LUISS

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Árbediehtu: Knowledge at Stake

A critical analysis of climate change impact on indigenous non-economic resilience. The case study of Sámi reindeer herding.

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Table of Abbreviations

CC: Climate Change

CoE: Council of Europe

EK: Ecological Knowledge

IK: Indigenous Knowledge

ILK: Indigenous and Local Knowledge

ILO: International Labour Organization

IM: Indigenous Methodology

IPCC: Intergovernmental Panel on Climate Change

IWGIA: International Work Group for Indigenous Affairs

LK: Local Knowledge

TEK: Traditional Ecological Knowledge

TK: Traditional Knowledge

UN: United Nations

UNEP: United Nations Environment Programme

UNESCO: United Nations Educational, Scientific and Cultural Organization

UNFCCC: United Nations Framework Convention on Climate Change

WGIP: Working Group on Indigenous Populations

WIPO: World Intellectual Property Organization

Introduction

Since the 1800s, human beings have been the main driver of Climate Change (Saami Council & Sametinget, 2023), an unequivocal influence according to the IPCC (2021). This new era, called Anthropocene (Crutzen & Stoermer, 2000), has already caused a 1.1°C increase in planet temperatures (Bhandari et al., 2024), with a forecast of a 1.5°C/ 2°C growth throughout the 21st century (IPCC, 2018). This has, in turn, caused substantial damage to ecosystems, often hindering the adaptive capacities of people living in them. Within this scenario, the Arctic has experienced the earliest effect of climate change and the quickest rise in temperature, almost three times faster than the world average rate, with the most significant variations happening in the winter and spring (Arctic Council, 2016).

In light of the anthropogenic changing climate, the over 476 million indigenous people living worldwide (World Bank, 2023b) are generally recognised as among the most vulnerable categories and the first to experience this deterioration (Furberg et al., 2011). The United Nations Declaration on the Rights of Indigenous Peoples (2007, art. 11) protects their right to "practice and revitalise their cultural traditions and customs" and, more generally, to exercise and express their cultural, spiritual, linguistic, and historical heritage. However, climate change emerges as additional external pressure, adding to the legacy of colonisation, globalisation, marginalisation, and the years of cultural assimilation (Pearce et al., 2015). Despite the longstanding climate concern raised by indigenous people, they are the first to experience the consequences (Kaczmarek, 2021). In the words of the former Sámi Norwegian Vice Minister for Labour and Social Inclusion: "Those who are most dependent on nature will also be most vulnerable" (Oskal et al., 2009, p. 24).

Within the subarctic region, there is an area called Sápmi, which means 'land of Sámi[1]' (Jaakkola et al., 2018). The approximately 100,000 Sámi people (IWGIA, n.d.) living there have a longstanding adaptive capacity that shapes their resilience (Ford et al., 2020); however, anthropogenic changes are seen as a disturbing factor rather than a natural course of action. The speed and non-linearity of global

[1] The word Sámi can be spelt differently – Sami, Saami. This study uses the spelling "Sámi" following modern Northern Sámi orthography and its usage for the official names of the Sámi Parliaments in Finland and Norway.

environmental change limit Sámi's ability to keep their traditional knowledge alive, pushing them toward the limits of resilience (Furberg et al., 2011).

In light of the described scenario, there is an urgent need to reduce gas emissions to mitigate cascading effects (Saami Council & Sametinget, 2023). Nevertheless, some research revealed the presence of some unavoidable losses, especially cultural ones (Pearson et al., 2023). For instance, traditional weather forecasting strategies, typically preserved in folklore and folksongs, are hindered by climate change (Tripathi & Singh, 2013), and many agricultural ritual practices are declining (Vidaurre de la Riva et al., 2013). Despite the increasing demand for applying traditional knowledge to global environmental management and sustainable development, even by international institutions like the UN (Oskal et al., 2009), there needs to be more attention to the relationship between intangible consequences of climate change and community resilience. Therefore, this study aims to contribute to the existing literature on the topic, adding a level of analysis which merges the concepts of non-economic loss and indigenous community resilience through a single working concept of 'non-economic resilience', which refers to the role of traditional knowledge in perpetuating indigenous community resilience to climate change. Hence, the research question: "To what extent does climate change impact Sámi non-economic resilience?". The case study of Sámi reindeer herding will be used to examine the question.

The study is divided into four different chapters. The analysis will start with a literature review on the concepts of non-economic loss and community resilience, addressing their relevance for indigenous people in light of climate change. In this first chapter, the academic works will be the basis for providing research-tailored definitions of the two concepts and develop a working definition of 'non-economic resilience'. At the end of this first section, an overview of the Sámi people and the reindeer herding sector will be presented. The second chapter will introduce the theory of landscape memory, as developed by Näkkäläjärvi (2008). This theoretical background will guide the evidence research for the case study. Thirdly, a methodological chapter will detail the approach, data collection, and analysis methods. While adopting an Indigenous Methodology (IM), this dissertation was written by a non-indigenous person whose positionality might affect the literature interpretation and research. Finally, the case study on the Sámi people will provide evidence and arguments to answer the research question. Sámi was chosen as a case study as they are the only indigenous people recognised in the European Union (Näkkäläjärvi et al., 2022), and, living in the Arctic, they are experiencing the fastest changing and warming landscape of the whole globe. The reindeer herding sector is the most viable livelihood and the core expression of

their culture and identity (Markkula et al., 2024; Nilsson, 2014). Hence, this dissertation aims to study the impact of climate change on this sector by shedding light on the consequences for traditional knowledge, which the core component of indigenous resilience. The argumentations envisage the assessment of the impact on (1) reindeer herding traditional knowledge transmission to new generations, (2) Sámi reindeer herding language, and (3) the effect on reindeers' materials handcraft called *duodji.* Findings reveal a reduced sector attractiveness and a gradual loss of transmission of traditional knowledge. The latter unveils a consequent threat to the survival of specialised language and an authenticity issue for *duodji*. The almost total consequentiality of these effects proves the theory of landscape memory in that it shows that traditional knowledge is a lifelong learning process built on different stages.

Chapter One
Literature Review

This literature review offers a comprehensive picture of the academic knowledge developed around 'non-economic loss' and 'community resilience' concepts. This academic basis will position this study within the existing literature and draw from it to define the working concept of 'non-economic resilience', which will be the interpretation key for the analysis. At the end of this section, an overview of Sámi identity and the reindeer herding sector will be presented as an introduction to their culture and knowledge, deemed an essential step before proceeding to the core of the analysis.

1.1 Non-Economic Loss

The expression “total climate losses” is frequently used in climate change studies. It entails the sum of mitigation and adaptation costs, losses, and damages (UNFCCC, 2013). The appearance of the concept of loss and damages dates back to the first drafting of the United Nations Framework Convention on Climate Change in 1991, under Vanuatu's proposal to introduce an international insurance scheme to compensate for small island sea-level rise impacts. Nevertheless, it only appeared in the Bali Action Plan (2007), and gained proper attention with the 2013 Warsaw International Mechanism on Loss and Damage. All these efforts resulted in the creation of the Santiago Network on Loss and Damage (SNLD) and an official loss and damage fund at COP27. Since then, no official definition of loss and damage has been agreed upon at the UN level (Bhandari et al., 2024). Nevertheless, this expression has been widely used to refer to the negative consequences of climate change despite mitigation and adaptation. Barnett and his colleagues claim that "loss arises when people are dispossessed of things that they value, and for which there are no commensurable substitutes" (Barnett et al., 2016, p. 976). Values are socially and culturally constructed; thus, personal and collective experience influences them. They are time- and space-bounded, and, as such, they are embedded in lived experiences, memories, and aspirations.

It is common to distinguish between economic and non-economic losses. The former refers to the effects on markets, resources, goods, and services. Contrarily, the concept of 'non-economic loss' refers to intangible losses that are not formally or informally traded in markets and thus absent in national accounts (UNFCCC, 2013) but are highly valuable for those who suffer from their disappearance (Pearson et al., 2023). Although the distinction between economic and non-economic losses may sometimes overlap, it is essential to note that the latter may have an even stronger impact on communities than the economic losses (UNFCCC, 2013).

1.2 Traditional Knowledge

Among the eight types of non-economic losses distinguished by the UNFCCC technical paper, this dissertation will focus on traditional knowledge (2013). While acknowledging that climate change may also create the conditions for developing new knowledge (McMillen et al., 2017), this analysis will only focus on the threats and losses. Within the literature, there is no agreed definition of Traditional Knowledge (TK) (Kihwelo, 2008; Mugabe, 1999), and it is often interchanged with Indigenous Knowledge (IK), Local Knowledge (LK) and Ecological Knowledge (EK), where sometimes some of these terms are used together to reinforce each other (Purcell, 1998).

Since their appearance, the terms indigenous and knowledge have evolved and got different connotations. As investigated by Purcell (1998), the term indigenous brings a whole history of colonialism and the subsequent western need to identify the non-Caucasian groups of people met by Europeans in their world explorations. However, with time and being adopted by indigenous people, this word has lost its hegemonic connotation. Similarly, with the epistemological revolution of the 17th century, knowledge was associated with verifiability and replicability, thus automatically excluding culturally based knowledge as the indigenous one. However, the '80s marked an essential moment in the history of indigenous rights recognition at the UN and ILO. The Working Group on Indigenous Populations (WGIP) and the 1957 ILO Convention revisions paved the way for adopting indigenous knowledge in development policies. Since this age, traditional environmental knowledge has acquired substantial attention to cope with global environmental change (Matsui, 2015). Thus, reframing the longstanding

dichotomy of science as opposed to tradition and laying the ground for a co-production of knowledge (Berkes, 2009).

Most of the debate emerged around the term ‘traditional’ and its definition. On the one hand, some researchers have considered the word ‘traditional’ to evoke something archaic or obsolete (Anderson, 2009) as if it were a romanticised, static picture of the past antithetical to modernity (Bendix, 1967). On the other hand, scholars like Shils (1981) highlighted the dynamic transmission of traditions through generations, thus subjected to evolution and change. He advanced the belief that traditions exist within the people, communities, or states, and as such, they adapt to a changing environment; they are fluid and made up of people who perpetuate them (Tilley, 2006, cited in Matsui, 2015, p. 8). In this light, other scholars added to the debate that tradition is constructed through present social categories (Linnekin, 1983), advancing the idea that modernity permeates traditions (Singer, 1971). In this sense, traditional knowledge is not only a transmitted content but, most of everything, is a process of observing, reading natural signals, making sense of reality, and generating knowledge out of it (Berkes, 2009).

There are some recurrent elements in defining these concepts. Firstly, it is developed according to a specific geographical area. For some, it is a nonindustrial society where knowledge is accumulated and transmitted through generations to explain the relationship between living beings and the surrounding environment (Jaakkola et al., 2018). Indigenous and local knowledge is a community-based capital, often linked to the local environment. It is embedded in social, cultural, and spiritual practices and constitutes a community's identity (UNFCCC, 2013). It is context-specific, developed through "long histories of interaction with […] natural surroundings” (Nakashima et al., 2017, p. 8). Boven and Morohashi (2002, p. 6) attribute the same meaning to indigenous and local knowledge, defining them as "a complete body of knowledge, know-how and practices" generated and transmitted by people constantly interacting with the environment. From these definitions, it follows that it is orally transmitted across generations (Brush & Stabinsky, 1996), holistic (Kihwelo, 2008), dynamically built (Grenier, 1998), adaptive in nature (Berkes, 2009), and experiential rather than theoretical (Ngulube & Onyancha, 2011). WIPO’s definition (WIPO, 2001) adds a level of analysis that considers indigenous knowledge as one of the different components of more generic traditional knowledge. It is also understood as the tool used to handle socio-economic and ecological issues (Mugabe, 1999) and for advancing decision-making and communication within societies (Flavier et al., 1995 cited in Boven & Morohashi, 2002).

Among these definitions, Traditional Ecological Knowledge (TEK) highlights the link between living creatures and the surrounding environment and reiterates the practical skills gained in interacting with nature (Pearce et al., 2015). It attempts to explain the intrinsic ecological knowledge embedded in indigenous lifestyles and livelihoods (Lemet & Näkkäläjärvi, 2009). According to the Convention on Biological Diversity, it represents the body of knowledge necessary to conserve biological diversity (UNEP, 2011, Article 8j), which nowadays accounts for 80% of the world's remaining biodiversity (World Bank, 2023a). Some studies define it as the thorough knowledge of one's land, which paves the way for adaptations to biophysical variations and the use of environmental resources (Pearce et al., 2015). It entails local observations, practice, and people's relationship with the ecosystem (Berkes et al., 2000). Within this context, when talking about indigenous territories, the term land is recurrent as it evokes a more comprehensive picture, not stopping at the mere geographical territory but including waters and spiritual environments in the concept itself (Ford et al., 2020). This holistic understanding of the land expresses indigenous people's relationship with the place where they live. Indeed, strong links between indigenous communities and their land are recorded worldwide, being the linchpin of their cultural systems. In this sense, "livelihood, health and well-being" are directly determined by land-related activities such as hunting, fishery, and reindeer herding (Ford et al., 2020, p. 532).

Although the debate on terminology remains, this study will use IK, TK, TEK, and LK interchangeably to refer to the body of knowledge, endorsing know-how, beliefs, skills, and practices developed by a specific community in constant interaction with the land and transmitted orally across generations. However, this is a working definition because it is recognised that no universal conceptualisation can be provided given the cultural specificity and the right of each indigenous community to decide what constitutes their own body of knowledge (WIPO, 2001).

1.3 Community Resilience

The concept of resilience emerged in scientific studies to define physical materials' ability to return to equilibrium despite perturbations (Norris et al., 2008). Later, it was introduced to the field of systems by the ecologist Holling to understand to what extent a system can be disturbed before changing its entire structure (1973). Early social sciences borrowed this conceptualisation, emphasising this ability to resist change and restore the original conditions (Perz et al., 2013). However, it lacked the flexibility to capture the complexity of human adaptation throughout time; it did not consider people's historical memory, resulting in a too-static conceptualisation (Kirmayer et al., 2011). Indeed, climate studies have challenged the so-called 'bounce back' definition, pushing academia to embrace a more transformative perspective (Walker et al., 2004). With time, resilience has been widely defined, reflecting the diversity of fields that have adopted this concept. It has been studied as a system through its founding characteristic; as a process with its intrinsic actions; or as the final, desirable or undesirable, outcome (Moser et al., 2019). A fourth definition emerges, which is resilience as a strategy, often related to managing uncertain events, such as climate change (Moser et al., 2019). In this case, it is not a system characteristic or outcome, but it is rather understood as the strategic process behind building resilience (WIPO, 2001). Most studies share the idea of resilience as adaptive capacity (K. Brown, 2016; Norris et al., 2008), which is the ability to adjust, take advantage and cope with consequences (IPCC, 2014). In this regard, Kirmayer et al. (2011) defined resilience as 'resourcefulness' (*débrouillard*), which is the ability to solve problems creatively, taking care of oneself, family, and community.

When it comes to community resilience, it can manifest through resistance to perturbations (Geis, 2000), social recovery from the shocks (Adger, 2000), and creativity to exploit transformation, enhancing the system's functioning and gaining strength (Kulig, 2000). In all these cases, it may express the wideness and endurance of interpersonal connections (Kirmayer et al., 2009). Among the interpretations of community resilience provided by the same authors, this study will focus on how resilience is exhibited, which, according to Brown and Kulig (1996), is rooted in community culture. The latter will be understood holistically as the "anthropological sense of a way of living and understanding the world" (Ekerwald, 1998, p. 16). By the nature of indigenous lifestyles, resilience often assumes a collective feature in the pursuit of constant relationships with other people and the environment (Ekerwald, 1998). Indeed, as indigenous belief systems are often rooted in loyalty and communalism, goals are achieved

through collective actions (Galappaththi et al., 2019). The latter stands as a significant source of resilience for two main reasons: (1) the act of sharing is more than a simple material exchange, and cultural norms of reciprocity are crucial in situations of disaster management (Neef et al., 2018); (2) collective action generates shared leadership, which bringing together different perspectives, and leads to a cultural framework of flexibility and commonality (Ford et al., 2020). This part of the literature on the indigenous ability to cope with environmental changes does not overlook the magnitude of climate change; instead, it aims to raise awareness of the longstanding resilience of socio-ecological systems, a concept which evokes the inextricable relationship between humans and nature (Cinner & Barnes, 2019).

Ford et al. identified six common elements affecting the indigenous ability to cope with and adapt to climate change worldwide, namely "place, agency, institutions, collective action, indigenous knowledge, and learning" (2020, p. 532). In this study, indigenous knowledge will be the main focus, which naturally interwinds with place and learning.

Place is a significant source of resilience as indigenous land attachment explains a sense of moral responsibility to take care of nature (Ford et al., 2020). However, the place can create as much vulnerability through environmental disruptions, which may generate ecological grief. Vulnerability is often defined as a lack of resilience (Arctic Council, 2016). The latter manifests as the inability to cope and adapt to changing conditions. If this is often considered the "flip side of resilience" (Ford et al., 2020, p. 532), the two concepts can also coexist in a complex dynamic of interaction (IPCC, 2014). On this note, Ford and colleagues found coexisting cases of vulnerability and resilience, demonstrating that one does not exclude the other and that these conditions may vary according to the community, time, and external risks. An example of place resilience may be found in the indigenous community of Ka'ūpūlehu in Hawaii, which developed a solid relationship with different places, thus overcoming the vulnerability risk linked to one-place attachment and bringing forward a new, non-static, configuration of "place" (McMillen et al., 2017). This adaptive behaviour showcases a resource management strategy that, rooted in flexibility and mobility, allows the maintenance of the "symbolic, cultural, and livelihoods roles of place" (Ford et al., 2020, p. 534).

Moreover, learning is the process of absorbing and generating new knowledge to reframe problems (Cinner & Barnes, 2019). Experiential learning is vital to indigenous communities because it exposes them to natural conditions and trains people to develop practical responses (Ford et al., 2020). Given the environment's evolving nature, the indigenous knowledge system must be understood as dynamic, pragmatic, and constantly adapting to a changing climate (Ford et al., 2013). The Arctic Resilience

Report definition highlights the "capacity to learn" and implement knowledge while adapting and ensuring a socio-ecological change (Arctic Council, 2016, p. 8).

Lastly, indigenous knowledge emerges as a core component of a community's resilience to climate change (Galappaththi et al., 2019), constituting the grounding system of belief (Ford et al., 2020). Indeed, studies show that indigenous youth perform a higher level of resilience when they feel a sense of belonging to their traditional culture (Kirmayer et al., 2009) and to nature (Brendtro et al., 2001). Indigenous ecological knowledge is developed through careful observations, monitoring (Pearce et al., 2015), and an ability to detect changes (Savo et al., 2016). Additionally, it is considered highly valuable for adaptability (McMillen et al., 2017), for instance, in readapting traditional calendars and readjusting resource management (Ford et al., 2020). Differently from Tilman and Downing (1994), who link the concept of resilience with stability, flexibility is often preferred as it evokes an indigenous lifestyle characterised by a "constant adaptation to changing conditions" (Johan Mathis Turi in Oskal et al., 2009, p. 27). Indeed, it can be considered a dynamic process of adjusting, coping and transforming (Gallopín, 2006). For instance, the herding sector is characterised by seasonal mobility, depending on the availability of water and pasture (Liao et al., 2016). Similarly, in subsistence hunting, the traditional knowledge of species' behaviour and ecosystems makes adaptability to available livestock possible (Pearce et al., 2015). This history of adaptation is not only relevant to the Sámi people as similar patterns have been found in other indigenous communities in the Canadian Artic (Kirmayer et al., 2011; Pearce et al., 2015), in Australia (Vella et al., 2012) or Latin America (Fernández-Llamazares et al., 2015). Drawing from Pearce et al. (2015), adaptive capacity is a feature of human systems comprising a set of resources that can be contingently useful for adaptation, among which there is traditional ecological knowledge.

With all this said, traditional ecological knowledge is considered a core element of resilience, yet it is conditional upon its "development, accumulation and transmission" across generations (Pearce et al., 2015, p. 233). In this sense, it is possible to talk about narrative resilience, rooted in disseminating stories enriched by cultural values, reinforcing communal ties and creating a shared identity. For instance, Pearce et al. (2015) found that despite Inuit's longstanding ability to adapt to environmental changes, the speed of anthropogenic climate change, together with other socio-economic factors, has made experiential and hands-on education very hard. Learning has also been challenged by the increasing diffusion of ecological grief (Cunsolo & Ellis, 2018). In this light, some studies document a loss of traditional knowledge and a weakening of traditions and their transmission to new generations

(Fernández-Llamazares et al., 2015). Cultural continuity is an essential aspect of resilience (Kirmayer et al., 2009) in that it provides the strength to face adversities while maintaining traditional values and beliefs (Reynolds et al., 2006). In addition, it also impacts new generations' identity, adaptability, and capacity to perform cultural roles within the community (Ford et al., 2008). Elders have always been vital in transmitting knowledge; however, language loss and land detachment triggered what has been labelled the "shifting baseline syndrome": a misconception of ecosystem change caused by a shifting point of reference and inter-generational amnesia (Pauly, 1995). In this light, a lack of information or direct experience with past conditions may be the reason why new generations are more prone to accept environmental situations, in which they were raised, as the new norm (Ford et al., 2008). The latter must be understood as an unnoticed loss of knowledge due to scarce communication across generations (Fernández-Llamazares et al., 2015) or disengagement from the land and related activities (Pearce et al., 2015). It is crucial to acknowledge the existence of some other significant external stressors, which, however, fall outside the scope of this study, such as the increasing land and resource exploitation by the majority culture, modernisation and the almost exclusive emphasis on formal teaching methods that discourage experiential learning and reduce inter-generational communication (Fernández-Llamazares et al., 2015). As a consequence, the above-described ability to make sense of the changing environment and resilience might be undermined (Ford et al., 2020).

In light of the academic literature, this dissertation will adopt the following definition of resilience developed by the Arctic Council in 2013: "it relates to their capacity to cope with disturbances and recover in such a way that they maintain their core function and identity. It also relates to the capacity to learn from and adapt to changing conditions, and when necessary, transform" (Arctic Council, 2013). It combines the plethora of concepts reviewed and emphasises the maintenance of the identity, a key concept for the analysis. Moreover, its holistic approach to resilience fits the aim of the study, which is to assess what makes resilience possible for indigenous communities, namely traditional ecological knowledge. Finally, this study highly values the adoption of a conceptualisation that has been participated in by Arctic indigenous people, among which is the Saami Council.

1.4 A Working Definition of "Non-Economic Resilience"

Drawing from the academic literature review on the concepts of traditional knowledge as an expression of non-economic loss and indigenous community resilience, it follows the necessity to develop a working concept for the current analysis, which can add a critical perspective to the investigation. When discussing climate change impacts on communities, resilience is often understood economically, focusing on the ability to "minimise welfare losses" (Hallegatte, 2014, p. 2). Otherwise, when talking about indigenous resilience, the term refers to the community's overall resilience, not necessarily linked to climate change. Talking about non-economic losses alone would take the distance from economic studies, but it would exclude the whole literature on community resilience. Moreover, adopting the term indigenous resilience would be too broad to address the research question on climate change. Therefore, developing the working concept of 'non-economic resilience' naturally sheds light on the non-economic aspects of resilience and immediately links it with climate change. Therefore, this working concept refers to the role of traditional knowledge in exhibiting and perpetuating indigenous community resilience to climate change.

1.5 An Overview of Sámi People

Sámi people descend from the first people who lived in northern Europe after the Ice Age (CoE, 2015). The region where they live nowadays, called Sápmi, has existed since before the creation of state borders in the 19th and 20th centuries (Oskal et al., 2009), and it spans from northern Norway, Sweden, and Finland to the Kola Peninsula in Russia (Furberg et al., 2011). Not all Sámi live in Sápmi, as only half of Sámi actually speak the language as their mother tongue (Nilsson, 2014). It follows that all nine Sámi languages are classified as endangered (CoE, 2015; UNESCO, 2010), and only a few people speak the minor languages (Jaakkola et al., 2018).

Sámi identity is defined by a complex interaction of numerous elements, which can be more or less subjective and can vary according to time and place. In the three countries of Norway, Sweden and Finland, Sámi is mainly defined through linguistic knowledge or kinship (Näkkäläjärvi et al., 2020). However, Sámi ethnicity also means integrating into community life, especially in small villages where Sáminess is the majority (Berg-Nordlie, 2022). According to a Sámi ontology, humans and nature are profoundly interlinked, and the ultimate aim is the maintenance of harmony within the ecosystem (Saami Council & Sametinget, 2023). Therefore, Sáminess is grounded on *gulahallat eatnamiin*, which expresses the idea of living in harmony with nature (GRID ARENDAL et al., n.d.). Reality is constructed from an animistic perspective according to a dynamic interplay between humans and non-humans living in the same environment (Helander-Renvall, 2010). Indeed, all Sámi traditional livelihoods draw from nature, like fishing, hunting, reindeer herding, gathering and handcrafting (in Sámi called *duodji*). Sámi people have been reindeer herders since ancient times. They are among the twenty indigenous people in the Arctic engaging in reindeer herding as their primary activity (Oskal et al., 2009). In Sweden and Norway, only Sámi people can be reindeer herders (Jaakkola et al., 2018), while in Finland, there is no such legal limitation; nevertheless, Sámi herding areas are separated (Oskal et al., 2009). This profession is vital for the Sámi economy as it provides meat production and materials for traditional handcrafting *duodji* (Oskal et al., 2009). However, a reindeer herder is not just a businessman, as in many other industries, but a cultural holder who retains and transmits knowledge (Nilsson, 2014) through Sámi professional language (Oskal et al., 2009). The reindeer herding sector is organised through *siidas*, which is an *ensemble* of independent households. The *siida* does not own reindeer, and it is not an economic enterprise but provides the necessary resources for the households through its own pasturing and

migration routes. The only exception to privately owned reindeer is in the Russian area (Oskal et al., 2009). *Siida* foundation is at the base of reindeer herding; within these units, it is important to know the Sámi language and a specialised terminology (Sara, 2009). At the core of reindeer herding is that Sámi exercises control over the animals; however, it should respect the reindeer's autonomous adaptation to pasturage and the environment. Therefore, the whole practice is based on observing and understanding reindeer nature (*bohcco luondu* in Sámi) (Oskal et al., 2009). This holistic view of the relationship between the herders, the reindeer and the surrounding environment is embodied in the word *árbediehtuv*[2], which means traditional knowledge (Porsanger & Guttorm, 2012). Heritage, traditions and lifestyles are the cornerstones of this knowledge, collectively generated, individually carried, and orally transmitted. It is dynamic in nature as it adapts to the changing environment and across generations (Sametinget, 2019).

[2] "*Árbi* means heritage and *diehtu* knowledge" (Porsanger & Guttorm, 2012, p. 98)

Chapter Two

The Theory of Landscape Memory

The theory of landscape memory is adopted as a theoretical framework to add a level of accuracy to the development of traditional and ecological knowledge and to assess how it is affected by climate change. At the origin of the relationship between landscape and one's memory, there is Schama's book "Landscape and Memory" (Schama, 1996), which draws from Magritte's idea that the surrounding landscape is a mental representation of an internal experience, thus resulting in a mutual shaping relationship. On this ground, Näkkäläjärvi develops an alternative way of looking at landscapes that aim to grasp the intricate relationship humans have with the land (2008). Therefore, a threefold perspective emerges for landscape analysis: material, symbolic, and functional. The landscape is materially perceived through the visible physical elements, symbolically experienced through the attached cultural meanings, and functionally perpetuated through rituals and practices which keep the memory alive. In this sense, it develops the concept of a second landscape, which overcomes the idea of a mere physical surrounding nature and assumes a deeper connotation shaped by its cultural significance (Hirsch & O'Hanlon, 1995). This theoretical model brings under the same umbrella concept the practical professional knowledge and the learning process of Sámi reindeer herders (Näkkäläjärvi, 2008). This way, traditional and ecological knowledge is placed within a more comprehensive learning process invested in individual and community memory. It goes beyond what has been defined as 'land skills' by Pearce et al., entailing mere environmental knowledge and skills acquisition (2011). Within the reindeer herding field, landscape memory is the ability to monitor, perceive and adjust to changes (Saami Council & Sametinget, 2023), is passed on through generations and is thought especially with direct experience in nature (Näkkäläjärvi et al., 2020). Some studies prove that this culturally built landscape memory is typical of various indigenous knowledge systems, not only Sámi (Näkkäläjärvi et al., 2022).

The theory of landscape memory starts from the individual ethno-ecological niche involving personal memories and experiences. This stage highly relies on the family, which introduces children to this sector already at an early age (6-12 months) and sets the ground for individual learning (Bongo & Eira, 2023). However, it is essential to complement reindeer herding sectors with a collective experience. Indeed, the

enculturation process is the primary mechanism linking the individual niche to the landscape. Differently from socialisation, which is understood as a universal learning process toward societal integration, and acculturation, which is considered the assimilation within the mainstream culture, enculturation is a lifelong learning process of one's own ethnic culture (Zimmerman et al., 1996), which entails actual embeddedness as final stage (Mead, 1963). It is a multidimensional lens to look at ethnic identity, articulating from the more abstract values to the practical technical skills (Zimmerman et al., 1996). It is a collective and dynamic learning process where knowledge is orally transmitted and shaped by each generation. Through this experiential process, landscape acquires deep cultural significance (Näkkäläjärvi, 2008). For Sámi reindeer herders, enculturation happens within the *siidas* (Bongo & Eira, 2023), constituting the professional forum where knowledge is held, tested, and renovated through community debate on practice-oriented solutions (Sara, 2009). This knowledge is held by communities and anchored in careful observations of nature and animals (Oskal et al., 2009). A crucial component in this process is language. Drawing from sociolinguistic studies, enculturation and language learning occur simultaneously and shape each other (Ochs & Schieffelin, 1984). Hence turning in a "language enculturation" (Näkkäläjärvi, 2008, p. 46). The latter acquires great relevance when applied to reindeer herding as it evokes the oral and informal nature of traditional and ecological knowledge, which is held by the community and articulated through specific terminology. As a result of these two phases, cultural know-how is developed, as the practical skills related to the sector. All this said, the theory of landscape memory emerges as a tool to holistically interpret the indigenous learning process.

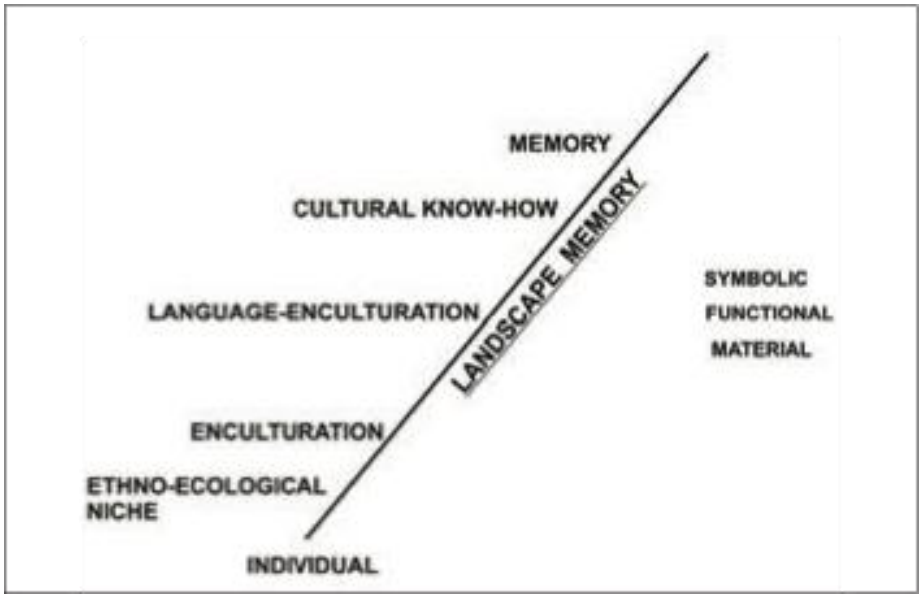

Figure 1: The dynamic process of landscape memory (Näkkäläjärvi, 2008, p. 44)

In light of the research question, exploring the impact of climate change on the non-economic resilience of the Sámi people, the chosen theoretical model will be examined in relation to climate change. In this way, the analysis will focus on how climate change serves as an external stressor within the landscape memory process. In this way, it will be possible to investigate the impact climate change has on the different phases, whether it is consequential starting from the ethno-ecological niche or whether a different interaction dynamic is found. It will also reveal whether climate change modified the landscape's symbolic, functional, and material features for Sámi. This theory guides the development of context-specific argumentations drawing from the four main components of a landscape memory: ethno-ecological niche, enculturation, language-enculturation and cultural know-how. Mirroring these phases, this study will focus on (1) the transmission of reindeer herding knowledge, (2) the Sámi language role in this mechanism, and finally (3) reindeer materials in traditional handcrafting *duodji*. The aim is to reveal the extent of climate change's impact on traditional knowledge, which is the cornerstone of non-economic resilience.

Chapter Three
Methodological Approach

The methodological approach ensures that the author's non-indigenous positionality would not perpetuate a Western approach to indigenous research. Hence, adopting an indigenous research paradigm entailed understanding an indigenous ontology, epistemology, methodology and axiology (Wilson, 2001). The ontological and epistemological approaches to what reality is and how indigenous think about reality was informed by the principle of 'wholism' understood as the interconnection among animate and inanimate things (Pidgeon & Riley, 2021) sharing the "essence of life" (Smith, 2012, p. 74). A wholistic perspective was considered necessary to approach *árbediehtu* (traditional knowledge) to prevent any "loss, erosion and exploitation" of knowledge within and through the research (Armstrong, 2010, p. 84). The methodological approach was guided by indigenous axiology, specifically Sámi publications on ethical guidelines (Heikkilä, 2021; Jonsson, 2011; Porsanger, 2004). Finally, an Indigenous Methodology (IM) rooted in the principles of respect, relevance, reciprocity, and responsibility was adopted (Pidgeon & Riley, 2021). As a non-indigenous person conducting the research, the first step toward adopting a respectful and responsible approach to indigenous knowledge was understanding and working on my positionality in interpreting data, acknowledging the possibility of some bias as research limits. Relevance and reciprocity were informed by informal contacts with Sámi people – at the 'Arctic Forum and Indigenous People Dialogue' organised by the European Commission [3] and via correspondence – to which the research objectives were exposed and with whom general knowledge on the topic was exchanged. Complemented by a through academic literature analysis, the following research question was developed: "To what extent does climate change impact Sámi non-economic resilience?". This question will be investigated through the Sámi reindeer herding case study. It was decided to focus on indigenous people for their strong attachment to the land and consequent high susceptibility to climate change (Vella et al., 2012). Specifically, Sámi people because, among the world's indigenous people, those living in the Arctic are experiencing the fastest-changing climate. Hence, the Sámi people, the only indigenous people recognised in the European Union, were considered a good case study for a more in-

[3] The Forum was organised by the EU Commission and the EEAS on the 14th and 15th of May in Brussels

depth assessment of non-economic resilience. The novelty of the approach lies in combining the concept of non-economic loss and community resilience in one working definition of 'non-economic resilience' and assessing how climate change has affected it through the theory of landscape memory perspective. The research collects evidence for climate change's impact, assessing the intergenerational transmission of knowledge, the related linguistic component and the consequent impact on traditional handcrafting *duodji*. Some studies highlight that spirituality is critical to indigenous resilience (Armstrong, 2010). However, following informal, informative contacts with Sámi, it was decided to leave Shamanism and rituals related to reindeer herding out of the analysis as an outsider study of this topic could harm the revitalisation process and perpetuate western stereotypes and exotification of indigenous culture.

A qualitative indigenous critical analysis guided the collection of relevant data for the case study. It envisaged desk analysis of several relevant sources. Despite the lack of direct interaction with Sámi reindeer herders in an ethnographic study, this research tried to be as close to people's declarations as possible. Analysis of the case study heavily relied on primary sources presenting fieldwork or qualitative interviews with *árbečeahpit* [4] (Sámi knowledge holders), which include Arctic Council (2016); GRID ARENDAL et al. (n.d.); Magga et al. (2011); Näkkäläjärvi et al. (2020); Oskal et al. (2009); Saami Council & Sametinget (2023). Secondary sources have complemented these argumentations, namely Axelsson-Linkowski et al. (2020); Furberg et al. (2011, 2018); Jaakkola et al. (2018); Löf (2013); Markkula et al. (2019). Sources were consulted in English and translated from Norwegian, Swedish, Finnish, and Sámi to ensure a wider variety and a closer approach to the community.

Aware that Sámi people live in four different countries and that some differences exist among them, this study emerges from the need to develop a comprehensive picture of the whole region, as stated by Näkkäläjärvi et al. (2020). Indeed, similarities exist within the cross-country reindeer herding sector, namely the organisations in *siidas*, the construction of landscape memory, the identarian relationship with this profession, and the pasture cycles, among others (Näkkäläjärvi et al., 2022). Therefore, this research decided to study the whole geographical area; thus, collecting more reports and studies based on first-person declarations.

[4] "*Árbečeahppi* (plural: *árbečeahpit*) is a person who has, or can perform, *árbediehtu*" (Jonsson, 2011, p. 98)

Chapter Four
Case Study: Sámi

This chapter provides evidence on the impact of climate change on non-economic resilience experienced by Sámi people in relation to reindeer herding. Evidence is collected to develop three main arguments rooted in the landscape memory theory: enculturation, or reindeer herding knowledge transmission, traditional know-how called *duodji*, and language enculturation.

4.1 Enculturation: Knowledge Transmission

Reindeer herders are deeply interlinked with the ecosystem; therefore, above everybody, they are highly exposed to climate change (Furberg et al., 2011). Historically, reindeer herding has always been grounded on adaptive capacity and resilience. At the core of the herders' traditional knowledge is the survival strategy of living in a changing nature (Magga et al., 2011). However, Furberg et al., (2011), in their direct interaction with Sámi reindeer herders, report that, differently from the other environmental changes, the Anthropogenic ones are something they do not recognise. They feel that seasons have changed and been disturbed (Karen Anna Logje Gaup, Reindeer Herder in Oskal et al., 2009).

Indeed, climate change brought seasonal variations, reducing the typical eight seasons of the herding sector to four (Magga et al., 2011). Herders have perceived longer autumns, shorter winters and springs, with an increase in temperature throughout the year. The overall changes seem to be more extreme: the sun is hotter, rain is more abundant, especially in winter, snow is more intense, but it melts faster, and wind increases in frequency and intensity, especially in Finland and Sweden (Näkkäläjärvi et al., 2020). More specifically, the autumn season has extended, becoming wetter and warmer with temperatures approximating 0 °C (Furberg et al., 2018). Winter is warmer and, overall, much more unstable than before. There is an increasing unpredictability between freezing, thawing and precipitation rates (Oskal et al., 2009), which can be highly distressing for herders (Furberg et al., 2011). Earlier springs can be

seen as an advantage for some but also a significant disadvantage for others because of their impact on the calving period and the absence of snow crust, making migration harder (Furberg et al., 2011). Some predictions for 2070-2099 report an increase of around 11°C and 7°C during winter and spring and 5°C during summer and autumn. Contrasting perspectives have been collected on summers, which are perceived as the least changed season overall (Furberg et al., 2018). While some complain about the warmer weather melting the 'nival patches'[5], some others believe that real hot summers do not exist anymore. Interestingly, a few interviewed reindeer herders brought a positive outlook on climate change, highlighting the benefits of a longer summer season and a shorter severe winter benefitting reindeer pasturage and survival (Furberg et al., 2011). Overall, temperature fluctuation in winter, and longer heat periods in summer, caused significant instability, snow-related accidents and heat stress (Näkkäläjärvi et al., 2020). In light of the evidence on environmental variations detailed above, reindeer herders feel that their longstanding knowledge does not match reality, new phenomena are occurring, and the old signs are not reliable anymore (Furberg et al., 2011). In addition, some interviews express concerns about whether the reindeer can adapt to a warmer world (Markkula et al., 2024).

As reflected by herders' declarations, this sector has experienced three main challenges, namely grazing lands availability, migration difficulties and predator's threat.

Firstly, pasture availability is the core of reindeer herding; therefore, any reduction in this resource will strongly affect reindeer health and survival. However, climate change has strongly impacted pastures (Saami Council & Sametinget, 2023). Among the main changes, grazing areas and tree-hanging lichen are disappearing throughout the migration route, the frozen lichen on the ground prevents reindeer from grazing properly (Axelsson-Linkowski et al., 2020), the tree line is rising to what was bare mountain before, and spruce forests are growing where they should not be and have never been in the past. Lichen is growing slower, and other vegetation has taken its place, like bushes, brushwood (Furberg et al., 2011) and moss. Moreover, climate unpredictability makes it difficult to make grazing predictions (Saami Council & Sametinget, 2023), thus challenging the usefulness of passing down elders' knowledge to new generations (Näkkäläjärvi et al., 2020). Indeed, some herders feel uncertain about trusting their reindeer and grazing knowledge (Saami Council & Sametinget, 2023). Given the varied seasonality, the most frequent and diffused adaptation method is a modification of grazing cycles (Näkkäläjärvi et al., 2020). Sudden and early springs forced the herders to leave the mountain before usual to prevent destroying the

[5] Scattered areas of land covered by snow (Furberg et al., 2011, p. 5).

grazing lands. According to some declarations, this was unthinkable years ago, yet it became necessary due to climate change. Moreover, poor and scattered pastures made labour more intense, and supplementary feeding necessary (Furberg et al., 2011). Nevertheless, the latter is only a last-resort tool as it is considered expensive and also work-intensive (Löf, 2013).

Secondly, migration over land has become one of the main challenges, especially when lakes and rivers are encountered throughout the path (Saami Council & Sametinget, 2023). When the waters would freeze in October, herders could move the reindeer through the lakes following the migration route. However, as the lakes freeze much later or the ice is too thin, migration toward winter-grazing lands is challenged (Furberg et al., 2011). Similarly, snow can appear early but disappear, leaving space for rainy December and reappearing soon after. In addition, early sleet can drive reindeer to migrate too early (Furberg et al., 2011). All this said snowmobiles are becoming necessary for monitoring and herding reindeers. Nevertheless, they bring additional costs and problems, making tracks very hard and impeding reindeer to dig through and walk on easily (Axelsson-Linkowski et al., 2020). Moreover, due to the use of technology, some herders shed light on the possible loss of knowledge on foot migration (Axelsson-Linkowski et al., 2020).

Thirdly, due to the absence of thick snow, predators can move around more easily and attack reindeers. Predators' threat is an additional pressure, as it creates a risk for the industry and mental stress for the herders as they grieve for their reindeers (Furberg et al., 2011). GPS and helicopters emerged as useful technologies for monitoring the herds from predators and preventing them from spreading around, especially during warmer summers in search of early mushrooms (Furberg et al., 2011).

Although TEK helps them be flexible and readapt to changing circumstances (Axelsson-Linkowski et al., 2020), traditional methods seem more and more inapplicable to today's climate (Furberg et al., 2011). While climate change advances, this sector relies increasingly on state subsidies, which help the herder in case of loss to predators, need of supplementary feeding or as a slaughter subsidy (Furberg et al., 2011; Næss et al., 2011). New solutions had to be found, like the use of motor vehicles for travel, trucks for reindeer transportation and additional feeding to compensate for the reduction of pasture, especially in winter (Näkkäläjärvi et al., 2020). Climate unpredictability, the changed seasonal routine and the availability of grazing lands have posed numerous challenges (Axelsson-Linkowski et al., 2020), causing, in turn, income uncertainty and a reduced sector attractiveness for new generations (Furberg et al., 2011). According to Marrakula et al., the combination of climate change and external land use will reduce the number of reindeer herders in the future (2024), questioning their occupational safety

(Näkkäläjärvi et al., 2022). Decreasing grazing land and an increasing need for bigger herds make it hard to survive financially only in this profession. Many people need to have a second job or often decide to abandon this livelihood and dedicate their time to different industries (Furberg et al., 2011). Indeed, reindeer herders' income in Sweden usually derives from commercial trade and economic compensations in case of losses due to predators. Some studies found that among Swedish herders' households, most income derives from women's employment. Therefore, given the situation, some see the herding profession as becoming only a hobby in the best-case scenario (Furberg et al., 2011).

One core consequence of the changing nature of this sector is that new generations will acquire a shifted landscape memory. Similarly to what was defined in the academic literature as the shifting baseline (Fernández-Llamazares et al., 2015; Pauly, 1995; Pearce et al., 2015), youth interested in perpetuating this tradition will get climate-adapted knowledge (Saami Council & Sametinget, 2023). Some declarations recognised the generational nature of climate knowledge as if it was more of a renewal rather than a loss, especially when it comes to new technological knowledge (Näkkäläjärvi et al., 2022). Nevertheless, more evidence highlights that climate change is among the major threats to the sector's survival (Markkula et al., 2024). Moreover, all the uncertainties related to this sector of climate adaptation make it very hard for youth to start this profession (Saami Council & Sametinget, 2023) to learn practical skills experientially (Furberg et al., 2011), causing, in turn, a generational skills gap (Näkkäläjärvi et al., 2022). The gradual loss of knowledge may also threaten younger generations who, lacking thorough landscape memory, are more inexperienced in coping with dangers (Pearce et al., 2011). Explicative of the fast-changing environment is the fact that new generations affirm they have never lived a 'normal' winter as it was in the past, temperatures are set to rise 7-8°C in the next century in Sápmi, and the Artic is expected to be sea ice free at least once in the years before 2050 (Saami Council & Sametinget, 2023). Similarly, knowledge of the traditional annual cycle is disappearing as seasons drastically change. Some more hopeful Sámi are willing to do their best to perpetuate this tradition, but even in these cases, uncertainty is the central theme (Näkkäläjärvi et al., 2020). All reindeer herders interviewed by Axelsson-Linkowski et al. (2020) emphasise the importance of learning this profession from family. Although youth recognise the importance of learning from elders and acquiring traditional knowledge, the difficulties brought by climate change led to a reduced enculturation mechanism hindering not only the chances to acquire relevant skills but, most importantly, to approach it holistically as the source of livelihood and part of oneself ethnic identity (NUOR, 2021). The elders' concern about the gradual loss of transmission of traditional ecological knowledge to younger generations mirrors

Pearce et al.'s findings on the different rates of skills transmission among generations, where the youngest rated the lowest (2011). In terms of effects at the community level, the increasingly limited number of jobs within this field created an inter-generational discrepancy and an increased rate of outmigration. Not to mention the increased stress and concerns for the permeance of culture, TK, and skills (Näkkäläjärvi et al., 2020). An interesting perspective comes from those who believe that retiring without children willing to carry on the tradition seems to be a relief (Furberg et al., 2011). To signify that the pleasant memory and the quality of life this profession would bring in the past cannot overcome the numerous difficulties and worries herders face nowadays.

Indigenous cultural continuity is a core component of resilience (NUOR, 2021). Within this context, future generations will not only lose a tool for adaptation but also significant part of their landscape memory. Therefore, the threat to knowledge transmission impacts Sámi overall adaptability, well-being and quality of life (Daerga et al., 2008).

4.2 Traditional Know-How: *Duodji*

A direct consequence of climate impacts on reindeer herding is the whole ecosystem of cultural practices and traditions related to it. This framework places great attention on the traditional handcraft called *duodji*. The latter refers to the objects used daily and those holding a more spiritual significance for Sámi (Larsson et al., 2021). The etymological roots of the word suggested that anything hand-made can be *duodji;* however, with time, it has mainly been associated with utensils, clothes, knives, jewellery, cradles and sledges, more spiritual articles, or nowadays, even more artistic items (Koslin, 2010; Larsson et al., 2021). It is an expression of the profound relationship Sámi has with nature (Valkonen & Valkonen, 2014), from which they take "inspiration, themes and materials" (Markkula et al., 2019). *Duodji* requires specific knowledge of materials, qualities, and seasonality (Lethola, 2001 cited in Valkonen & Valkonen, 2014, p. 31). Indeed, materials are collected when seasons make them available according to their rhythms (Näkkäläjärvi and Juntunen, 2015 cited in Markkula et al., 2019, p. 1080). Some examples of materials traditionally employed to craft functional objects are bones, leather, and wood (Koslin, 2010). Among them, reindeer materials are essential for *duodji*, especially because of their thermal feature, which keeps the human body warm even at subzero temperatures (Koslin, 2010).

As declared by a Sámi *duojár* [6], reindeer antlers are used for various handcrafted products, like knives. However, if climate change alters pasture availability in spring, antlers in autumn are of bad quality and cannot be used for handcraft (Saami Council & Sametinget, 2023). Moreover, access to good wood material is challenged by felling forests and moths' outbreaks on birch trees, facilitated by increasingly warmer weather (Markkula et al., 2019; Vindstad et al., 2022). Materials' access issues led many *duojár* to craft objects with plastic in spite of reindeer antlers or wood. Typically, none of the handcrafted objects would contain plastic and would only be made out of natural materials because items were crafted with the idea that they could eventually return to earth (Larsson et al., 2021). Plastic's diffused availability and low costs have influenced traditional handcrafting, presenting a solution to the limited availability of materials. Whether it offers a modern twist on traditional Sámi techniques, allowing for the preservation of cultural heritage while experimenting with contemporary materials, these adaptations raise a question of authenticity (GRID ARENDAL et al., n.d.). It raised debate about the balance between tradition and innovation, quality standards and synthetic materials. Therefore, the decrease in the use of natural resources and the emergence of plastic are leading to significant cultural developments that have impacted *duodji* traditions and language. In addition, it is worth considering that decorations and colours are inspired by nature, which attaches symbolic value to the items (Larsson et al., 2021). Thus, a changing landscape, like the typical northern lights and autumn foliage, equally impacts the final product (Saami Council & Sametinget, 2023).

Following the above-described impacts on reindeer herding, direct consequences are recorded on *duodji* handcrafting. Climate change may limit the access and use of necessary materials or change the season for the gathering; thus challenging one of the practices that hold most symbolic value for the Sámi people (OECD, 2019).

[6] A person who practices *duodji* (GRID ARENDAL et al., n.d.)

4.3 Language Enculturation

Sámi languages are at the core of indigenous culture; they enable traditional knowledge transmission across generations and perpetuate the community's memory (Lemet & Näkkäläjärvi, 2009). They serve as a link to the culture and the surrounding environment (CoE, 2015). Therefore, language preservation is fundamental to keeping culture and traditions alive. Sámi technical vocabulary related to reindeer herding has been transmitted for thousands of years. This terminology was transferred from deer hunting to reindeer herding without significant modifications (Lemet & Näkkäläjärvi, 2009). Words and concepts that have existed since the Stone Age are now threatened to become obsolete and disappear due to climate change. According to Lemet and Näkkäläjärvi (2009), Licentiate in Philosophy and former President of the Sámi Parliament in Finland, respectively; protecting traditional knowledge, livelihoods, and models is a necessary condition for indigenous language preservation. In this light, transferring language is not only a matter of words for communication but, most importantly, the transmission of cultural know-how (Näkkäläjärvi et al., 2020). Indeed, the reindeer herding industry is carried out through the Sámi language (Nilsson, 2014), which retains a linguistic heritage that can only be recovered if knowledge is transmitted to future generations.

Their wealthy knowledge of landscapes – spanning from forests, coastal areas, and mountains to snow and reindeer herding – is pivotal to the Sámi livelihood and ecological process to the extent that it is embodied in their language (Jaakkola et al., 2018). Around 2000 terms in North Sámi are only used to describe nature (Lemet & Näkkäläjärvi, 2009). Moreover, since herders need to be able to recognise reindeers, to define herders' movements and reindeer's pasture (Näkkäläjärvi et al., 2022), around 1000 words exist to describe reindeer appearance, among which 50 refer to antlers specifically (Eira et al., 2008). Furthermore, Sámi reindeer terminology is so specialised that it envisages 318 words to describe different types of snow and snow conditions (Eira et al., 2018). Knowledge about snow is necessary for survival, especially during these rapidly changing climates. For instance, different words have been developed to refer to (1) the possibility of finding moss under the snow cover *guohtun*, (2) untouched snow by the reindeer *oppas*, (3) reindeer grazing hole *suovdnji*, and (4) the area where reindeer have been grazing *fieski* (Eira et al., 2008). Additionally, the Sámi language includes many terms particularly important for handcrafting, like those describing reindeer skin sex, colour, age, slaughtering period, and the tanning or fat used for preserving it (Koslin, 2010). In this light, scarcity or change in materials'

quality may cause a linguistic loss relevant to the *duodji* sector. Finally, supplementary feeding would turn reindeer herding into a domestication of the animals. It means that the more reindeer are domesticated, the less they need to migrate within the environment. Hence, this will challenge not only the nature of the profession but also the terminology related to migration and different landscapes. If grazing cycles change, the wide variety of plants, around 300, consumed by reindeer disappears, affecting in turn fat and taste composition of reindeer meat. What follows is that vocabulary related to this concrete reindeer herding knowledge will gradually become obsolete (Lemet & Näkkäläjärvi, 2009). On the other hand, the emergence of new phenomena is also causing a significant threat to the Sámi language and knowledge transmission as it cannot describe the environment and the new circumstances (Axelsson-Linkowski et al., 2020).

From this evidence, it is possible to say that the Sámi language is experiencing a twofold challenge: the obsolescence of specific vocabulary describing phenomena that no longer occur and the lack of terminology to describe new conditions (Näkkäläjärvi et al., 2022). In this light, language loss concerns coexist with the urgency to develop new vocabulary (Eira et al., 2008). Languages need practice and active use to survive (Nilsson, 2014). Hence, the gradual loss of inter-generational transmission of reindeer herding and *duodji* practices may cause a consequent linguistic loss. In this light, some herders interviewed by Näkkäläjärvi et al. (2022) express their concern about Sámi survival as the working language of reindeer herding. Language alone is not the answer to climate hazards. However, language revitalisation is a core element of indigenous resilience (Kirmayer et al., 2009). The importance of linguistics is also shared and recognised by young people who are afraid of losing a big part of their identity, as declared in the Sámi Youth Declaration on Climate Change (NUOR, 2021). Consequently, a loss of linguistic diversity will likely diminish Sámi adaptive capacity because the body of knowledge they can rely on is likewise reduced (Bernard, 1992).

4.4 Discussion

Sámi reindeer live according to nature's rhythms, migrate on a seasonal basis and adapt to changes. Thus, a thorough familiarity with the environment and nature has always been the key to resilience (Lemet & Näkkäläjärvi, 2009). Recalling the theory of landscape memory, knowledge is constructed through a life-long learning process that starts from an individual experience and develops through community enculturation, where language plays a vital role and ends in developing cultural know-how. This theoretical framework guided the evidence research related to the impact of climate change on the reindeer herding sector and the resulting consequences for knowledge transmission, linguistic survival and *duodji* know-how.

Overall, evidence showed that environmental variability threatens knowledge transmission to new generations for several multifaceted reasons. Interestingly, the fast-changing landscape questions the actual usefulness of transmitting knowledge to new generations. The emerging phenomenon made traditional knowledge inapplicable and sometimes unable to support forecasts, the definition of cycles and rotation systems (Näkkäläjärvi et al., 2020). However, despite the number of new phenomena, the existence of this body of knowledge remains the linchpin of the herder's adaptive capacity. Therefore, despite the debate on the usefulness of transmission, it is still widely considered the core component of resilience. Nevertheless, readaptation did not come without costs. Introducing new technologies and supplementary feeding increased the general expenditure in light of unstable revenues. Financial instability, the need to complement income with secondary jobs, and the increasing need for state subsidies have reduced the sector's attractiveness to new generations and, in some cases, reduced parents' willingness for their children to take on this profession. This, together with the reduction of experiential learning and a more general clime of uncertainty, is gradually reducing the transmission of traditional knowledge to new generations. The results are (1) a shifted baseline for climate adaptation, (2) the rise of possible risk in coping with unexpected hazards, (3) the increased outmigration of people in search for new professions, (4) the overall impact on resilience, well-being, and quality of life. These findings show that climate change primarily impacts the first two phases of the landscape memory theory, namely the individual ethno-ecological niche, rooted in family experience, and the community enculturation, with a possible cascading effect on the sector's know-how and skills.

Changed seasonality and reindeer herding difficulties are mirrored in the traditional handcrafting *duodji*. Inaccessibility and poor quality of natural materials with increased availability of plastic have changed traditional crafting. In this case, the evidence did not show an alarming threat to the sector's survival or the transmission of knowledge. However, it raised the debate on whether alternative materials can ensure authenticity. In this case, as part of the more holistic reindeer herding sector, *duodji* know-how is indirectly affected by climate change for what concerns its authenticity and tradition but not necessarily for its endurance in time.

Regarding linguistic enculturation, evidence shows a more complex and less linear reality than the one described in the theory. Indeed, drawing from the theoretical approach, language constitutes the tool for enabling enculturation and holding traditional knowledge. This relation is confirmed by the analysis in that a reduced transmission of knowledge and its inapplicability is the cause of language loss or obsolescence. However, it was also found to be a reversed interaction. The emergence of new phenomena has questioned linguistic appropriateness, urging the creation of specific terminology for transmitting knowledge. Therefore, the lack of *ad hoc* vocabulary is also hindering the transmission knowledge. Sámi reindeer herding proved that language is an essential tool for thinking and to shape people's thinking; it shapes culture as much as culture shapes languages (Sapir, 1968).

Overall, climate change has impacted Sámi's non-economic resilience, understood as traditional knowledge, and the whole landscape memory process. It triggered a cascading effect from the individual ethno-ecological niche through the enculturation and language-enculturation mechanism, arriving at the more holistic reindeer herding know-how, which includes *duodji*. Therefore, adding climate change as an external variable to the theoretical framework has confirmed the consequentiality of the life-learning process, although adding a new level of interaction for what concerns linguistic enculturation. It also affected the material, symbolic and functional features of a landscape. At the roots, climate change had a direct impact on the material landscape, causing a physical change in nature; it followed a reduced transmission of knowledge influencing the symbolic feature of the landscape; the functional feature was only explored through *duodji*, in respect of Sámi people advice to leave Shamanism and rituals out of the scope of the analysis. Drawing from evidence, it seems that climate change has slightly brought a functional impact on *duodji* as it changed the source of inspiration and the quality or availability of materials, without drastically threatening the functional perpetuation of the sector.

Conclusion

Rapid global environmental changes are affecting people's lives and means of subsistence worldwide. Within this scenario, the Arctic is the fastest-warming region globally, and indigenous inhabiting this area have been experiencing many difficulties. Their heavy dependence on nature makes them more vulnerable to a constantly changing and unpredictable climate (Lemet & Näkkäläjärvi, 2009). Therefore, this dissertation aimed to investigate the impact of climate change on the non-economic resilience of the Sámi indigenous people. The choice of indigenous people helped shed light on the precarious life they are experiencing due to climate change. In particular, in the Arctic, Sámi people face the consequences of the fastest-changing environment.

The analysis started revising the academic literature on climate non-economic loss and community resilience to support the conceptualisation of a working definition of 'non-economic resilience'. Non-economic resilience must be understood holistically as a complex interaction between one community and the surrounding ecosystem, culture, and land (Kirmayer et al., 2009). This step was deemed crucial for the research because of the lack of a unique, clear, and straightforward concept that expresses the relation between the non-economic aspect of resilience, namely traditional knowledge, and climate change. The investigation adopted the theory of landscape memory to guide the evidence research and analysis. It provided the framework to understand climate change's role as an external stressor in lifelong learning. Evidence demonstrated that climate change impacts the transmission of traditional knowledge, language survival, and the authenticity of *duodji*. While the changed landscape has partially altered the sense of place and place attachment, which is the linchpin of indigenous people's identity (Saami Council & Sametinget, 2023).

These findings need to be placed in a multiscale analysis that conceives climate change losses as inextricably linked to the existence of other power phenomena. In this regard, it is essential to note that indigenous communities are suffering from the legacy of previous colonisation and current globalisation (Ford et al., 2013), the years of state assimilation policies, issues in legal status recognition, and the influence of an economic structure (Fylling & Melboe, 2019; Näkkäläjärvi et al., 2022). Further research

could investigate this multifaceted interaction, as done by Tyler et al. (2021) in their comparative study of human and climate impact on reindeer herding. Moreover, in light of the indigenous methodology, further research should adopt a participatory approach to ensure a co-creation process of academic knowledge. This approach was not adopted throughout this study due to limited response by the community and the linguistic barriers.

Therefore, three main takeaways can be drawn from this analysis. Firstly, it demonstrated an almost entirely linear and consequential impact, which means that addressing the direct effect climate change has on reindeer herding will, in turn, reduce the cascading effect on traditional knowledge, language, and know-how. It is crucial to understand and mitigate the loss before it happens, as reparations offered through legal cases are never enough for the incommensurable loss experienced by indigenous communities (Barnett et al., 2016). The UNFCCC itself has embedded the concept of a precautionary approach to prevent the worst scenario, thus calling on Parties to the convention to act in a precautionary way through mitigation (Barnett et al., 2016). Secondly, climate change has hindered Sámi's resilience to climate change itself. As emerged in the literature review, resilience is rooted in Sámi traditional knowledge (Eira et al., 2008). Therefore, any threat to this body of knowledge and a gradual transmission loss has a consequent impact on Sámi's resilience to climate change in a circular cause-effect dynamic. In this light, non-economic losses can reduce the ability to achieve future goals (UNFCCC, 2013) and hinder future community resilience (Ford & Smit, 2004). Thirdly, the process of climate adaptation and resilience proves to be an actual cultural adaptation process (Näkkäläjärvi et al., 2020); it is altering the cultural structure of Sámi identity (Markkula et al., 2019). Thus, it emerges spontaneously questioning the cost of this cultural adaptation and to what extent climate adaptation will be able to happen while preserving an indigenous identity. These are all insights for future research.

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