Transdisciplinary research with Sámi reindeer herders: A comparative case study analysis

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Case Report

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Abstract

There is a growing interest in conducting research with Indigenous Peoples in Arctic regions. Sámi herders, practicing reindeer husbandry for centuries, are increasingly involved in social-ecological research. This study reflects on transdisciplinary research projects conducted in collaboration between researchers and Sámi herders. In particular, the study investigates how the transdisciplinary projects implemented co-production of knowledge and which ethical considerations were followed to assure responsible collaboration. A comparative case study analysis was conducted to gain insights about transdisciplinary research practices, reviewing the content of publications and reports of five case studies in Fennoscandia. The results show a variety of methods of co-production, levels of participation and involvement, as well as a lack of a shared ethical approach. In conclusion, the results suggest that TDR represents a spectrum of research modes that can be improved in their efforts to be ethically responsible. On this basis, the study encourages researchers and participants to report their experiences and reflections in research collaboration to promote learning on how to conduct TDR responsibly. Further, the study stresses the need for an ethical framework for collaborative research developed by Sámi.

Introduction

Arctic regions are subject to rapid changes that interact and fundamentally affect their ecosystems and societies. Climate change is an essential driver of change since the Arctic is warming twice as fast as the global average (IPCC 2014). However, in many contexts, social, political and economic drivers, including the increasing demand for resources and need for transportation, migration, geopolitical changes and globalization, can have even more significant impacts than global warming. Consequently, many arctic social-ecological systems face multiple stressors simultaneously, leading to adverse effects for Indigenous and Non-Indigenous peoples (Arctic Council 2013). Natural resource-based communities, like reindeer herding communities, are particularly exposed to the ongoing global environmental change (Huntington et al. 2005, 2005).

Reindeer husbandry, an Indigenous Sámi livelihood, represents an Arctic social-ecological system in which Indigenous people interact closely with the ecosystem they depend on for their way of life (Forbes et al. 2006, Furberg et al. 2011). This extensive land-use practice is carried out in Sápmi, the traditional Sámi land covering Northern Norway, Northern Sweden, the most Northern part of Finland and the Kola Peninsula in Russia (Fig. 1). Reindeer husbandry is highly exposed to weather conditions and increasing competition over land and resources (Löf 2014). In Sweden, for instance, reindeer herders are already “facing the limit of resilience” (Furberg et al. 2011) concerning climate change.

In this context, science could support well-informed decision-making in Arctic regions, which is needed to enhance social-ecological systems' adaptive capacity and resilience (Wheeler et al. 2020, Chapin III et al. 2015) . Reindeer husbandry in Sápmi is not an understudied topic (Löf 2014). The trend to involve reindeer herders in research is growing internationally (Forbes et al. 2006, Riseth et al. 2011, Löf 2014) . The majority of contemporary research in this field originates from the natural sciences (Forbes et al. 2006). Several studies explore current issues herders deal with, such as conflicts between reindeer husbandry and other land-use practices (Forbes et al. 2006, Sandström and Widmark 2007) or climate change (Reinert, E. S., et al. 2008, Furberg et al. 2011, Pape and Löffler 2012, Tyler et al. 2021).

The increased interest in research collaboration with Sámi reindeer herders bears risks. (Smith 2012) points out that Indigenous Peoples are often treated as objects rather than subjects, and research has been (and still is) used as a means of oppression and exploitation. A global systematic review that analyzed the degree of Indigenous community participation and decision-making in climate research processes drawing on Indigenous knowledge (IK) supports this statement (David-Chavez and Gavin 2018). Results show that most studies (87%) practice ‘knowledge

extractivism'. This means outside researchers use IK systems with minimal participation or decision-making authority from communities that hold them. Only a few studies report on outputs that directly serve Indigenous communities, follow ethical guidelines for research practice, or provide Indigenous community access to findings (David-Chavez and Gavin 2018) .

With regard to the Sámi, in the seventies, the Sámi scholar Keskitalo, among other forerunners, criticized the ways Sámi were situated and represented in research. He called for a change in the hierarchical research design since Sámi were only considered research objects and 'others' (Keskitalo 1994). However, Sámi people continue to be a popular research subject of projects that do not emerge from community needs, concerns or consultations, according to Sámi scholar Kuokkanen (2006). (Kuokkanen 2006) further notes the fact that outside researchers throughout history have come to Indigenous communities to collect data and disappeared with the knowledge shows how research is deeply involved in the process of colonisation of Indigenous Peoples. Hence, researchers have been increasingly urged by Indigenous scholars to acknowledge their responsibilities to Indigenous Peoples as part of healing and decolonization processes (Battiste 2000, Menzies 2001, Mihesuah and Wilson 2005, Kuokkanen 2010). Decolonizing research and methodology implies "having a more critical understanding of the underlying assumptions, motivations and values which inform research practices" (Tuhiwai Smith 2012, Smith 2012).

In contrast to the critical research practices mentioned above, transdisciplinary research (TDR) offers an approach that aims to include non-academic actors, like Indigenous peoples in the research process. Many authors define TDR as a collaborative process of knowledge production, involving scientists from different disciplines (interdisciplinarity) and non-academic stakeholders from, for instance, business, government and the civil society to address highly complex sustainability challenges and develop solution options (Pohl 2008, Wiek 2007, Lang et al. 2012, Jahn et al. 2012) . Some authors use the term 'co-production of knowledge' others use 'co-creation of knowledge'. Due to similar definitions, I consider these terms as interchangeable for the purpose of this study. (Jacobi et al. 2022) developed an understanding of co-creation in TDR in form of a spiral with five steps, based on previous work by (Rist and Herweg 2016), including: (1) joint definition of the problem and project's contents; (2) integration of natural and social sciences; (3) integration of non-academic actors and their knowledge; (4) social learning process and joint reflection on the goals; and (5) collective action for implementation. Similar approaches are categorized under various labels such as action research (Whyte 1991), post-normal science (Funtowicz and Ravetz 1993), Mode 2 (Gibbons et al. 1994) and transformative or participatory sustainability science (Lang et al. 2012, Wiek et al. 2012). At the core of these approaches lies the integration of different knowledge bodies, which ideally occurs on several levels: problem framing, project management, data collection, results synthesis and knowledge application (Lang et al. 2012). It can include knowledge bodies, like Indigenous Knowledge (IK) and Traditional Ecological Knowledge (TEK). The term TEK is defined by (Berkes 2017) as "a cumulative body of knowledge, practice, and belief, evolving by adaptive processes and handed down through generations by cultural transmission, about the relationship of living beings (including humans) with one another and with their environment" (p. 8). IK and TEK are widely recognized as crucial for developing effective strategies addressing social-ecological challenges (Berkes and Jolly 2002, Dowsley 2009, Laidler 2006, Tengö et al. 2017). According to Tangö et al. (2017), "bridging indigenous and local knowledge systems with scientific knowledge systems is vital to enhance knowledge, practice, and ethics to move towards sustainability at multiple scales" (p. 17). In terms of bridging different knowledge systems, TDR faces a significant challenge. TDR is called to bridge the gap between an academic system that was "created as an epicenter of colonial hegemony" (Shizha 2010) and IK (Chilisa 2017). (Battiste 2013) argues that, when bridging knowledge systems, the underlying assumptions each foundation has, need to be considered.

Despite the recognition of IK and TEK, collaborative research projects in the Artic depict only a slight increase in adopting collaborative research practices. This is shown in a review of Arctic research projects conducted during 1965

and 2010 (Brunet et al. 2014). Brunet et al. (2014) argue, “there is clearly room for more community involvement in Arctic science” ("conclusion," para. 2). Within literature about community involvement in Arctic regions, lies a greater focus on North America than on other parts of the Arctic (Kouril et al. 2016). Hence, there is a need to support collaboration and co-creation to build experience and capacity across the Arctic where it is more limited (Wheeler et al. 2020) . Moreover, (Wheeler et al. 2020) calls for “transformative changes in the use of Indigenous knowledge along with science for environmental decision-making in the Arctic” (p. 544). Their study shows that Arctic IK holders and experts working closely with IK consider research with collaboration and co-production as “very important” (Wheeler et al. 2020, p. 552), along with autonomous Indigenous-led research. Based on experiences made during a process of co-creating a research project, (Omma et al. 2020) describes benefits for the participating Saami Council. Firstly, the process challenged their distrust of outside researchers resulting from previous experiences when the research was not based on respectful relationships and failed to incorporate culturally appropriate ethical standards. Secondly, the participation built capacity in the organisation, such as gaining expertise and self-esteem to continue applying for, and collaborating in research projects. Thirdly, the co-design process motivated the community to think more actively about urgent issues where more knowledge is needed. The aspect of self-esteem is mirrored by a study of (Jacobi et al. 2020). Their findings suggest that TDR together with the co-creation of knowledge can contribute to the empowerment of otherwise marginalized actors.

However, indicators for responsible inclusion of IK and Indigenous communities into environmental science, as well as evidence on the extent to which research projects follow responsible research practices, are lacking (David-Chavez and Gavin 2018). In recent scientific literature, efforts have become evident to fill this knowledge gap. For instance, (Wilmer et al. 2021) developed an expanded framework for ethical transdisciplinary research partnership in natural resource management science. (Chilisa 2017) proposed a typology of methodological frameworks that can serve as a tool in the process of decolonizing sustainability science and transdisciplinary research. Considering Sámi perspectives, (Eriksen et al. 2021) conducted a study about ethical considerations for engagement in Community-Based Participatory Research (CBPR). Literature that explicitly addresses TDR with reindeer herders in Sápmi originates mainly from experiences made in single TDR projects. (Löf and Stinnerbom 2016) and (Horstkotte et al. 2021) reflect in their papers on how to make collaboration work, drawing on the respective TDR projects they worked in. In sum, it can be concluded that the TDR community does not yet have a common understanding of ethical considerations nor a framework explicitly addressing TDR and Sámi people. These insights are the starting point for my research.

The present study recognizes the need for more knowledge on ethical research partnerships in TDR. Therefore, the study aims to contribute to the learning process on TDR with Sámi reindeer herders. The study reviews a set of TDR projects by following the guiding research questions:

1) How have TDR projects with Sámi reindeer herders implemented co-creation of knowledge?

2) What ethical considerations and approaches were followed to ensure responsible collaboration?

This article is organized in the following way. First, the framework that forms the basis for the analysis is presented. Then follows information about data selection and the analysis. The implementation of co-creation of knowledge and ethics is then explored and discussed in five case studies. The paper concludes with reflections on the implications of the findings for improving transdisciplinary approaches that contribute to more responsible and ethically sound research.

Data And Methods

Analytical framework

In order to examine the implementation of co-creation and ethical considerations, the framework examining community engagement in research practice developed by David-Chavez and Gavin (2018) was employed. This framework was chosen because it not only adapts scales and typologies for assessing participation in environmental science from participatory research but also draws on Indigenous, community-based and participatory action research theory (David-Chavez and Gavin 2018). The framework was complemented with variables for *involvemen*t adapted from Newig et al. (2019), who developed these variables for a comparative quantitative analysis of 81 sustainability-oriented research projects. The additional indicators *methods* and *ethical considerations* were further added.

1) Implementation of knowledge co-creation

Firstly, concerning co-creation, the analysis focuses on a) the applied *methods*, b) the *involvement* of Sámi in the research process of transdisciplinary research projects and in the leading project team, as well as c) the overall level of *participation*.

a) Methods

TDR addresses complex problems by combining knowledge and methods from different disciplines. These so-called 'wicked' problems, or sustainability challenges, are life-threatening and urgent, have long-term impacts, are highly complex and cannot be solved with simple remedies (Funtowicz and Ravetz 1993, Wiek 2011). TDR thus offers a wide range of applied methods and procedures (Bergmann et al. 2010), which are looked at in the five cases.

b) Involvement

The involvement of Sámi reindeer herders in the research project is operationalized through the four independent variables *early_involvement*, *practicioner_values, practitioner_knowledge* and *practitioner_decision* (Table 1), adapted from (Newig et al. 2019). In addition, the composition of the lead project team (non-Sámi only/ Sámi only/ mixed) may provide insights on involvement.

Table 1 *Variables and variable description for involvement adapted from (Newig et al. 2019)*

Variables	Variable description
early_involvement	measures whether Sámi herders contributed to the identification of the research problem and the formulation of a project's research question
practicioner_values	measures whether Sámi herders contributed by formulating needs and goals, normative values or conditions for change in their field of practice.
practitioner_knowledge	measures whether Sámi herders contributed with knowledge about the area of activity
practitioner_decision	measures whether Sámi herders were involved in relevant project decisions

c) Participation

The overall level of participation of Sámi reindeer herders is assessed according to a scale developed by (David-Chavez and Gavin 2018). It measures the participation of Indigenous communities in research projects based on who has authority over the research process. Projects are categorized as *contractual, consultative, collaborative, collegial* or *Indigenous* (Fig. 2).

2) Ethical considerations and approaches

Secondly, the analysis focuses on ethical guidelines and approaches applied in the TDR projects. This study agrees with Adams and Faulkhead (Adams and Faulkhead 2012) "there is more to working in partnership with Indigenous communities than just meeting ethics guidelines" (p. 1032). Adams and Faulkhead (Adams and Faulkhead 2012) suggest that research partnerships need to engage both the community and researchers to take responsibility for the research, as well as careful thought on how to engage the community so that they also benefit. Therefore, in addition to the focus on reported ethical considerations, this study includes six indicators of responsible research practice defined by David-Chavez and Gavin (2018). These indicators include a) *access* to findings, b) *relevance* of findings to Sámi herders, c) *credit* of herders' contributions, d) *outputs* benefitting herding communities, e) *no harm* and f) *ethics* (Tab. 2).

The indicator *outputs* includes the principles 'sensitivity towards needs' and 'giving back', which are essential for research collaboration (Kuokkanen 2006, Smith 2012). According to Sámi scholar Kuokkanen (Kuokkanen 2010, 2006), the principle of 'giving back' "calls for a commitment and desire to ensure that academic knowledge, practices and research are no longer used as a tool of colonization and as a way exploiting indigenous peoples by taking their knowledge without ever giving anything back in return" (p. 49). Kuokkanen (Kuokkanen 2006) further stresses that Western researchers' motivation to conduct research with, or on, Indigenous Peoples should derive from the needs of the Indigenous communities and benefit them.

Table 2 *Variables and variable description for indicators for responsible research practice with Indigenous communities adapted from David-Chavez and Gavin (2018)*

Variables	Variable description
access	measures whether findings are accessible to Sámi herders
relevance	measures whether reported findings are relevant to concerns and interests pre-identified by Sámi herders
credit	measures the degree to which research credits knowledge holders for their contributions (no acknowledgement, acknowledgement only, co-authorship)
outputs	Measures whether the study reports any outputs for the Indigenous community
no harm	Measures whether the study address intellectual property rights or risks for Sámi reindeer herders
ethics	Measures whether the study report ethical considerations followed

Data selection

The study applies a case study approach. This approach can be particularly used for achieving an in-depth understanding of social phenomena where context plays an important role (Yin 2009). Hence, this approach allows a more detailed analysis of some aspects of the data. For the analysis, five cases were selected. The unit of analysis are research projects. They either consist of an activity within a larger research project (case 3, 4 and 5) or an entire research project (case 1 and 2) that addresses issues regarding reindeer herding in Sápmi. Research projects are temporally, financially and staff-wise limited activities connected to research goals and hence relatively clear-cut, allowing comparative empirical research (Newig et al. 2019). Comparative case studies are an essential method to analyze questions of human-environment interaction (Knight 2015). They can provide more informative and stringent insights than single case studies (Newig and Fritsch 2009). The study design reflects the idea that without more detailed comparative studies, the benefits of participation in sustainability science might remain largely unproven (Zscheischler and Rogga 2015).

The cases were found through snowball scanning literature of participatory research projects with reindeer herders in Sápmi. Due to the small number of TDR projects with Sámi reindeer herders this method was chosen, since it is useful to generate sufficient samples starting with only a few individuals (Clark et al. 2021) . Projects were defined as TDR if they used the terms “co-production” or “co-creation of knowledge”, “transdisciplinary”, “action research”, or “participatory” to describe their research approach and complied with the before mentioned characteristics of TDR. One criterion for the selection was the completeness of information on the projects’ implemented participatory processes. Another aspect of the sampling criteria was to assure a variation in terms of a) topics in sustainability research, b) project aims, c) location, d) involved actors, e) duration and time when they were conducted, f) lead institutions, as well as e) research formats and methods (Table 3). The final number of cases selected for the analysis was resulting from the narrow choice of cases, which were fulfilling the selection criteria. The study does not claim to cover all conducted TDR projects carried out with Sámi reindeer herders, nor generalize TDR in this context but rather analyze some cases in depth. Although the content for the analysis is public, I decided to anonymize the cases, because I have not the agreement of all authors to critically analyze their reports and articles.

Table 3 *Overview of case studies*

	Case study 1	Case study 2	Case study 3	Case study 4	Case study 5
Topic	Climate change impacts and adaptation	Climate change impacts and adaptation	Adaptation strategy (Supplementary feeding)	Cumulative effects assessment (CEA) governance	Sustainable land use management
Project aim	investigate climate change impacts on reindeer herding and opportunities for adaptation	gather information about the environmental changes which Arctic reindeer herders are facing and give concrete examples of herders' traditional knowledge leading their adaptation to changing conditions	create an arena for reindeer herders and researchers from Finland, Norway and Sweden, allowing exchange about experiences, knowledge and perspectives on supplementary feeding	address CEA governance dilemmas in a dialogue among Swedish state authorities and Sámi reindeer herding communities	participatory assessment and systems analysis of different reindeer management regimes and development of integrative scenarios and management plans for future sustainability
Location	Sweden	Sweden, Norway, Finland, Russia, Canada	Sweden	Sweden	Finland
Main actor involved	scientists, people of Sámi village	local authorities, scientists, reindeer herders	reindeer herders from Finland, Norway and Sweden, researchers	reindeer herders, researchers, permitting authorities of extractive industries, wind power and forestry	government officials, researchers, reindeer herders
Approx. duration	3 years	5 years	1 year	2 years	3 years
Category of the lead institution	University (Sweden)	Sámi herders representing institution, University (Norway)	University (Sweden)	Research Institute (Sweden)	University (Finland)

Data analysis

Evidence is collected through an in-depth document analysis using reports and scientific publications as empirical material. For the analysis, principles of content analysis were followed. Hereby the directed and conventional approach was employed (Hsieh and Shannon 2005). This combination of deductive and inductive research practice allows both; 1) building on relevant research findings as guidance for codes, as well as 2) generating codes directly from the data (Hsieh and Shannon 2005). A directed content analytical approach was used for *involvement*, *participation levels*, and indicators of responsible research. A conventional approach was applied when dealing with the question of what kind of *methods* or *ethical considerations* were mentioned. I searched for sections where corresponding information was given in the texts. Hereby, I added new codes as they emerged, like the *final report's language* and *reflexivity* about the research process.

First, I scanned the empirical material for each case study to identify the basic parameters of the projects presented in Table 3. Then I collected evidence concerning the research questions by following the binary variables and indicators and reading each document of the empirical material. The binary variables showed if the corresponding aspect was 'reported' or 'not reported'. The categorization into levels of participation is based on my interpretation of the reported information concerning who had authority over the research project.

Results

In this section, I show my empirical results in terms of 1) co-creation of knowledge and 2) ethical guidelines and approaches.

1) Implementation of knowledge co-creation

a) Methods

My analysis of the five selected cases shows that the chosen combinations of different research methods vary from case to case. However, all cases fall within the framework of transdisciplinarity or action research, aiming to co-create knowledge. Every case chose to conduct workshops. In case 2, 3 and 4, individual workshops were organized in a single location. They aimed to bring different actors together and create an arena for dialogue and exchange. Case 1 and 5 organized more than one workshop. They applied a similar approach, defining workshops as a tool to validate the interpretation of results. Interviews were additionally applied to the workshops by case 1, 2, 4 and 5, allowing an in-depth understanding of critical issues. For instance, case 2 conducted 60 interviews with reindeer herders in western Finnmark about snow and its role in reindeer herding. Other applied methods were participatory GIS and focus groups (case 1 and 4), as well as scenario building and visioning (case 4 and 5). Surprisingly, none of the cases reported that explicitly Sámi methods were applied.

b) Involvement

The study revealed an uneven involvement of reindeer herders across the cases. For instance, *early_involvement* of reindeer herders was given in four out of five cases (case 1, 2, 4 and 5). The involvement of Sámi reindeer herders in relevant project decisions (*practitioner_decision*) was given in three out of five cases (case 1, 2 and 4). However, all

cases reported that herders contributed with knowledge about the area of activity *(practitioner_knowledge)* and that they could formulate normative values or conditions for change in their field of practice *(practicioner_values)*. Further, the analysis looked at the composition of the leading project teams. Four cases were organized by a project team consisting of non-Sámi researchers and Sámi (case 1, 2, 4 and 5). In the project team of case 3 no Sámi were included.

To sum up, the majority of the cases reported the involvement of herders in almost all mentioned aspects. Case 3 presents restricted early involvement and no Sámi involvement in the project team. Case 3 and 5 present restricted involvement in decision-making.

c) Participation

Further, the study categorizes the participation of Sámi within the five TDR projects into different levels. Case 3 and 5 present a c*onsultative* level of participation. Community members were asked for opinions and consulted, whereas researchers made decisions. Although the project team of case 5 included Sámi, it was professional researchers who had considerable power over the structure and functions of the project. They allocated project resources, shaped workshop agendas, and finalized project reports. The level of participation in case studies 1 and 4 is categorized as *collaborative*. Community members were involved in all stages of the research process. Case 2 shows a *collegial* level of participation, presenting more substantial ownership and leadership by Indigenous peoples themselves.

Overall, the projects show mixed levels of participation. None of them is *contractual,* describing the lowest level, whereas none is *Indigenous* either. Latest would mean that community members have authority over the research process, which is centered in Indigenous value systems.

2) Ethical considerations and approaches

The following section presents the results concerning the indicators of responsible research practice (*access, relevance*, *credit*, *outputs, no harm*, *ethics*).

The indicator *access* to the findings was reported in all five cases, though different aspects of *access* were considered. Three cases distributed the final versions of the reports among the participants (case 3, 4 and 5). Beyond that, case 1 reported findings in Sámi media. They further discussed and deliberated findings in different places in Sápmi during workshops presentations, conferences and meetings with herders. Researchers made additionally sure that data was available or stored with community members. For instance, interviews were returned both in written and digital form. If interviewees permitted, the material could be shared with family members and the community board. Moreover, it was vital to investigate if materials from the studies were produced in local languages concerning access to findings. The authors of two case studies (case 2 and 3) mention that findings were reported in local languages, such as Northern Sámi. Language was considered a challenge by cases 3 and 4. For instance, in case 3, this originated from the fact that participants of the workshop did not share any common language. During the writing of the final report, handling multiple languages was described as complex and time-consuming. Researchers of case 4 pointed out a persistent dilemma concerning language: by using the majority language (Swedish), there remains a risk of unwillingly contributing to silencing Indigenous conceptions despite the aim to include Sámi views and show respect. Although Sámi helped to construct the agenda and frame for the workshop of case 4, they were still talking a language amenable to government authorities and the researchers. To sum up, *access* to findings was guaranteed through different ways; 1) presentations and distribution of publications, 2) data available or stored with community members and 3) materials from the study produced in local languages.

The indicator *relevance* of findings is difficult to measure. Nonetheless, case 1 reports efforts to conduct useful research to the community. This case selected the community for the TDR project due to an internally recognised need to increase knowledge on climate change impacts and adaptation opportunities.

The indicator *credit* investigates how Sámi herders were credited for their efforts and knowledge contributions. Four case studies credited the herders by co-authorship (case 1, 2, 4 and 5), one by acknowledgement (case 3). In case study 1, the project participants were economically compensated for the time devoted.

Regarding *outputs*, all five cases report outputs for the herding community. In three cases (case 3, 4 and 5), the output was considered as the final report, which was distributed among the participants. In each case, a draft was sent to the participants before publication. Then participants could give feedback and suggest corrections or additional input. In the remaining two cases (case 1 and 2), the outputs were more aligned according to the principles of 'sensitivity towards needs' and 'giving back'. This becomes evident in several examples. Firstly, in case 1, researchers provided the interviewee and community copies of the conversations. Secondly, meetings and workshops were organized with sensitivity to herders' ability to participate, both in rotating places and timing. Thirdly, researchers arranged workshops for the community to build capacities according to the needs. One workshop for the youth was on interviewing techniques. For another workshop, researchers invited experts and organized a role-play exercise on consultation with forestry. Moreover, within case 2, researchers enhanced the recruitment of young scientists from local communities. They further developed a bachelor course in reindeer husbandry at the Sámi University College in Kautokeino, Norway. For Sámi herders, who had insufficient opportunity to participate in ordinary education programs at colleges and universities, the project developed an online education programme. Overall, the research project claims that it provided new insights to reindeer herders' communities, organizations, and relevant local, regional, and governing agencies. An example for a situation when 'sensitivity towards needs' of reindeer herders was lacking becomes evident in case 3. Here, the time of the workshop coincided with ongoing work herders had with the reindeer. Consequently, some representatives from Finnmark, the area with the largest number of reindeer in Norway, could not participate. Nonetheless, it was reported that the participants who were able to attend the workshop of case 3 pointed out that the workshop inspired them to continue with further projects aiming to learn from each other and discuss the experiences of herders across the countries' borders.

Furthermore, four cases (case 1, 3, 4 and 5) do not report whether the study addresses intellectual property rights or risks for Sámi reindeer herders (*no harm*). Case 2 mentions issues with intellectual property rights, but it is not further explained how it was considered in the project.

Concerning *ethics*, four cases (case 1, 2, 3 and 4) report ethical considerations followed. Looking more closely at the ethical considerations, the study reveals that the ethical considerations or approaches vary across cases. Two cases (case 1 and 2) refer to documents concerning Indigenous Rights. Case study 1 mentions the Free, Prior and Informed Consent (FPIC), recognized in the United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP) (United Nations 2007). This case study further refers to the ethical guideline document Te Ara Tika (Hudson et al. 2010), which provides an overview of recommendations for research concerning the Indigenous Māori. Case 2 refers to the Yakutsk Declaration from the Association of World Reindeer Herders(Association of World Reindeer Herders 2005) and the Convention on Biological Diversity Article 8(j) about Traditional Knowledge, Innovations and Practices (United Nations 1992). Case 4 refers to norms of Indigenous self-determination. Additionally, case 4 invited two legal experts to the workshop. However, the motivation was more content-driven for the workshop dealing with the CEA process in Sweden.

In cases 1 and 3, the authors show reflexivity about the shortcomings of the analyzed indicators. In both cases, researchers admit shortcomings and point out what they would do differently in the future. Both cases reflected on lessons learned and challenges. For instance, case 1 provides take-home messages for researchers and reindeer

herding communities during different stages of research. Case 3 summarizes lessons learned from researchers perspectives for planning and arranging collaborative stakeholder processes. The other cases did not report self-critical reflections about their research process.

On the whole, my analysis reveals that the five cases did not report on all six indicators of responsible research with Indigenous communities. The indicators *access* to findings and *outputs* for the community were the only ones captured by all cases. However, *access* to findings concerning the aspects of the availability of data for the community, as well as findings translated to local languages, are only reported in the minority of cases. The indicator *relevance* is hard to measure. Co-authorship is the dominant measure to *credit* Sámi herders' efforts and knowledge contributions. All cases report on *outputs* provided for the herding community. Aspects of intellectual property concerning *no harm* are barely reported. Most cases mentioned ethical considerations followed (*ethics*), whereas ethical considerations vary among the cases.

Discussion

My study offers insides about co-creation of knowledge and ethical approaches in TDR with Sámi reindeer communities in Arctic regions. The results indicate a variety of applied methods, levels of participation and involvement, as well as inconsistent ethical approaches within five TDR projects conducted in collaboration with Sámi reindeer herders.

Spectrum of transdisciplinary research

The findings align with the spectrum of transdisciplinary research identified by Jahn et al. (Jahn et al. 2021). Their empirical research on transdisciplinarity illustrates the diversity of research approaches and demarcates clusters of five different transdisciplinary research modes. This diversity of transdisciplinarity is the expression of each project's unique and

individual circumstances and corresponding design decisions (Fernández González et al. 2021). Jahn et al. (Jahn et al. 2021) connect their findings to Mobjörk's (Mobjörk 2010) distinction between 'consulting' and 'participatory' transdisciplinarity. Whereas 'consulting' refers to limited involvement mainly as information inputs from the practice side, 'participatory' describes research with substantial involvement and knowledge co-creation. My results also reflect this distinction, as two projects were classified as *consultative*, whereas the others have a more participatory character.

Highest level of participation

The study demonstrates a pattern between levels of participation, the project team composition and allowed *practitioner_decision.* I observed the highest levels of participation (*collaborative* and *collegial*) in studies authored by teams that include Indigenous scientists and community members and involve them in relevant project decisions (*practitioner_decision*). Although the representativeness of this identified pattern can be challenged due to a small number of analyzed cases (n=5), there is evidence supporting this finding. David-Chavez and Gavin (2018) reviewed a more significant number of research projects (n=125) and observed the same pattern, showing the highest levels of engagement (collaborative and collegial) in studies with teams that include Indigenous scientists and community members. Moreover, findings from (Jacobi et al. 2022) show that the early involvement of non-academic actors, as well as their overall involvement in diverse roles, enhances the utilization of research knowledge. Thus, in order to achieve a high level of participation and utilization of the generated knowledge, practitioners and Indigenous

people should be involved at an early stage of the research project and included in the project team and decision-making processes.

Lack of common ethical approach

My results show a lack of common ethical considerations among the projects. This reflects Drugge's (Drugge 2016b) findings revealing a great uncertainty among scholars about ethical considerations within the Sámi research field in Sweden. Drugge (Drugge 2016b) demonstrates that although research proposals often refer to research ethics, a common view on which guidelines to use is lacking. This could be explained by the fact that Sweden has not yet implemented ethical strategies specifically suited for Indigenous research. Discussions on Sámi research ethics have usually been positioned within the more general Ethical Review Act (Drugge 2016a), which does not contain specific guidelines for structuring research related to Sámi issues (Lag om etikprövning av forskning som avser människor 2003:460 (Ethical review Act)) . The Sámi are still discussing the development of Sámi ethical guidelines (Linkola et al. 2016, Paksi and Kivinen 2021). Meanwhile, the Sámi University of Applied Sciences follows the research standards of the World Indigenous Nations Higher Education Consortium (World Indigenous Nations Higher Education Consortium (WINHEC) 2004). Guidelines developed for other Indigenous contexts can serve as an inspiration. However, they are not automatically transferrable to a Swedish academic setting and need to be tailored to the specific research context in Sweden and Sápmi (Drugge 2016c). Concerning the elaboration of guidelines for Indigenous research, it is crucial that the development process is initiated and led by Indigenous representatives to gain legitimacy within the Indigenous community (Battiste and Henderson 2000). Hence, this study stresses the need to develop formalized ethical guidelines for conducting transdisciplinary research with the Sámi people, which other researchers have already expressed (Drugge 2016b, Eriksen et al. 2021).

Methods

None of the TDR projects reported that Sámi methods were adopted during the process of co-creation. (Chilisa 2017) warns, that an exclusion of Indigenous research methods often leads to interventions that are not compatible with local communities. IK-driven methodologies, in contrast, could enhance the decolonization of sustainability science, address power imbalances, and promote the integration of knowledge systems (Chilisa 2017). He further identifies the dominance of European or Western paradigms and methods within TDR (Chilisa 2017). According to (Battiste 2013), recognizing this "interpretative monopoly that [the] Eurocentric thought reserves for itself is the key to understanding the new transdisciplinary quest to balance European and Indigenous ways of knowing" (p. 95). Hence, future TDR projects in Indigenous contexts could use their methodological freedom and apply Indigenous and decolonizing research methods to strengthen Indigenous methodologies and epistemologies.

Dichotomies

The results reveal a tension related to the theory and practice of TDR, which has been identified before in the scientific literature. Transdisciplinary approaches often imply a conceptual dualism of science and society or scientists and practitioners (Jahn et al. 2021). My study can also detect this 'conceptual researcher-practitioner dualism'. I am using the wording 'Sámi herders' and 'researchers'. Thus, I assign actors to either science or Sámi community according to their main professional attribution. Especially case studies with Sámi in the leading project team, which work with reindeer husbandry aside to the research activity, raise the question about who should be defined as a 'researcher'. Additionally, many researchers are Indigenous themselves. Therefore, dichotomous terms, such as 'scientific' and 'Indigenous knowledge' are not applicable, according to Virtanen et al. (Virtanen et al. 2021). Thus, I suggest future research to overcome the scholar-practitioner dualism by focusing on roles that an actor can take on in transdisciplinary research (Bulten et al. 2021) instead of referring only to actors through their (formally) attributed

status. For instance, within future research, Indigenous participants could be called according to their role as ‘co-authors’, ‘co-creators’, ‘co-researchers’, or ‘co-teachers’ (Snow et al. 2016).

Limitations

This case study analysis provides a snapshot of TDR projects in the context of reindeer herding. Analysing only five cases might be insufficient as further details on methods for co-creation and ethical considerations are required. The study presents a local focus of TDR projects conducted in Sweden, as three cases were led by Swedish institutions and conducted with Swedish Sámi herders. Hence, the study cannot provide data to conclude patterns or differences between TDR projects among countries. More cases conducted in the parts of Norway, Finland and Russia forming Sápmi are required to conclude patterns or differences between TDR projects in the respective countries.

It is beyond the scope of this study to find evidence about the variable *relevance* due to the lack of data and constraining methodological choices. First, the empirical material analyzed did not explicitly indicate the extent to which the results were relevant to herding communities or whether the outputs benefited them. Second, the relevance of reported outcomes to Sámi-defined concerns, issues, or interests is difficult to measure from an outside perspective. The chosen method of a content analysis of publications and reports did not provide the possibility to find data for this variable. The question about the relevance of the findings can only be answered by involved reindeer herders themselves. Hence, additional semi-directed interviews with Sámi herders might complete this study and provide evidence if the findings were relevant for them and if the outputs benefitted them.

Further, it exceeds the scope of the study to give practical recommendations for responsible collaboration with Sámi reindeer herders. Practical recommendations should derive from Sámi researchers’ experience in research collaboration themselves. Nonetheless, based on the results, which report researchers’ reflections only in two cases, my study encourages researchers to share their self-critical reflections in publications and final reports. Snow et al. (Snow et al. 2016) consider the researcher’s reflexivity as an integral part of the entire research process. This includes honesty, openness about values and biases, and exploring power dynamics. The learning process about implementing co-creation responsibly will be enhanced by ensuring that not only practices are documented and shared, but researcher’s reflections.

Due to the history of oppression and discrimination in research, I think that I as a non-Indigenous researcher, have ethical obligations conducting Indigenous-related research and the obligation to reflect on my role, language and which information I use. In my view, critical reflection on TDR could make the process more ethical and respectful, however, the identification of colonial continuity within research is a substantial part of it. My research mirrors shortcomings identified in the cases. For instance, my use of language, methodology and knowledge, which I build my research on, is originating mainly from Eurocentric science. With my research based on documents mainly written by non-Sámi scientists, only parts of the whole picture are covered. Further, in my analysis about co-creation of knowledge is only one type of knowledge included, which is a contradiction in itself. The purpose of this study was to learn, as an early-career researcher in sustainability sciences, about how to conduct TDR in a responsible and sensitive way. However, the study is based on literature originating from mainly non-Sámi publications in English and Swedish and should be verified and complimented with Sámi views for a broader perspective. Checking the findings with the case study participants could enhance the validity of my results. Furthermore, it has to be considered that the publications used for the database might only mention information about the cases, which is in the interest of the publishing authors. It is possible that information about shortcomings or challenges, which would have been valuable for the analysis, were not reported. The analyzed publications might only represent perceptions and interpretations of the author's experiences

during the research process. Perceptions of other participants might differ from the information given in the publications.

In future work, it may be helpful to study particular aspects of challenges to collaboration. Challenges are complex and require a better understanding since they might originate from hierarchically structured relations between Indigenous communities and majority societies in which research has played a key role (Löf and Stinnerbom 2016). Further research on overcoming these challenges and how to conduct responsible forms of collaboration and co-creation methods in TDR should be conducted not only by mainstream academia but also by Sámi researchers to improve future collaboration and broaden perspectives.

Conclusion

Focusing on the context of reindeer husbandry in Sápmi, I used a mixed inductive-deductive case study analysis approach to explore the implementation of co-production of knowledge and ethical approaches within TDR. I compared the content of publications and reports concerning five cases of TDR projects, presenting research collaborations between Sámi reindeer herders and researchers of different disciplines.

The results contribute to a clearer understanding of how TDR was conducted with Sámi reindeer herders. It illustrates that different methodological approaches for co-production were adapted, allowing different levels of participation. Although TDR projects might present a high degree of participation and involvement, the study shows that they are not automatically responsible in their research process. Thus, the study stresses the need for an ethical framework developed by Sámi for collaborative research. Further, the study encourages researchers to report their lessons learned, as well as shortcomings and challenges of their experiences made in research collaboration. These are valuable insights and contribute to the learning process on improving TDR and conducting it more responsibly.

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Declarations

The author (Marleen Schwarze) declare no competing interests.

Figures

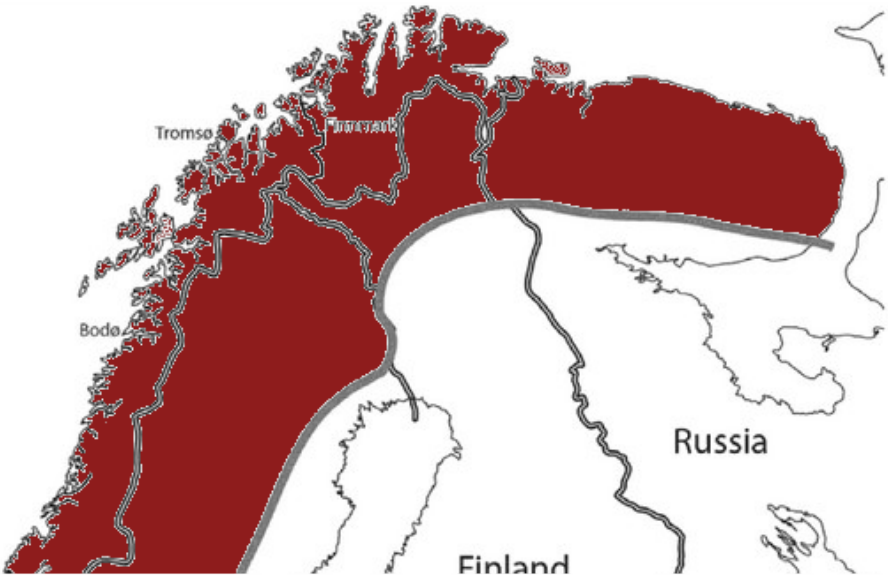

Figure 1

Map of Sápmi, adapted from Bjorn Hatteng, Centre for Sámi Studies (Shanley and Evjen 2015)

Figure 2

Scale for assessing levels of Indigenous community participation based on who has authority over the research process. Adapted from David-Chavez and Gavin (2018, p.4)

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- AnalysisTDR.xlsx
- Annex1Literatureoverview.xlsx