest and also have the right to use the vegetation produced in these forests for their economic benefit by feeding the reindeer and selling the reindeer products (Brännström, 2017). This poses an unusual property-rights situation as the extent of these rights overlaps and thus does not ensure that these rights will and can be exercised parallel without interfering with each other (Brännström, 2017). However, the overall legal framework of how this dual rights situation is regulated gives more power over management decisions to the property owners than to the holders of reindeer herding rights (Brännström, 2017).

To address the issue of overlapping use rights, the Swedish Forestry Act (1979:429) includes a requirement for forest owners to consult with samebyar if management plans affect year-round-pastures and outlines which issues necessitate such consultations (GS7). These year-round-pastures as well as winter pastures are outlined in the Reindeer Husbandry Act (1971:437), which also establishes that Sami people who are members of a sameby have the right to land and water for themselves and their reindeer. Accordingly, in such cases, forest owners arrange for consultations with the affected samebyar before declaring the management plans for major activities with the forest agency, although consultations can also be arranged voluntarily for example to comply with standards for forest certifications (Wennström & Vestman, 2012; Skogsstyrelsen, 2013; Berggren, Persson & Edlund, 2015) (GS5).

5.1.4 Actors

The name of this variable was changed from 'users' to 'actors' to make the SES framework more applicable to settings without a specific natural resource with the understanding of 'user' as a subgroup of 'actor' (McGinnis & Ostrom, 2014). In this SES in northern Sweden, the relevant actors consist largely of those people using the forest resources. While forest owners make use of the trees on their property, the resource is further of importance for and used in a variety of other related forest industries, which in 2016 overall employed over 9.000 people in the Swedish regions of Norrbotten, Västerbotten, Jämtland and Dalarna (Axelsson, 2019) (A1). In the same regions, ca. 3.800 people were recorded as owning reindeer in 2017 (Axelsson, 2019). However, in addition to the reindeer owners themselves, other people such as family members contribute their time and work for reindeer husbandry (SSR, 2019b). Further, it needs to be taken into account that the number for

forestry includes industries in all of Dalarna, although only small areas of Dalarna are included in the reindeer herding area, which is mainly located in the regions Västerbotten, Norrbotten and Jämtland (Axelsson, 2019) (A4).

The utilisation of forests for forestry and reindeer husbandry has changed and developed over time. As described in chapter 2.2, forestry practices changed since the beginning of the 20th century to include a stronger focus on regrowth to support increasing production of forest products (Lindahl et al., 2017; KSLA, 2015) (A3). Since the middle of the 20th century, forestry practices changed to mainly monocultural tree stands of even age and although subsequent changes to the Swedish Forestry Act required the consideration for ecological and social concerns in addition to goals for production, the responsibility for this lies mainly with the forest owners (Lindahl et al., 2017; KSLA, 2015). As forestry practices changed during the 20th century, these changes included also the introduction and widespread plantation of *Pinus contorta*, a tree species from Canada and foreign to Swedish forests (Sandström, 2015). Such changes in forestry practices were supported by increasing mechanisation (Skogsstyrelsen, 2013) (A9). Technological advancements such as snowmobiles also changed practices of reindeer husbandry and allowed reindeer herders to become more sedentary compared to traditional lifestyles (Pape & Löffler, 2012).

As reindeer husbandry depends on the quality of pasture conditions (Pape & Löffler, 2012), it is sensitive to changes in the forest conditions. As a result, the production of reindeer meat and as a result also their income can vary and disturb the basis of their livelihood (Tyler et al., 2007) (A2). Although both industries depend on resources from the forest, this illustrates that reindeer husbandry relies more heavily on specific forest conditions that allow for the growth of lichen as additional feed needs to be bought if forest pasture conditions are insufficient (A8), further impacting the economic situation of reindeer herders (SSR, 2019a).

The different actor groups from reindeer husbandry and forestry had been found to have good knowledge about their own activities. However, the need for a better knowledge of each others activities had been identified (Skogsstyrelsen, 2013) and as a result, prompted efforts to improve the understanding (Sandström, 2015) (A7). Despite such efforts, the interviews with the respondents revealed that the level of trust between these actor groups is in several cases very low, although it can vary greatly (A6).

5.1.5 Resource systems

The resource system relevant in the case examined in this thesis are forests (RS1) in northern Sweden, specifically in the regions of Norrbotten, Västerbotten, Jämtland and small parts of Dalarna (RS9). More than 50% of Sweden's land area, ca. 22 million ha, falls within the boundaries regulating which land may be used for reindeer herding (Sandström, 2015; Carlsson & Boström, 2014). Much of this area includes productive forest lands (Sandström, 2015), making up ca. 9 million ha forest area (Skogsstyrelsen, 2013) (RS3). Although the extent of the area for each sameby is defined individually, these areas can overlap (*Rennäringens markanvändning*, 2016) and do not align with borders of forest properties. This hinders attempts to define system boundaries (RS2). Additionally, although forests tend to exhibit more predictable system dynamics (Ostrom, 2009), the changing climatic conditions increase uncertainty (RS7).

5.1.6 Resource units

Although both forestry and reindeer husbandry utilise forest resources, different resource units are needed for each as forestry makes use of trees for timber and pulp, while reindeer husbandry depends mainly on lichen as feed for reindeer (Pape & Löffler, 2012). In 2016, the value from forest industries in the regions of Norrbotten, Västerbotten, Jämtland and Dalarna was over 9 billion SEK (Axelsson, 2019) (RU4). However, only small areas of Dalarna are used for reindeer herding, while the majority of herding takes place in the other three regions. Without considering the value from forests in Dalarna, the value derived from forests in the other three regions was over 6 billion SEK. (Axelsson, 2019). The value derived from slaughtered reindeer in 2016 was ca 90-95 million SEK for the regions of Norrbotten, Västerbotten, Jämtland and Dalarna combined (Axelsson, 2019). Besides reindeer husbandry and the direct profits from the slaughtered reindeer, other sectors also economically benefit from reindeer herding, such as tourism (SSR, 2019b).

As both trees and lichen stay in the places where they grow, both resource units are very stationary (RU1), although both have slow growth rates and replacement requires long time periods (RU2). The average time for the rotation of tree stands is ca. 100 years, but can vary between 80 and 120 years depending on forestry practices and the species of tree (Carlsson & Boström, 2014). The main reason that the north american pine *P. contorta* has become a popular choice to plant is because it grows up to 40% faster than the pine trees native to Sweden (Carlsson & Boström, 2014), thus shortening the time of replacement. Similar to trees, Lichen is also slow to regrow as, for example, the types of lichen on trees grow predominantly in older tree stands when the trees are around 60 years or older,

with the amounts of lichen increasing over time (Edlund, 2017). The forest area with high amounts of lichen on trees or on the ground decreased by as much as 70% (Skogsstyrelsen, 2020).

Forestry activities can greatly influence the growth of lichen, both the types growing on the ground as well as those growing on trees, which are central for the winter grazing of reindeer (Sandström, 2015) (RU3). While many activities such as clear cutting, especially of older tree stands, or planting of foreign tree species such as the pine *P. contorta* can be serious hindrances for the growth of lichen, some forestry measures such as thinning can also support the growth of lichen (Skogsstyrelsen, 2020). The type of lichen growing on trees is only found on relatively old trees. Therefore, if the tree stands are cut down early as to have short rotation age which would favour the interests of forestry, it would leave only short periods of time for the amount of lichen to increase and provide the forage necessary for reindeer (Edlund, 2017; Pape & Löffler, 2012). Ground lichen, on the other hand, grow best in forest areas with lower tree density (Edlund, 2017). Thinning the forest stands can therefore be beneficial for reindeer pasture conditions and allows the reindeer to move through the area more easily (Skogsstyrelsen, 2020). As some tree species like the pine *P. contorta* grow more densely and faster, thus allowing tree stands to be clear cut earlier (Carlsson & Boström, 2014) and as a result hindering both the mobility of reindeer as well as the growth of lichen, the choice of which tree species to plant can influence the opportunities for reindeer herding. Additionally, as reindeer generally tend to avoid areas with human activity (Skarin & Åhman, 2014), forestry endeavours like felling trees or construction of infrastructure like forest roads (Carlsson & Boström, 2014) can temporarily inhibit the availability and usefulness of certain forest areas as pasture grounds even if lichen is present in those places. On the other hand, reindeer herding and thus the presence of reindeer in the forests has also impacts on the opportunities for forestry. The grazing behaviour of reindeer includes the scraping through layers of snow and potentially some ice to forage for lichen on the ground, which can damage small and young trees that had been planted (Nilsson, 2007). Reindeer also scratch their antlers against tree trunks, especially during spring, which damages the bark of those trees and can lead to further damage from the development of fungus infestations (Nilsson, 2007).

5.1.7 Interactions

The factors of both the social and ecological context considered in the previous sections affect each other in a variety of complex interactions. The deliberation between the actor groups from forestry and reindeer husbandry about forest management takes mainly place in consultations before management plans about major activities are registered with the forest agency and although such

consultations have been taking place since the middle of the 20th century, the exact processes have changed and developed over time (Wennström & Vestman, 2012) (I3). Today, the consultations are predominantly organised just between the involved sameby and the forest owner or representatives from forestry companies without much involvement of the forest agency (Wennström & Vestman, 2012; Skogsstyrelsen, 2013) (I7). However, the assistance from representatives of the forest agency during these consultations can be requested, for example if difficult issues are discussed and no agreement can be reached (Wennström & Vestman, 2012). Although the Swedish Forestry Act (1979:429) outlines which issues necessitate such consultations, the consultations can include discussions about additional activities and further voluntary consultations can take place, for example for the purpose of forest certifications (Berggren et al., 2015; Wennström & Vestman, 2012; Skogsstyrelsen, 2013). However, in the past, consultations have been perceived by reindeer herders as unidirectional and more like a notification about forest management with little possibility to take additional input or concerns from the sameby into account (Sandström, 2015). A similar opinion was expressed during the interview with RH who felt that the sameby's opinions about forest managements hold little weight in decision-making with only the potential to influence the timing of when measures will take place. Due to this dissatisfaction with the consultation processes, there have been continuous processes and efforts to improve the dialogue between the groups and to mitigate conflicts (Sandström, 2015). On the other hand, the interview with the FOA representative revealed that formal consultations are not always seen as necessary when good relationships exist between reindeer herders and forest owners. Instead, issues might be resolved more informally in local discussions. In addition to the consultations, new means for deliberation between the groups from reindeer husbandry and forestry have been proposed in the form of contracts. Contracts about forests used for reindeer herding have been introduced as a voluntary measure to address issues between these groups which are not regulated or included in the consultations (Berggren et al., 2015).

Reindeer herders and foresters pursue distinct resources from the forest and as such have different needs and requirements that are supported or hindered by different forestry management measures and strategies (Sandström, 2015). This differing view on which type of forestry management should be followed can create conflict between the users (I4). However, according to the FOA representative, these conflicts are not happening to the same degree among all groups in northern Sweden as in their experience, the cooperation between the groups can work well through the efforts on both sides, reindeer herders and forest owners. On the other hand, the FOA representative noted that in some of the cases when such conflict cannot be avoided, the dispute about forestry management might be taken to court which would not improve the relationship

between those two actor groups. The court can then deliberate and decide on the overlapping rights to the land.

The exchange of information between the actor groups from reindeer husbandry and forestry takes mainly place for the purpose of facilitating the cooperations, especially during the consultations (I2). For this purpose, the forest owners share their plans about the forest management with the relevant samebyar. (Wennström & Vestman, 2012). However, the amount of information and level of detail can vary between forest owners as they might focus on what they perceive as relevant information for the consultation, which can differ from the perceptions of the reindeer herders (Wennström & Vestman, 2012). Samebyar are creating increasingly detailed plans about how and where they use forests for their activities, so called renbruksplan, which has been supported through the use of GIS (Sandström, 2015). This plan can be used to share information about the sameby's requirements with the forest owners (Sandström, 2015; Wennström & Vestman, 2012), although concerns have been raised by some reindeer herders about how the information of such plans might be interpreted and used during the consultation (Wennström & Vestman, 2012). To further increase understanding between these two actor groups and for each other's activities, the forest agency has over the years organised several courses and also published information material about reindeer husbandry for foresters, although the publication of equivalent information about forestry for reindeer herders was discontinued (Skogsstyrelsen, 2013). Apart from the information sharing between the groups from forestry and reindeer herding, the forest owners and reindeer herders also exchange knowledge among themselves. Within a sameby, information might be shared during official yearly meetings or meetings of the board, but also informally between the reindeer herders (Wennström & Vestman, 2012), which matches the experience recounted by the RH. Beyond the extent of their own sameby, the RH described during the interview that information and experiences are shared most commonly with those other samebyar that are located close by, although meetings with other samebyar further away also occur and support the knowledge exchange. Similarly, the FOA representative explained that such associations support the contact and sharing of information and experiences between forest owners themselves through meetings and more educational courses. Further they explained that through cooperation with local samebyar and the association for Swedish Sami such meetings might specifically focus on discussions and exchange of information with the reindeer herders.

Both the association for Swedish Sami as well as forest owner associations also provide other services to their members. During the interview, the FOA representative described that the association represents the forest owners politically as well as to a variety of other actors, such as other companies or governmental authorities (I6). Furthermore, the associations can support

networking (I8). The RH stated during the interview that their sameby can turn to the association for Swedish Sami to facilitate contacts, while according to the FOA representative, promoting and supporting contact and communication between forest owners is one of the goals of the forest owner association. An additional space for networking could also be the central advisory group for issues relating to forestry and reindeer husbandry. Since 1971, the central advisory group assembles representatives from a wide array of stakeholders (Sandström, 2015; *Centrala samrådsgruppen skogsbruk-rennäring*, 2017), such as the Swedish forest agency, Sametinget, forest owner associations and the Swedish Sami association (*Centrala samrådsgruppen skogsbruk-rennäring*, 2017). However, the physical distance and due to this, the time expenditure and financial burden required for meetings can inhibit networking activities (Skogsstyrelsen, 2013).

5.1.8 Outcomes

The complex interactions within the SES bring about a variety of effects. For example, forestry practices such as clear cutting have been shown to decrease biodiversity in the forests (Edlund, 2017) (O2). At the same time, the loss of reindeer grazing areas, either physically or functionally, causes an increase of pressure on the other still available grazing areas as the herders utilise them more in compensation, resulting in degradation of those parts of the forest (Forbes, 2006; Pape & Löffler, 2012; Pape & Löffler, 2016). Such issues as well as the influence of the activities of reindeer herding and forestry on each other, form central challenges for sustainability (O1, O2) as there are already difficulties in satisfying the various present human needs without compromising the planet's "life-support system" (Kates, 2001, p. 641) which will be further exacerbated by climate change impacts and the necessity to consider future needs.

5.2 Social context for adaptive governance

In this chapter, the results of the analysis using the framework for the social context of adaptive governance will be presented. This will be guided by the variables of this framework. First, the knowledge generation, integration, and sharing will be considered, followed by the collaboration within social networks and the facilitation of such collaboration through a common vision, trust and bridging structures. Then, the division of both power over and responsibility for decision-making will be examined as well as the distribution of agency.

5.2.1 Knowledge

For the emergence of adaptive governance, knowledge, its generation, integration, and sharing play important roles. Therefore, in this section, these aspects will be examined: 1) is the knowledge

production aimed at improving the understanding of the whole system? 2) are different knowledge systems, such as scientific research and traditional knowledge, being integrated? 3) are experiences, knowledge and information collected and shared among the actors?

Knowledge production

Although individual research might be focused, there are efforts and interests to combine these different efforts to a wider understanding of the system (Skogsstyrelsen, 2013). With this intention, the research programme Heureka financed a project from 2002 to 2009 to develop computer based tools to integrate information from several fields and disciplines and provide information about the entirety of forest dynamics and the influence of forest measures, thus supporting forest analyses of both short and long term perspectives (Skogsstyrelsen, 2013). However, Sandström (2015) found that the dialogue between stakeholders has been hindered not only by the lack of data, but also by the limited use of knowledge already available.

Integration of different knowledge systems

As Sandström (2015) found, existing knowledge was not used to its potential for the communication between stakeholder groups from forestry and reindeer husbandry, prompting efforts were made to formulate tools that enabled the integration of a variety of knowledge and information. Forest plans have been used for the strategic and operational planning of forestry and could be used for communication purposes (Sandström, 2015). Corresponding to forest plans, reindeer husbandry plans were developed by the samebyar (Sandström, 2015) and included the reindeer herders knowledge about their requirements from the forests and supplemented by GPS data of the herd movements that can support and legitimise the herders traditional knowledge (Wennström & Vestman, 2012). For these purposes, a participatory GIS was developed that collected and co-produced knowledge as well as integrating traditional knowledge (Sandström, 2015). Various other groups aim at the integration of formal research with informal or traditional knowledge and experiences and the Swedish Sami association includes it even as one of their goals in their vision document (SSR, 2018). The Future Forests research project about forests and forestry, running from 2009 to 2017, included among other projects also transdisciplinary research, thus including knowledge and experiences of local stakeholders into the formal scientific research (*Kunskap öppnar nya dörrar mot framtidsskogen*, 2019).

Collecting and sharing knowledge

Several measures and projects aimed at improving the sharing of information and experiences, especially through tools or efforts to gather or collect this knowledge. In projects such as the participatory GIS, knowledge is both collected and archived but also shared to inform dialogue processes (Sandström, 2015). For forestry in particular, the forest agency developed an online platform to support the exchange between forest owners who could share their experiences of own experiments they tested out on their forest lands (Sollander et al., 2016). The online platform therefore served to collect, document and share knowledge (Sollander et al., 2016). Further, other interactions between actors from forestry and reindeer husbandry can involve the sharing of information, such as sharing plans for formal consultations (Wennström & Vestman, 2012).

5.2.2 Collaboration

Adaptive governance relies heavily on collaboration between actors. To examine this aspect, the following factors will be considered: 1) how developed is the social network, especially between both actors within the SES as well as external actors? 2) do the relevant actors share a clear and compelling vision that strengthens their collaboration? 3) do the relevant actors have trust in each other? 4) is collaboration supported by bridging organisations or structures?

Social networks

A lot projects and initiatives to develop and improve the cooperation between reindeer husbandry and forestry are financed by governmental institutions, eg forestry agency and regional governments (Sandström, 2015; Skogsstyrelsen, 2013; Wennström & Vestman, 2012). However, the forest users, through associations like Samebyar, the association of Swedish Sami or regional associations of forest owners, also contribute resources (Skogsstyrelsen, 2013). Such collaboration between national and regional governmental organisations, the samebyar, the associations for both Swedish Sami and for forest owners can additionally facilitate the development of further network links between those groups. Furthermore, the FOA representative reported that associations such as their forest owner association aim to connect their members with each other thus strengthening the networks within these actor groups. Outside these groups, the level of contact between people from reindeer husbandry and forestry varies. The FOA representative explained that the forest owners he represents often live close to the reindeer herders, potentially living in the same village, and thus have contact with each other even through their private lives and are able to discuss forest management issues in informal settings. On the other hand, the RH shared during the interview that outside of formal consultations, there is only occasional contact with representatives from forestry.

Clear and compelling vision

Based on their diverse needs and interests in the forest, the various user groups have different visions for how the future of these forests should look like. (Skogsstyrelsen, 2013). The association of Swedish Sami envisions a future with reindeer husbandry that is viable and supported by nature based pastures, while working on improving the sustainability by reducing their carbon footprint (SSR, 2018). In the considerations from the forest agency about the climate adaptation of forests and forestry, the first goal is to ensure a good production and economy both short and long term (Skogsstyrelsen, 2020). The second goal of counteracting the negative effects on functions important for society, nature and culture is phrased more general although it stresses the need to support climate adaptation of reindeer husbandry (Skogsstyrelsen, 2020).

Trust

According to the FOA representative and his experiences over several decades, the relationships between reindeer herders and the forest owners of the land in their sameby district can present very different situations. In some cases, where the relationships are good and there is even informal private contact between people, for example through their children attending the same school or them living in the same village, the communication between the groups may happen in a more relaxed manner as well. While formal consultations may take place, they could often be replaced by more informal discussions in local settings. This willingness to keep the discussions informal indicates a level of trust between the groups. However, in the experience of the FOA representative, the will to work for a good relationship is required from both sides which might not happen if some people are opposed to such cooperation. As such, the relations between groups from forestry and reindeer husbandry are more strained in other areas of northern Sweden. This is supported by the interview with the RH, in whose opinion, the reindeer herders in their sameby have not a lot of trust in people from forestry as they do not feel like reindeer husbandry is being respected. In the opinion of the FOA representative, the complex legal situation is not helpful to the relationship and trust among the reindeer herders and forest owners, especially if the disputes cannot be solved through dialogue and discussions and instead need to be settled via court decisions. Relationships between reindeer herders and forest owners that are more tense and strained might also be reflected in the perception among some reindeer herders that they have little influence on the decision-making for forest management during the consultations (Sandström, 2015; Wennström & Vestman, 2012) which was also expressed by the RH during the interview, while other samebyar report more satisfying cooperations during their consultations with forest owners (Wennström & Vestman, 2012). That the level of trust between samebyar and forest owners is in some cases very weak is also demonstrated

by the concerns that the information from reindeer husbandry plans might be used against the sameby's interest by the forest owners, especially when the plans were still being developed and as such not complete or up to date (Wennström & Vestman, 2012).

Bridging structures

Although there has been cooperation and collaboration between a variety of organisations, this has been mainly for shorter projects. Associations have the potential to link the specific groups they represent to other organisational levels. However, structures or an organisation that serves as a link between the groups from reindeer herding and forestry has not been identified.

5.2.3 Agency and decision-making

Linked to the collaborative nature of adaptive governance are considerations about decisions-making such as 1) is the power over and responsibility for management shared among actors, among them users, communities, and organisations? 2) are there multiple centres of agency which act side by side?

Managerial power and responsibility

Both reindeer herders as well as foresters have the legal right to manage their activities in the forest (Brännström, 2017), therefore a certain level of shared managerial power exists at least legally. The consultations aim to give each group also more participation in the other groups activities, which is supported by voluntary consultations (e.g. because of forest certifications) that go beyond the requirements of the law (Skogsstyrelsen, 2013). However, several samebyar have experienced these consultations to consist mainly as a notification about forest management with little power to influence these decisions (Sandström, 2015; Wennström & Vestman, 2012). Additionally, there are concerns about future developments of the shared managerial power. A document from the Swedish Sami association to support the development of a regional forest programme for the Jämtland region (SSR, 2019b) mentions concerns about some ideas from earlier meetings for this project such as the suggestion to strengthen property rights, as this would shift more decision-making to the forest owners instead of the reindeer herders who rely on their use rights.

Multiple centres of agency

In the past, projects have been initiated and developed by and in collaboration with various organisations on different administrative levels. Similarly, based on a regional request by and in collaboration with several samebyar, a model for the reindeer husbandry plans was developed by the

regional government organisations. (Wennström & Vestman, 2012). This was later developed further by the national forest agency, again due to the initiative and in collaboration with local samebyar, to create a communication strategy to support the usefulness of the reindeer husbandry plans for consultation processes. (Wennström & Vestman, 2012). Other non-governmental organisations have also initiated and financed projects, such as a project about dialogue and collaboration between reindeer husbandry and forestry on family owned and managed land which took place from 2002 to 2004 (Skogsstyrelsen, 2013). As the interview with the FOA representative revealed, there are still efforts to continue dialogue projects between reindeer herders and forest owners. The consultations between foresters and reindeer herders which happen mainly on a local level without much involvement of the forest agency are an example on a local level where management decisions are made decentralised for each forest property and sameby (Wennström & Vestman, 2012).

6 Discussion

Through the analysis using the SES framework a detailed perspective on which factors are currently influencing the SES is given. Especially of importance for the current state of affairs, are the activities of forest owners and reindeer herders in the forests that are used by both groups, their impacts on the resource units of trees and lichen as well as the complex and overlapping legal rights of both groups to use the forests as these are the sources of conflict between reindeer herders and forest owners. Many of the interactions between forest users are aimed at mitigating these conflicts by navigating the different and often opposing perspectives on forest management and facilitating dialogue. This can be through the requirement for formal consultations or via developing and improving the exchange of information. However, political efforts to address the legal situation which is the basis for many of the issues between reindeer herders and forest owners have not been successful (Brännström, 2017).

The potential for adaptive governance to emerge is strongly linked with the potential for self-organisation (Folke et al., 2005; Chaffin & Gunderson, 2016; DeCaro, 2017) and as Ostrom identified several second-tier variables with the potential for self-organisation (Ostrom, 2009), these have also an influence on the potential for the emergence of adaptive governance. Therefore, in addition to the information from the analysis using the framework for the social context of adaptive governance, the information from relevant SES framework variables will be discussed as well.

Overall, much attention had been paid in the past to efforts to improve several aspects of knowledge collection and sharing, aided by the utilization of technologies such as GPS and GIS. Although this compilation of information seems to largely be separated between the groups from reindeer husbandry and forestry, the results can be shared and are used to inform the dialogue between the groups. Through this type of integration of information from different sources, a broader understanding of the SES and the activities of reindeer husbandry and forestry in it is possible. This understanding can decrease costs of self-organisation (Ostrom, 2009).

The variety of projects involving participants from multiple actor groups shows the capacity for collaboration. However, the limitations in time and space of these projects prevents the development of widespread and long term collaboration, especially as the large number of relevant actors increases the costs of getting people to agree on decisions and changes (Ostrom, 2009). This is especially difficult as the lack of trust between reindeer herders and forest owners in parts of northern Sweden, especially in combination with the differing interests and lack of a common

compelling vision, can further increase the transaction costs (Ostrom, 2009). While in other areas of northern Sweden the trust and communication between the groups works better, establishing and developing common organisations could have the potential to link these groups and as a result, also lower the transaction costs of self-organisation (Folke et al., 2005). In an example from southern Sweden, adaptive co-management of a wetland emerged with the support of the creation and further development of a museum about these local wetlands which helped to link actors together and provide an arena to build trust (Olsson, 2007). Thus, this organisation served as a bridging structure, lowering the transaction costs of self-organising (Olsson, 2007).

The collaborative nature of adaptive co-management as a feature of adaptive governance, requires the sharing of power and responsibility over the management (Folke et al., 2005) and as such often presents in multiple centres of agency (Folke et al., 2005; DeCaro, 2017). In this context, while some projects addressing the relationship and communication between people from reindeer husbandry and forestry have been started top-down by governmental institutions, there have been other places of agency as several projects were set up due to more local initiative. However, not all samebyar feel like they are able to influence management decisions made by the forest owners. This indicates that in these cases, the power and responsibility are not shared equally between actors and such experiences can further influence the relationship between them. As the power relations between the actors reinforce structures of decision-making, this is important for the potential emergence of adaptive governance (Folke, 2007; Cleaver & Whaley, 2018) and opens the possibility for future research, for example by incorporating concepts about the distribution of power more closely.

Although the emergence of adaptive governance happens generally through self-organisation, Cosens et al. (2019) note that many of the conditions for adaptive governance can be facilitated through legislation and actions on higher levels. Past efforts have had some success at improving knowledge gathering and information sharing. However, to improve collaboration and thus also the potential for adaptive governance, supporting the relationship between the actor groups from forestry and reindeer husbandry would be a suitable goal for future policy. For example, the establishment and development of bridging structures or organisations can facilitate cooperation and conflict resolution (Folke et al., 2005).

Ostrom (2009) noted that the perception of abundance or scarcity of a resource can also influence if actors see the need to self-organise. Similarly, a real or perceived crisis can facilitate the emergence of adaptive governance by prompting knowledge generation and management changes (Folke, 2005) as a way of avoiding such an undesirable state (Chaffin et al., 2014). Although the activities of reindeer husbandry and forestry affect each other, it is mainly reindeer herders who perceive

scarcity due to these impacts. Climate change impacts, however, are perceived as crisis by both groups as it exacerbates the scarcity perceived by reindeer herders, but also leads to increasing risks and damages to the trees, thus disturbing forestry activities.

Furthermore, forests are generally considered predictable resource systems and as the resource units of trees and lichen are stationary, this supports the management as the costs of monitoring are lower and it is easier to estimate results of rules or policies (Ostrom, 2009). However, as climate change is increasingly changing the climatic conditions with wider impacts, the resource system dynamics become more unpredictable. As anticipatory governance aims to manage this uncertainty through the development of scenarios and related strategies (Hurlbert & Gupta, 2016; Boyd et al., 2015), future research focusing on applicability and importance of anticipation for this shared land used by reindeer herders and forest owners could provide further insights.

This study takes on a broad view on the shared land use between reindeer husbandry and forestry in northern Sweden. But as especially the social interaction between users varies greatly, a more detailed analysis is needed to focus further on the local level and the particular features of specific subsystems of the SES. This is relevant as the size of the resource system can also influence the potential for self-organisation (Ostrom, 2009). While the forest land properties, the reindeer herding area as well as the extents of the samebyar in Sweden are on their own well defined, the various boundaries do not align exactly. This complexity combined with the large size of the resource system hinders the definition of boundaries, resulting in higher costs for monitoring and knowledge generation (Ostrom, 2009). Furthermore, a wider perspective on the governance of northern Sweden might also be necessary. Although it is significant for forestry and reindeer husbandry to consider each others activities, these are not the only industries in northern Sweden as other land uses such as mining, tourism and energy generation also influence northern Sweden. Therefore, a consideration of additional other relevant activities is necessary for a wider evaluation.

7 Conclusions

The challenges of climate change continue to increase complexity, risk and uncertainty within the SES in northern Sweden, where reindeer herders and forest owners share the same forest lands for their activities. In this context, the study was aimed to explore the potential of adaptive governance to improve the cooperation between reindeer herders and forest owners. This research seeks to contribute to the field of sustainability science as it is driven to address the problems arising from the shared use of forest lands, and considers the potential of adaptive governance as an alternative way forward. In this context, the interactions of natural and social systems are examined, utilizing information from a variety of fields and disciplines, while accounting for the knowledge and experiences of relevant actors. For this study, policy documents and academic literature, supplemented by two interviews with a reindeer herder and a representative from a forest owner association, were analysed using two frameworks. The analysis was guided by the SES framework first proposed by Ostrom (2009; McGinnis & Ostrom, 2014) and a framework based on Folke et al.'s (2005) exploration of the social context needed for adaptive governance. In that context, particular attention has been paid to the factors of knowledge, collaboration and decision-making which can support self-organisation and adaptive governance.

The findings indicate that the impacts of forestry and reindeer husbandry practices on each others activities and the capacity to make use of the forest resources is a major influence on the interactions within the SES. This is based on the use rights of both groups to the same land, corresponding to the property rights of forest owners and the rights of longtime customary use as reindeer herders belong to the indigenous Sami people. While generally each group makes use of different forest resources, this can impact the resources utilised by the other group in a variety of ways. Climate change contributes to changes of the conditions in the SES, thus affecting the quality, availability or accessibility of forest resources. Although the impacts from each group's activities are felt more acute by reindeer herders, the changing climatic conditions pose risks for both reindeer husbandry and forestry. Past efforts included collaborations between several organisations including reindeer herders and forest owners or their associations, with high involvement of governmental institutions to improve the dialogue and cooperation. Such projects developed the collection and exchange of information and knowledge between reindeer herders and forest owners, improving the understanding of each other's activities and requirements in the forest. However, regarding the production-oriented forest management, the collaboration is more ambivalent as several reindeer herders feel like they have little influence on the decision-making. The level of satisfaction with the

current cooperation between forest owners and reindeer herders is also demonstrated in how the relationships between those groups are assessed. While the cooperation works well in parts of the reindeer herding area, the amount of trust and respect is perceived as very low by other reindeer herders. Therefore, in order to improve the cooperation between reindeer herders and forest owners, and as a result also increasing the potential for adaptive governance, focus needs to be on encouraging collaboration and trust, for example through bridging or boundary organisations.

8 References

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9 Appendices

Appendix A.

Interview guides

Note: the original interviews were conducted in Swedish.

- Introduce myself
- Shortly explain the topic of my thesis
- The information of the interviews will be handled anonymously
- Ask for consent to record the interview

A.1 Interview with a reindeer herder

- In your opinion, how well does the cooperation between reindeer herders and forest owners generally function?
- How much does your sameby communicate with forest owners outside of formal consultations?
- In your opinion, is enough information about each other's activities being shared?
- Do you believe that more information would improve the cooperation?
- How much contact does your sameby have with other samebyar?
- Do you share a lot of experiences among samebyar?
- How would you evaluate the communication within your sameby?
- Does the communication within your sameby take place in formal or informal settings?
- Are there people you turn to if you need to get in contact with other people or organisations?
- How would you evaluate the general level of understanding and trust between people from reindeer husbandry and forestry?

A.2 Interview with a representative from a forest owner association

- Please describe what is your role in [forest owner association].
- What is [forest owner association]'s role in the cooperation between forest owners and reindeer herders?
- What is your experience with the interactions between the groups from reindeer husbandry and forestry?
- In your estimation, how does and will the effects of climate change influence the cooperation between foresters and reindeer herders?
- From your experience, how are concerns or suggestions from reindeer herding taken into account when [forest owner association] is giving advice on forest management?
- In your experience, are voluntary consultations often initiated and for what reasons?
- In your your experience, does how much do forest owners keep in contact with the samebyar?
- How would you evaluate the communication between forest owners?
- Do they share information and experience about their forest management, both in general and regarding reindeer herding?
- Does [forest owner association] support contact between foresters and how?
- How would you evaluate the level of trust between RH and forestry?

Appendix B.

First-tier and second-tier variables of the SES framework. Adapted from McGinnis & Ostrom (2014).

First-tier variable	Second-tier variable	Code
Social, economic and political settings	Economic development	S1
	Demographic trends	S2
	Political stability	S3
	Other governance systems	S4
	Markets	S5
	Media organisations	S6
	Technology	S7
Related ecosystems	Climate patterns	ECO1
	Pollution patterns	ECO2
	Flows in and out of focal SES	ECO3
Governance systems	Government organisations	GS1
	Nongovernmental organisations	GS2
	Network structure	GS3
	Property-rights systems	GS4
	Operational-choice rules	GS5
	Collective-choice rules	GS6
	Constitutional-choice rules	GS7
	Monitoring and sanctioning rules	GS8
Actors	Number of relevant actors	A1
	Socioeconomic attributes	A2
	History or past experiences	A3
	Location	A4
	Leadership/entrepreneurship	A5
	Norms (trust-reciprocity)/social capital	A6
	Knowledge of SES/mental models	A7
	Importance of resource (dependence)	A8
	Technologies available	A9
Resource systems	Sector	RS1
	Clarity of system boundaries	RS2
	Size of resource system	RS3
	Human-constructed facilities	RS4
	Productivity of system	RS5
	Equilibrium properties	RS6
	Predictability of system dynamics	RS7
	Storage characteristics	RS8
	Location	RS9

Resource units	Resource unit mobility	RU1
	Growth or replacement rate	RU2
	Interaction among resource units	RU3
	Economic value	RU4
	Number of units	RU5
	Distinctive characteristics	RU6
	Spatial and temporal distribution	RU7
Interactions	Harvesting	I1
	Information sharing	I2
	Deliberation processes	I3
	Conflicts	I4
	Investment activities	I5
	Lobbying activities	I6
	Self-organising activities	I7
	Networking activities	I8
	Monitoring activities	I9
	Evaluative activities	I10
Outcomes	Social performance measures	O1
	Ecological performance measures	O2
	Externalities to other SESs	O3