ADVANCING THE INCLUSION OF INDIGENOUS AND LOCAL KNOWLEDGE IN POLICY

Towards legitimate and effective assessment and planning

Fernanda Ayaviri Matuk van Maurik

Propositions

1. By bridging scientific and non-scientific knowledge systems in a non-hierarchical way, policy practitioners and locals deliver policy goals and local needs effectively and legitimately.
   (this thesis)

2. Fostering nature conservation, biodiversity, and well-being simultaneously requires the consideration of both sociocultural and ecological diversity in local resource management.
   (this thesis)

3. The use of scientific classification systems makes it difficult for scholars of social and natural disciplines to do interdisciplinary research.

4. Environmental scientists need to communicate with Indigenous peoples and local communities, not just with governments.

5. Focusing on scientific-technological progress prevents societies from co-evolving with the diverse pluriverses that are part of humanity.

6. Dialogue fosters co-produced knowledge outcomes that are relevant to society.

Propositions belonging to the thesis, entitled:

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Fernanda Ayaviri Matuk van Maurik

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ADVANCING THE INCLUSION OF INDIGENOUS AND LOCAL KNOWLEDGE IN POLICY:

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Thesis

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Dedicated to all the Indigenous peoples and local communities of the world
and to those who maintain a solidary heart
and act towards social and environmental justice!

The message below represents a common struggle and unfair treatment that is given to Indigenous peoples and local communities worldwide. This message is proposed to be put into reflection by the readers of this thesis.

"*Typical of actual historical accounts that reveal the importance of nature is a Gaelic song, "O Green Morvern of the Hills", written by Donald Mackinnon, a West Highland bard, between 1845 and 1860. MacKinnon laments both the ecological and the social changes heralded after a wealthy Londoner, Octavius Smith, bought the 'property' in 1845 and cleared the Indigenous people away to other lands on the tall ships to create space for ecologically devastating sheep ranching.*

O green Morvern of the hills
You look full of despair and sorrow
The situation has become very desperate
That you might turn completely into a wasteland

The reason for my sadness
Is to be gazing at your hills
Down beside the Sound of Mull
Toward the ships of tall masts

It is your non-native lords
Who left the natives dispossessed
And who let the people who don't belong to you
Dwell in their place ...

They called you 'land of the woods'
And there was a time when you deserved that
But today your woods have been denuded
By the people of the pale-faces

(…) *Cauterization of the heart?*
The evidence I have touched upon from the bardic record suggests that the human heart became cauterized by historical vicissitudes - broken and sealed off from its cause of suffering. Could it be that, at an unconscious level, most of us still carry such echoes
of that painful past? Could it be that we accumulate the effects of bygone extinctions, degradations and colonizations, and that these inhibit our ability to act; bind us in our apparent powerlessness to resolve the major issues of our times?"

(Golliher, 1999, p.481).

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Regarding my PhD, I specially thank my promotor Esther Turnhout and my daily supervisor Jelle Behagel, from the Forest and Nature Conservation (FNP) Group of the Wageningen School of Social Sciences (WASS), who allowed me to conduct my research in an interdisciplinary, independent, and constructive way. They collaborated with me with willingness and kindness along the process of producing knowledge together. They embraced me in the group; supported me during the hard times of my learning process; and helped me to develop a personal discipline and a rigor with my research. They pushed me to go further and to learn the 'art' of writing for international journals with clarity and conciseness. They also had patience with my trend to "complicate" the writing and helped me doing a very important transition in my life, from "Soil sciences" to "Social sciences". This involved linking the areas in which I was doing research to study the knowledge of Indigenous peoples and local communities and the ways to integrate it and use for co-production of knowledge that includes also science – including physical and human Geography, Ethnoecology, and Ethnopedology – with environmental sciences and policy studies.

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Cheers to us!!!

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CHAPTER 1

ENVIRONMENTAL POLICIES, INDIGENOUS PEOPLES AND LOCAL COMMUNITIES, AND KNOWLEDGE

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1.1 Introduction

> "…*The United Nations released a report warning of the imminent extinction of as many as 1 million species, the result of climate change, pollution, exploitation of land and sea, and other human-created assaults on the environment. The report has tragic significance, but offers hope if "transformative change" occurs immediately. The problem is that the source of that transformative change has been largely ignored by most media; one must read the report's summary – all that has been released so far – to realize that such transformative change is largely about indigenizing our systems and institutions. It is about a worldview that connects us to nature*" (Four Arrows, 2019).

Indigenous peoples and local communities (IPLC) comprise a highly culturally diverse total population estimated to be around 2 billion people (FAO, 2013). Indigenous peoples account for around 5% of the world's population; for 7,000 ethnicities (Toledo and Barrera-Bassols, 2009); and for about 370 million people who live in 90 countries that are mostly located in the global South (FAO, 2013). Brazil alone is home to about 900,000 Indigenous people, who comprise around 305 ethnicities, 274 languages and live in 12.2% of the country's lands (IBGE, 2010; FUNAI, 2019). This proportion is relatively large, if we consider that Brazil (8,511,965 km²) is approximately the size of Europe (10,180,000 km²). Yet, only Brazil recognizes 1,800 types of local communities, which represent a mix of Indigenous, African, and European descendants (CBD, 2004) – that is, *quilombolas* (maroon communities that were formed by escaped slaves during the colonial period), *extrativistas* (rubber tappers and other gatherers types), among others.

IPLCs currently face challenges to their existence that are centrally linked to land access and livelihood support. These challenges include responding to changes that have been introduced in or imposed on IPLC landscapes, such as climate change (Eiros, 2012); adaption to natural resource management and governance to conserve socio-cultural and ecological diversity (Toledo et al., 2003); and the further recognition of cultural identity and acquisition of territorial rights (see ILO, 1989; Bond et al., 2015). Both a lack of recognition and enforcement of territorial rights, resulting from neocolonial rule of governors in partnership with (inter)national elites (UN, 2010), has opened up possibilities for land grabbing, among others. IPLC face these challenges in Brazil, for instance, where the Bolsonaro presidency has used the State guardianship of IPLC lands to create agribusiness in Indigenous lands and to halt the provision of land tenure to IPLC (Antunes, 2020; Mendonça, 2020). Also, within this scenario, deforestation rates have risen by 80% in Indigenous lands, and about 49% of these peoples still do not live in official Indigenous lands (IBGE, 2010). Such challenges do not only affect IPLC: it is estimated that the 50% of the planet's lands (Oxfam, 2016) that are managed by IPLCs hold up to 80% of the Earth's biodiversity, which is indispensable for global nature conservation and human well-being (IPBES, 2019).

The management and governance practices of IPLC, which are valued for contributing to biodiversity, are derived from the Indigenous and local knowledge (ILK) systems of these communities (Díaz et al., 2015). This is because ILK has co-evolved with the ecological specifics of the territorial and landscape contexts in ways that enable the sustainable reproduction of the local subsistence, development, and socio-cultural diversity (Maffi, 2005; Cocks, 2006; Merçom et al., 2019). ILK is intertwined with practices and holistic worldviews – or *cosmovisions* (Toledo and Barrera-Bassols, 2009). The classifications and meanings of ILK are accordingly connected the beliefs, values, and aspirations that are part IPLCs' worldviews and daily practices (Berkes, 2012; Descola, 2013). For

instance, IPLC may decide to manage forests and soils with technologies that consider the needs of both the community and animals and plants because they consider nature and humans as interdependent (Posey, 1996). While ILK adapts to social and ecological changes over time, its conservation is important, as this knowledge maintains the legacy of practices as well as the livelihoods and culture that sustain IPLC survival and contributions to biodiversity (Diegues, 2000; Toledo et al., 2003).

Environmental policies aim to enhance the contributions of IPLC for biodiversity, nature conservation, and human well-being (Tengö, 2014; Díaz et al., 2018). Even so, IPLC and ILK are currently not sufficiently included in policy processes, as these environmental policies are mostly based on Western scientific knowledge (Klenk et al., 2017). Examples of this may be observed across the world, for example, in 'Reducing Emissions from Deforestation and Forest Degradation' (REDD+) programs, such as those in Vietnam (Pham et al., 2017). The predominant inclusion of scientific knowledge by policies affects the legitimacy and effectiveness of policy processes and outcomes (Cash et al., 2000, 2003; Tengö et al., 2017). Such outcomes tend not to be adopted in practice by IPLC (Ayana et al., 2015) or are adopted at the cost of the disruption of the resilience of these communities' social and ecological contexts (Bohensky and Maru, 2011).

Thus, it is crucially important that the environmental policies that target IPLC and ILK advance the inclusion of these communities' knowledge, worldviews, and needs to enhance biodiversity, nature conservation, and well-being (Ayana et al., 2015; Tengö et al., 2017). This is needed, so that policies can understand – and attune to – the IPLCs' socio-cultural and ecological contexts, priorities, and practices to which these communities' contributions to biodiversity are related (Chan et al., 2012; Tengö et al., 2017). This means securing the legitimacy and effectiveness of the knowledge integration and co-production processes and outcomes that comprise both the environmental assessments of resources and ILK of local contexts and the planning of resource management and governance that is informed by these assessments. However, achieving this is a challenge because these processes involve different forms of knowledge, worldviews, power, and practices that belong to various actors and that are articulated in so-called science-policy interfaces (Huitema and Turnhout, 2009; Hill et al., 2020). These actors include policymakers, planners who carry out assessment and planning with IPLC, donors, scholars, international bodies, such as the 'Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services' (IPBES), among others. The next three sections of this chapter will introduce the three main challenges that are associated with the inclusion of IPLC and ILK in policies.

1.2 The challenge to include diverse knowledge systems

> *"No problem can be solved from the same level of consciousness that created it"* (Albert Einstein).

In this section, I address the tendency of environmental policies to prioritize Western scientific knowledge over ILK non-scientific knowledge systems. I also problematize the implications related to this challenge for policy legitimacy and effectiveness as well as for IPLC.

A hierarchical conception of knowledge systems has pivoted science as a superior form of knowledge by installing knowledge dichotomies[1] including the following:

i) '*Neutral versus value-laden*' – in which scientific knowledge is legitimate, as it is produced while being detached from personal worldviews and related values, beliefs, and aspirations, whereas ILK is value-laden and unreliable.
ii) '*Objective versus subjective*' – in which the knowledge produced in science is untainted by the observer, whereas ILK is intermixed with personal interpretation and cultural experience.
iii) '*Universal versus context-based*' – in which science is applicable in any context, whereas ILK is only relevant to the level of its local context.

The tendency of policies to prioritize scientific knowledge has challenged policy legitimacy and effectiveness. Nadasdy (2003) illustrates that Canadian planners who conducted an assessment with the *Kluane* Indigenous people – with the intention to inform the adaptive collaborative management (ACM) – or co-management –with these people related to the planning of the management of their sheep population – distrusted the oral knowledge that the *Kluanes* used to manage sheep and thus excluded this knowledge from the assessment. In response, the *Kluanes* found this scientific assessment decontextualized and ineffective to plan their practices. Prioritizing scientific knowledge is problematic, as it does not link policy with the ILK, practices, and specifics of IPLC's contexts (Tengö et al., 2014). For knowledge to be credible and legitimate (Cash et al., 2000, 2003), we need to overcome these dichotomies and work towards a non-hierarchical conception of knowledge systems that views all knowledge systems, including science and ILK, as situated in context (Haraway, 1988; Raffles, 2002) without a priori assuming the superiority, neutrality, objectivity or validity of one over the other (Turnhout et al. 2019).

The need for a non-hierarchical conception of knowledge systems is also relevant for co-production processes that integrate different knowledge systems. When scientific categories and frameworks are prioritized in these processes, the inclusion of ILK will be shaped by those categories and frameworks. This can have two implications. First, it can lead to the 'extraction' of ILK from its meanings and contexts (Klenk et al., 2017, p. 2). Second, it can lead to the reduction of knowledge diversity, since only those parts of ILK that can easily fit, or that can be translated to fit scientific frameworks and categories, will be included in policy outcomes. To illustrate, REDD+ policies that have included the IPLC category 'forest as a source of food and of sustainability' in assessments as 'a source of carbon storage' have blocked the access to livelihoods and the practices that have conserved forests locally (Bayrak and Marafa, 2016). These problems of extraction and reduction of diversity show that a clear understanding of how to integrate different knowledge systems is missing (Kenter, 2018).

Other scholars have also commented that the scientific frameworks that inform policies do not pay sufficient attention to the diversity of knowledge contents and meanings that are relevant to include in policy (Tengö et al., 2017; Hill et al., 2020). For instance, assessment frameworks that draw on the concept of ecosystem services (ES) entail a classification system that limits the inclusion of ILK. The

[1] These dichotomies were installed since the 19th century by the positivist modern science paradigm, whose influence predominates within science until today via its main focus on empirical-analytic research (Leff, 2004; Valkenburg et al., 2009).

concept of 'Nature's Contributions to People' (NCP) offers an alternative framework to address this that is more inclusive of IPLC knowledge systems and worldviews (Díaz et al., 2018). However, both ES and NCP do not clarify for planners how to access ILK that matters for IPLC and is important to inform planning, or what scientific knowledge is relevant to, and fits local specifics (Moreno et al., 2014; van Haaren and Galler, 2016; Peterson et al., 2018). Instead of relying on fixed frameworks, what is needed for policy processes and outcomes to be legitimate for both policy practitioners and IPLC are adaptive and collaborative forms of assessment and planning that are more flexible and responsive to context specific dynamics (Berkes, 2009).

The exclusion of ILK in knowledge production and policy has a long history that is rooted in the colonization of the global South by the West or the global North (Mignolo, 2009). Elements of colonialism can still be recognized in the 21st century in the (geo)politics of knowledge and these elements largely determine whose knowledge counts (Lander, 2003; Escobar, 2008, 2012). An example is the predominance of Western scholars, in comparison to Southern scholars and IPLC, in informing global policy agendas and methods. For instance, the work of the Intergovernmental Panel on Climate Change (IPCC) is largely done by experts from the North and the knowledge the IPCC has produced has facilitated global forms of governance that view the conservation of forests in Southern IPLC territories as an acceptable solution for problems that are primarily caused by practices of the North (Agrawala, 1998; Hulme, 2010). This political dimension of knowledge shows that the challenge of working towards a non-hierarchical concept of knowledge systems is not just a philosophical or epistemological exercise but also requires overcoming routinized and institutionalized divisions of labor and ways of working (Latulippe and Klenk, 2019).

1.3 The challenge to bridge worldviews

In this section, I address the challenge of bridging the different worldviews of policy practitioners, and IPLC (Tengö et al., 2017; Pretty et al., 2009). Worldviews are associated with social values, aspirations, and beliefs on humans and nature (Berkes, 2009; Kenter, 2018). These worldviews are informed by ontological understandings that consist of philosophical questions and assumptions – that is, who are we, and what is there to know and do. As such, worldviews underlie knowledge, decisions, and understandings related to human-nature relations. Worldviews are thus relevant for resource management and also affect nature conservation, biodiversity and human well-being (Rist and Dahdouh-Guebas, 2006; Díaz et al., 2018). Bridging different worldviews to support the two-way – or relational – understanding of human-nature relations is moreover considered crucial for the effectiveness and legitimacy of policies but it is also considered to be challenging (Thomas, 2011; Pretty et al., 2009; Pascual et al., 2017). Practitioners have found it hard to bring out IPLC's worldviews and reconcile them with pre-defined policy frameworks and agendas (Berkes, 2009). Even when practitioners are aware of the importance of bridging worldviews, they often approach IPLC with a pre-definition of the problems, concepts, and priorities that they think should be targeted in assessments and planning (Kenter, 2018). For example, Ayana et al. (2015) and Hill et al. (2020) show how planners' pre-defined ideas on sustainability often do not match with the worldviews of IPLC. Neglecting these worldviews leads to a misrecognition of local values and needs and to a lack of uptake of these policies by IPLC.

The difficulties of bridging worldviews are related to important substantive differences. In contrast to Western and scientific worldviews, IPLC worldviews are holistic. They are based on

animistic philosophies, which means that they ascribe liveliness and consciousness to other-than-human elements and emphasize the entwinement of people with nature and its biophysical entities (Rist and Dahdouh-Guebas, 2006; Berkes, 2009). As Toledo and Barrera-Bassols (2009) explain, these worldviews integrate local socio-cultural, ecological, economic, and political elements with Earth and Universe phenomena, and they link resource management, governance, and planning to rituals and celebrations, to the life cycles of fauna and flora, and to movements of the moon and constellations. There is a marked difference with the Western and scientific worldviews of policy practitioners that are much more reductionist and mechanistic in the sense that they consider reality in terms of discrete, fungible units that are connected by causal mechanisms and that are based on a distinction between humans and nature (Berkes, 2009). Yet, for policies to be legitimate for IPLC and relevant and actionable for their sustainable resource management, it is important that these policies reflect the relational understanding of humans and nature that is characteristic for ILK (Díaz et al., 2018).

Bridging worldviews involves processes in which IPLC, planners, and other participants in policy need to reflect on, exchange, and transform their different philosophical assumptions and worldviews, to co-produce shared values and goals (Pretty et al., 2009; Berkes, 2009; Irvine et al., 2016). This is no easy task, since these assumptions are often implicit and deeply rooted in cultural ways of thinking and practices (Mol, 2002; Lezaun and Woolgar, 2013). Indeed, actors often resist accepting worldviews that differ from their own (Hajer and Versteeg, 2010; Pascual et al., 2018). Yet, when we recognize that worldviews shape knowledge systems, the inclusion of diverse forms of knowledge in policy must also include the bridging of worldviews. If this is not done successfully, the inclusion of ILK is bound to fail and legitimacy and effectiveness cannot be ensured (Kenter, 2018).

1.4 The challenge to manage uneven power relations

This section addresses the uneven power relations that can occur in participatory planning and assessment processes and specifically the way in which these processes can reproduce the dominance of Western scientific epistemologies, methods, frameworks, and worldviews (Nadasdy, 1999; Turnhout et al., 2020). These asymmetries have been historically built worldwide and are linked to the differentiated economic accumulation of resources and power by different members of both elite groups, such as planners or scientists, and non-elite social groups, including IPLC (Harvey, 2011). They can manifest when planners dominate, instead of co-steering, policy processes and do not give voice to IPLC during these processes. Scholars have conceived managing uneven power relations in practice as a problem for the achievement of legitimate and effective policy processes (Tengö et al., 2017). A common response of scholars to this problem has been to focus on the perfection of participatory methods – that is, related frameworks, models, and approaches. The assumption then is that the use of such methods by policy actors[2] who intend to foster legitimacy will result in valid and legitimate outcomes (Klenk et al., 2017).

However, "good" methods and intentions alone are not enough to ensure policy legitimate and effective processes, as these processes may be performed – or shaped – in both intended and unintended ways (Law, 2009; Turnhout et al., 2012). Specifically, participatory processes are subject to historical pathways and power dynamics that can lead to different outcomes for each specific situation. For

[2] I address both scholars, practitioners, IPLC as social actors in the thesis, instead of addressing particularly these communities as stakeholders because all these actors usually demonstrate partiality which implicates on them holding stakes (Cash et al., 2003). This understanding also places these actors in a symmetrical positioning (Tromp et al., 2009).

instance, an earlier experience of how local communities were treated by policy planners in a top-down way may result in distrust or disengagement (Evans et al., 2006). This indicates that the legitimate and effective inclusion of ILK together with science in policy is not simply reducible to the efficiency of participatory methods but implies the need for a broader reflection on the practices and attitudes of planners (Klenk et al., 2017). This reflection involves consideration of the political dimensions of participation (Flinders and Buller, 2006; Turnhout et al., 2020). Studies have shown that the tendency to depoliticize participation has resulted in the reinforcement of dominant practices and ways of thinking (e.g. Nadasdy, 2003; Ayana et al., 2015) with the paradoxical outcome that these processes end up marginalizing the voices of those that they intended to include (Turnhout et al., 2010; Merino, 2018). This suggests the importance of politicizing participatory processes so that power relations are not ignored or normalized but actively deliberated.

The effectiveness and legitimacy of environmental policies will benefit from recognition of the agency of communities and from building their capacities to influence policy outcomes. IPLC can exercise agency in the way in which they adopt and implement policies and planning so that they fit their social-ecological contexts (de Koning, 2014; Arts et al., 2014). Including IPLC and building on this agency will support the effectiveness of policies. This means that levelling of power relations is important for ethical as well as instrumental reasons.

1.5 Research objective and questions

In this chapter, I have discussed the importance of including of IPLC and ILK to ensure the legitimacy and effectiveness of environmental policies, including the need to consider the rights and needs of IPLC and the contributions of these communities to conservation, biodiversity, and human well-being via sustainable resource management. However, this inclusion is often threatened by the dominance of Western scientific knowledge and worldviews in policy processes. As I have discussed in this chapter, enhancing the inclusion of IPLC and ILK requires including diverse knowledge systems, bridging different worldviews, and managing uneven power relations. A such, overcoming challenges of knowledge, worldviews and power is the central research problem of this thesis.

The thesis addresses the following **objective:** to understand how to advance the legitimacy and effectiveness of processes and outcomes of environmental policies that aim to include IPLC and ILK. This objective is further specified in three research questions:

1. *What scientific, Indigenous, and local knowledge needs to be included in policy related frameworks and outcomes to ensure that policies align with the needs and contexts of IPLC?*

This question is addressed by investigating the specific contents and meanings of different scientific, Indigenous, and local knowledge systems and how they relate to policy and management contexts. Based on this understanding, it is deduced what knowledge is important to include for legitimate and effective assessments and policy outcomes.

2. *How are worldviews bridged to enable the inclusion of relational understanding of humans and nature in assessment and planning?*

I address this question by investigating what worldviews can be recognized in the frameworks that are used by planners and in the discourses of IPLC to inform environmental assessment and planning of resource management related practices. This investigation is done by identifying the values, beliefs, and aspirations that are reflected in these worldviews, and by analyzing how and to

what extent they are bridged in practice towards relational understandings that are relevant for policy and management.

3. *How and to what extent do planners and IPLC acknowledge and overcome challenges of uneven power relations during policy participatory processes in practice?*

This question is investigated by analyzing participatory processes of policy assessment and planning with a focus on what approaches and attitudes were taken to address and mitigate conflict and disagreement in these processes and to what extent uneven power relations were recognized and managed to include ILK together with scientific knowledge in policy outcomes.

1.6. Thesis outline

Chapter 1 has introduced the central topic that is addressed in this thesis: the inclusion of ILK together with scientific knowledge in environmental policies by legitimate and effective processes and outcomes. It has also provided an overview of the challenges and research questions that are the focus of this research.

In **Chapter 2,** I present the research analytical and methodological strategy in which I draw on Ethnoecology to constitute an umbrella research approach. Ethnoecological methods and theory (on ILK and assemblages formed by knowledge, practice and worldviews are presented as elements of the research approach. Theory on Participatory Action Research (PAR), which is largely adopted in Ethnoecological in practice, is added to complement the ethnoecological theory used in the thesis. Two in-depth case studies on participatory environmental assessment with IPLC in Brazil are introduced. The data collection strategy is then described in detail. The qualitative analysis of the data is described to follow principles of methodological bricolage in order to integrate insights from various schools of thought used in this thesis under the umbrella of Ethnoecology. A thematic analysis is used to code data from the discourses of science, policy and society actors as well as from the performativity of policy processes and IPLC practices in local contexts.

Chapters, 3, 4, and 5 consist of three articles that were published in peer-reviewed journals. These articles were co-authored with the author of the thesis as the first author. In **Chapter 3**, I provide a theoretical-methodological framework: the "Territorial Social-ecological Systems Networks" (TSEN) framework. This framework contributes to an understanding of what knowledge is relevant to be addressed by environmental assessments of ILK and contexts to inform the planning of resource management and governance in a way that includes different knowledge systems and (social and natural) disciplines and that addresses needs from social actors of different spatial scales – that is, IPLC needs and policy goals. The TSEN framework extends the ethnoecological and post-colonial understanding of ILK, as compounded and informed by k-p-w assemblages, to the understanding of the scientific knowledge held by scholars and practitioners. Moreover, it unveils the local context associated with ILK as consisting of a landscape visual entity that expresses geographical territorial processes and functions (i.e. political, economic, cultural, and ecological components). These processes are shaped by social-ecological networks that operate as complex social-ecological systems (SES) and link epistemological, ontological, historical, and spatial scales. The TSEN is applied to a case study with a maroon community and explores the synergies and trade-offs between global and local needs that are related to different knowledge priorities. The chapter addresses **the research questions one and two** of this thesis.

In Chapter 4, I address an in-depth case study with an Indigenous community from Brazil involving the implementation of a REED+ policy to understand the challenges that planners and locals face to realize the legitimate inclusion of diverse knowledge systems, social and natural scientific disciplines, and worldviews that together enable an account for people and ecosystems in a relational way. I analyze how different discourses enact and shape policy processes – i.e. discourses of scholars contained in the global frameworks that draw on the concepts of ES and NCP; of practitioners who draw on these frameworks to plan ACM with IPLC; and of IPLC, in this case the Indigenous people with whom policy planners implement a policy assessment and planning. Moreover, I introduce and explore the concept of people's contributions to nature (PCN) as complementary to ES and NCP, which substantiates a discussion on relational worldviews on people-nature interplays. This chapter covers **all research questions** of the thesis by addressing the role of different forms of knowledge and worldviews to address people-nature relations and include ILK in its diversity and holism while tackling uneven power relations between IPLC and planners. Moreover, the chapter problematizes the gap between information of assessments and planning frameworks used by policies.

In Chapter 5, I also rely on the Indigenous and REDD+ policy case study to investigate how participants in policy processes of knowledge integration and co-production manage challenges to safeguard knowledge diversity and usability during policy assessment and planning. I show in detail the way in which integration and co-production processes complement each other and involve other knowledge processes, such as mobilization and translation of classification categories and nomenclatures. Moreover, challenges that emerge during the unfolding of these processes and strategies that succeed or fail to address these challenges are presented. The chapter targets **research question 1**, by analyzing how planners and the community studied manage power to address knowledge systems and their diversity and in a non-hierarchical way, thereby complementing the literature on integration and co-production, which focuses on best practices and methods.

Finally, in **Chapter 6,** I draw on, and bring together, the findings of the Chapters 3, 4, and 5 to present a final discussion and conclusion and to distill the theoretical and practical contributions provided by the thesis. First, the general and specific research questions are answered while being tied to the challenges and theory adopted in the thesis. Second, in four separate sections I provide a major theoretical contribution for science-policy interface actors to advance towards dealing with the challenges addressed in the thesis. In the first section, I discuss the inclusion of IPLC and ILK in environmental policies towards a co-production of knowledge legitimacy and effectiveness that tackles uneven power relations. In the second section, I unveil the understanding of knowledge diversity as entwined with socio-cultural and ecological diversity and discuss the need of moving from a colonial and hierarchical to a symmetrical way of addressing IPLC and ILK, by the politicization of policy processes and decolonization of science and policy. In the third section, I provide a reflection on the pros and cons of using Ethnoecology as an umbrella framework to link different schools of thinking while conducting PAR with IPLC. In the fourth and final section, I propose recommendations for scholars and practitioners that are drawn from the lessons in the cases studied to further the legitimacy and effectiveness of policies that include IPLC and ILK. The hope is that these scientific contributions become also social contributions is stressed, as part of my duty as an ethnoecologist.

CHAPTER 2

AN ETHNOECOLOGICAL ‘UMBRELLA’ RESEARCH APPROACH

Fernanda Ayaviri Matuk van Maurik

2.1 Introduction

In this chapter, I introduce the research approach I use to address the challenges that affect the legitimacy and effectiveness of the environmental policies that aim to include IPLC and their ILK together with scientific knowledge. To address these challenges, I draw on the theory and method of Ethnoecology as an umbrella framework. I use this theory to establish a symmetrical conceptualization of knowledge systems, which gives me a basis to study ILK and knowledge-integration- and co-production-related decisions. In addition, the research approach includes an analytical-methodological strategy that draws on PAR, which is frequently used in Ethnoecology (de Albuquerque et al., 2014). I explore the value of the PAR theory (Almekinders et al., 2009; Tromp et al., 2009) to understand how to advance the legitimacy and effectiveness of processes and outcomes of environmental policies that aim to include IPLC and ILK.

After explaining the use of Ethnoecology and PAR in my research, this chapter introduces the two in-depth case studies used in this thesis: the 'Malhada Grande Maroon Community' (MGMC), and the 'Kaxinawá Nova Olinda Indigenous Land' (KNOIL). MGMC is located in the Minas Gerais state (semi-arid middle-Northeast region) and KNOIL in the Acre state (Amazon Northwest region) of Brazil. For these case studies, I used Ethnopedology[3], a disciplinary branch or area of interest and inquiry of Ethnoecology (Alves and Marques, 2005) to focus the analysis of scientific and ILK-based classification systems on soils, landscape, and land use in the study areas. This strategy was chosen because soils are key for local decisions on resource management and governance, and because soils intrinsically relate to forests among other natural resources that are targeted by environmental policies (O'Sullivan et al., 2017).

Finally, after detailing the data collection methods, I explain the qualitative data analysis approach that was used, which focusses on the three central analytical categories: 'knowledge', 'worldviews', and 'power'. I also clarify how Ethnoecology is used as an umbrella approach by drawing on a methodological bricolage (Kincheloe, 2008) to link concepts and elements of analytical approaches that are adopted in the other schools of thought that I address to do this.

2.2 Research approach

2.2.1 A brief introduction of Ethnoecology

Ethnoecology and Ethnopedology emerged with the study of the anthropologist Conklin (1954) on the agricultural practices of the Hanunoó in the Philippines. Conklin proposed a new ethnographic approach, according to which culture was no longer conceived as an assembly of artifacts and behaviors related to the use of soils but as a system of knowledge and practices that could be comprehended through the study of folk systems of soil classification (Alves and Marques, 2005; Alves, 2008). Accordingly, a social group's ethnopedological classification was seen as a group's own cultural conception of soils. These folk classifications were focused in Ethnoecology as they were considered to provide an indication of the extent to which culture was universal or particular across several

[3] Ethnopedology mainly addresses ILK, cultural worldviews and practices that are associated with the use and relation of IPLC with the soils and landscapes of their territories. It relies on Pedology (Soil sciences) which is also addressed in the thesis as I have done research in this area during my Bachelor in Geography and my Master degree in Soil sciences (Matuk, 2010, 2012, 2014; 2017).

communities or groups in so far as different classifications were shared among cultures or not (Albuquerque and Alves, 2010).

A second focus of the ethnoecological approach was to match those vernacular names of folk classifications with scientific knowledge and related classifications (Barrera-Bassols and Zinck, 2003). The study of systems of classification relied on concepts that are related to taxonomy – that is, classificatory meanings, criteria, and typological patterns used to name and categorize things, people, and nature according to their similarities and differences. While ethnoecologists focused especially on Indigenous groups – as most anthropologists who adopted ethnosciences did by then (e.g. Strauss, 1964), they also made a strong attempt to bridge social and natural disciplines when studying the systems of classification and the cultural and biophysical context of these groups.

Ethnoecology was reformulated from the 1980s onwards and adopted a new approach and definition. This happened in response to critique from constructivist anthropologists (e.g. Geertz, 1973) who alerted that the study of classification systems did not reveal these systems as they really were. Ethnoecologists started re-appreciating the study of knowledge and classifications by giving a more significant consideration to the entwinement between these classifications and the practices of the social groups they studied and by problematizing the scientific validation of folk classifications. As ethnoscientists, they recognized that ethnography was shaped by personal interpretations, worldviews, inputs of individual group members, and fieldwork dynamics (Whitehead, 2002). By adopting this view, they conceived that ILK was a legitimate and useful body of knowledge and that knowledge and culture are not universal but diverse (Toledo and Barrera-Bassols, 2009). Finally, the prefix "ethno" employed in ethnosciences was changed in meaning. This prefix had been adopted from the Greek *ethnos,* which means people, nation, or tribe and referred to the cognitive system of "the other". After the reformulation of Ethnoecology, *ethnos* incorporated a sense of alterity and started referring to the study of ILK and to co-produced understandings on ILK by researchers and holders of this knowledge and (Albuquerque and Alves, 2010).

After its reformulation, Ethnoecology also assumed a new purpose. This happened especially in response to social contestations of Southern grassroots movements[4] against top-down policy development projects (Dayrell, 1998). These development projects addressed IPLC but they excluded their ILK and they were based on decontextualized knowledge that disrespected and compromised the sociocultural and ecological patrimony of IPLC (Diegues, 2000). Moreover, this happened in the face of protests of IPLC against the exclusion of IPLC from nature conservation areas and against several forms of territorial expropriation that have been widespread in the global South (Coelho, 2014). By recognizing that Ethnoecology had the potential to address not only Indigenous peoples but also local communities, including peasants[5] and even urban citizens in the local knowledge they use, Ethnoecology embraced these contestations and supported IPLC in a bottom-up way. Implementing this new approach, environmental assessments and planning processes started to be done in cooperation

[4] The IPLC grassroots movements that ethnoecologists address as well as ethnoecological studies are often linked with agroecological social movements, research, and practices, such as those that are linked with the Via Campesina in all Latin America. This link derives from the usual orientation of IPLC to align their management with natural ecological processes, which is the principle of agroecology (Dayrell, 1998).

[5] IPLCs include peasants who rely on local knowledge (cf. van der Ploeg, 2013). Although this group is often omitted from the literature on IPLC, they share characteristics with traditional and Indigenous local communities (cf. van der Ploeg, 2013).

with IPLC to advance resource management sustainability, sociocultural and ecological diversity[6], climate change mitigation, among others (Albuquerque and Alves, 2010).

2.2.2 Ethnoecological theory and methodological principles

Ethnoecology is currently considered as a hybrid discipline that bridges knowledge systems and disciplines. The main ethnoecological theory used to address ILK – and which I adopt in this thesis – was formulated by Toledo (1992) and Toledo and Barrera-Bassols (2009). This theory assumes that modern science is relatively "young" – as the scientific method as we know it today was established around the early 17th to 19th century during the Enlightenment – whereas the more than 7,000 ethnicities of Indigenous people and thousands of local communities in the world hold a millenary knowledge. This knowledge has resisted the expansion of capitalism and modern society while also sustaining ecosystems on a planetary level. The theory thus proposes the understanding and valorization of ILK, the recognition of IPLC's needs and contributions to the planet, the construction of sustainable futures, and a criticism of the technocratic modern world rationality.

Ethnoecology explains ILK[7] as formed by '*corpus-kosmos-praxis*' triads (Toledo and Barrera-Bassols, 2009, p.29) – which I translate from Greek to English as knowledge, worldviews, practices but put practices as central, as knowledge and worldviews come together in practices in my analytical framework. Accordingly, ILK may include soil classifications the categories of which are defined by the function of the soil texture (e.g. sandy, silty, and clayey), color, among other soil properties, which are identified by IPLC in their different contexts according to the types of land use and other soil related practices they undertake (cf. Zimmerer, 1994; do Vale Júnior et al., 2007). I also conceive these knowledge-practice-worldviews (k-p-w)[8] triads as assemblages, once they assemble categorizations, beliefs, values, aspirations, management, land uses, and governance, which are (re)shaped together in a spiral movement that links the renewal, continuation, and reformulation of their contents and meanings (cf. Folke, 2006; Berkes, 2012). This reshaping is entwined with social and ecological changes that happen in the territories and landscapes of IPLC. In this movement, knowledge is projected in time and space – for example, the knowledge of an individual shows her/his cultural baggage, which is partially related to the scale of her/his family and society. Worldviews may represent reasons why the group classifies nature in a certain way; believes in their identity and that they belong to the land; and holds certain values in relation to food, animals, forests, and so on. Moreover, worldviews include an animist ontology that defines people as part of and as related to biological and

[6] Cultural worldviews, practices, and nature form together what some scholars call 'bio-cultural' diversity (Maffi, 2002) but I call 'sociocultural and ecological' to stress that this diversity includes geophysical elements – that is, of water, minerals (cf. Diegues, 2000; Furbee, 2002) in addition to the biological and cultural – see Chapter 4.

[7] The knowledge of IPLC has been referred to in the literature using different terms. In this thesis, I adopt the term ILK because its definition fits with the ethnoecological conception of the knowledge of IPLC and it is currently mostly used by science-policy interface bodies, such as IPBES. ILK is defined by Díaz et al. (2015, p.13) 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. It is also referred to by other terms such as, for example, Indigenous, local or traditional knowledge, traditional ecological/environmental knowledge (TEK), farmers' or fishers' knowledge, ethnoscience, indigenous science, folk science."*

[8] These terms were appropriated by Toledo and Barrera-Bassols (2009) from Greek etymology. C*orpus* means body and refers to one or more knowledge repertoires. *Kosmos*, which means harmony or order, refers to the cosmology, cosmovisions, or worldviews of IPLC that conceive the universe as a whole entity that informs and is informed by knowledge. *Praxis* refers to practices that are dialectically shaped with knowledge and worldviews.

geophysical natural entities and that links macroscopic to microscopic phenomena, such as astronomy to soil microbiota as follows:

> "*Andean people in the highlands of Bolivia perceive life as a continuously changing interplay of social, spiritual and natural-material aspects. Humans, on the basis of their social, cognitive and emotional capacities, are participating in a spiritual world that is directly linked to social life and natural-material processes. The spiritual sphere of life becomes the main connecting element of the other domains of the life. Through this the physical space transforms into a 'living landscape' in which human beings, animals, plants and spiritual beings coexist. Time has a cyclical notion, which maintains that life, seasons, stars and planets, historic periods or natural resources are constantly moving on their cyclical way between the different spheres of existence. Such a pattern of interpretation is based on the assumption that 'nature', in the shape of 'Pachamama', 'talks' to people related with her* […] *The communication happens through 'signs of Pachamama'. This helps to assess the current state of the interplay between the three basic spheres of life, which are the material, the social, and the spiritual spheres. The relationship between humans and nature is thus showing a clear notion of co-evolution between the material, social and spiritual domains of life* […] *It is noteworthy that the Andean worldview is not finalist nor deterministic yet there is no concept suggesting that 'Pachamama' obliges people to behave or evolve in a preconceived direction. Thus, the relationship is based on communication rather than on determination… This brings into play a theory referring to 'how things are', which can be considered as an 'Andean ontology*" (Rist and Dahdouh-Guebas, 2006, p.478).

Toledo and Barrera-Bassols (2009) recommend the study of ILK to be executed together with the understanding of local social-ecological specifics through a broad assessment of how k-p-w assemblages and the context of IPLC have become configured as they are in the present. The integration of ILK and scientific knowledge is pursued to enable communication during this assessment and to inform the (re)planning of existent practices. Knowledge integration builds on ILK and relies on the bridging of worldviews by IPLC and science/policy actors to avoid extracting ILK contents and meanings and to make sense of the implications of the inclusion and exclusion of this knowledge. The same sense-making is expected in this integration, in relation to the inclusion and exclusion of scientific knowledge. Such an integration is approached through a search for knowledge correspondences and through the understanding of knowledge differences, which may respectively lead to classificatory matches and complementarities (cf. Krasilnikov and Tabor, 2003). This form of integrating knowledge helps scholars to find interdisciplinary connections that are considered crucial to understand ILK in its holism, to co-produce transdisciplinarity[9], and to inform adaptive learning and ACM (Toledo et al., 2003; cf. Berkes et al., 2000). It is also expected to result in a side-by-side combination of knowledge systems that respects the respective typologies, language, and criteria of these systems, and that in part preserves their diversity and in part creates new knowledge (Winkler Prins and Barrera-Bassols, 2004). To illustrate, the study of IPLC soil classification reveals soil criteria – or indicators – that support land use decisions (e.g. forest conservation or clearing for cropping). These are used by IPLC and planners

[9] Interdisciplinarity is defined as the effort to integrate knowledge from different disciplines to address common goals. It is different from multidisciplinarity, which does not imply the need of integration and is simply aimed towards the exchange of disciplinary knowledge – for example, as informative (Lélé and Norgaard, 2005). Transdisciplinary, in turn, may be performed involving different levels of participation of ILK and of non-scientists in knowledge production and in the framing and addressing of problems in research and policy (Pohl, 2010).

to consider management options that are aspired to as well as those management practices that need to be adapted to conserve sociocultural and ecological diversity.

While Ethnoecology is mostly applied based on Toledo and Barrera-Bassols' (2009) theory on ILK, it does not follow a fully fixed theory or method. Several scholars have proposed different ethnoscientific approaches for Ethnoecology (e.g. William and Ortíz-Solorio, 1981; Posey 1987; Balée 1989; Nazarea; 1999; Marques, 2001; WinklerPrins, 2000; Berkes, 2012). However, many ethnoecologists do not consider a fixed theory appropriate, given the broad range of social and ecological aspects involved in ILK and management (Albuquerque and Alves, 2010). Ethnoecological theories, including that of Toledo and Barrera-Bassols (2009), focus on conceptualizing knowledge but lack a theorization of the methodological principles that are commonly used in ethnoecological studies (Barrera-Bassols and Zinck, 2003). Rather, it is assumed that ethical and dialogical relationships between researchers or practitioners and IPLC must involve a sharing of power, agreements, and negotiations that contribute to these communities. Moreover, cooperation, trust, and engagement are needed to integrate, co-produce, and validate knowledge throughout different stages of the research to respect different worldviews and epistemologies. As PAR provides a theorization that further theorizes these principles and is widely adopted in Ethnoecology (de Albuquerque et al., 2014; Ruiz-Mallén et al., 2012), it also informs my ethnoecological umbrella approach.

2.2.3 Participatory action research

PAR has been conceived and used both by scholars and practitioners in two main ways (Almerkinders et al., 2009). In the first interpretation, PAR is seen as a fieldwork method that may complement a theory or experiment. In the second interpretation – which I adopt, PAR is conceived as an analytical-methodological approach that entails three principles about what science is and how research should be framed. First, it makes explicit its approach to knowledge and ontology. Science is not seen as a complete knowledge that can support the understanding of a local context alone but as a knowledge that needs to be complemented by non-scientific knowledge to inform policies and society. As such, boundaries between scientific knowledge systems and disciplines are not taken for granted. Second, it aims to contribute both to science and to social and ecological transformation. Third, it assumes that the values and goals of both the scientists and participants in research are part of knowledge production. The critical-emancipatory paradigm of PAR clearly differs from conventional scientific approaches[10] in which the researched is treated as a passive source of knowledge to be extracted; knowledge is produced based on scientific prerogatives whereas ILK is seen as biased; and social and natural phenomena are addressed by separate disciplines. PAR scholars concur that while they are open to different ontologies and forms of knowledge, they recognize that preconceptions cannot be entirely removed from research. They attempt to mitigate this bias through a transparent relation with the researched groups to arrive at objective but also consensual understandings (Tromp et al., 2009; cf. Toledo and Barrera-Bassols, 2009).

[10] Social sciences often distinguish three main research approaches: 1) empirical-analytical, 2) interpretative, and 3) critical-emancipatory (Valkenburg et al., 2009, p.20). The first approach focuses on methods whose objectivity, reproducibility, and controllability approximate the empirical analysis used in natural sciences. The second focuses on understanding the motives and intentions that shape people's practices through methodological rules and/or ethnography and describe reality as a narrative story. Scholars of the third approach aim at the emancipation of the ways of being and thinking of research and researched groups.

PAR is largely based on the post-colonial critical pedagogy of Paulo Freire (2000), who conceives the co-production of knowledge as an emancipatory practice that needs to be dialogical, meaning-oriented, and contextualized to make sense for people and their real-life-contexts (cf. MacDonald, 2013). This critical co-production has been proposed to rely on a 'methodological bricolage' approach, which I adopt to support my research (Kincheloe, 2008, p.4). This bricolage involves the bridging of methods, concepts, theories, and frameworks between multiple schools of thought and ILK towards the cross-fertilization of their related ontologies and epistemologies, as a way to create more robust strategies to address real-life contexts. Such an approach also calls for the use of improvisation by scholars to collaborative adjust the methods used during the participatory processes.

The co-production of knowledge in PAR is often done through in-depth case studies that comprise interactive learning processes in which the theory and data generated are cross-fertilized. The participation of group members is expected to happen throughout the data collection, analysis, and validation phases of research (Beukema and Valkenburg, 2009). Theories adopted beforehand in PAR are partially adjusted after researchers meet the participants in fieldwork. Adjustments are done to consider the participants' context and needs – for example, research questions and expected outputs are reframed to address local problems. The co-creation of shared understandings of problems and common goals helps the research participants to reduce differences between knowledge systems, disciplines, and worldviews and to find bridges among them (Reason and Bradbury, 2001). For instance, a soil that is conceived as a sacred entity by local communities is also addressed by them in a practical way to obtain food. The indicators and categories that they use for this practical purpose can be integrated, at this level, with scientific classifications (cf. Barrios et al., 2012; Matuk, 2017). Such co-creation fosters joint reflections on the relevance and validity of different forms of knowledge and the approaches used, which leads to grounded and reliable findings (cf. de Albuquerque et al., 2014).

Sharing power is a focal principle used in PAR, as its scholars recognize that the IPLC researched groups have historically had less power to influence knowledge decisions in science and conjecture that these groups should benefit from participating in research (Valkenburg et al., 2009). PAR scholars support this sharing by avoiding the usual extreme formality that scholars often adopt to relate to researched groups, and that prevents the creation of trust between parties, symmetrical relations, and legitimate data (cf. Cardew, 2020). In contrast, an active, dialogical, and reciprocal relation of trust and engagement is sought with IPLC, which aims to empower the researched group to act as research partners and to shape the data collection processes (cf. Freire, 2000). Yet, beyond providing knowledge that is scientifically relevant or simple reflections on their study's social impacts, researchers are also expected to indispensably contribute to the participants – for example, by giving visibility to the participants' causes through publications and by providing data that helps their needs. Yet, these participants must be treated ethically, which includes the socialization and co-validation of findings and outputs obtained with PAR by researchers and researched groups (Almekinders et al., 2009; cf. de Albuquerque et al., 2014).

In conclusion, PAR tackles the main shortcomings of positivist dichotomous thinking (see Chapter 1), as it actively enables the integration and co-production of knowledge that involves different forms of knowledge. It also favors the bridging of worldviews and the managing of power relations that are needed for a (post-colonial) non-hierarchical inclusion of knowledge diversity and a relational understanding that leads to legitimate and effective policy outcomes. The PAR theory, moreover, sheds

light on the methodological principles that, as previously mentioned, are frequently used in ethnoecological practices but had not yet been theorized together as I did in this section. The next sections introduce the thesis' two case studies and explain how the ethnoecological PAR has been applied to them.

2.3 Case selection and study areas

The research relied on case studies that were conceived to allow me to intensely study the human environmental experiences as well as the implementation of policies in a local spatial scale through in-depth data collection and analysis (Yanow et al., 2009). Considering these qualities, the cases enable me to answer my specific research questions and to address my main objective: to understand how to advance the legitimacy and effectiveness of processes and outcomes of environmental policies which aim to include IPLC and ILK. Before presenting these areas, I will introduce the national context of Brazil.

Brazil did not experience an effective agrarian reform after its independence from colonization and has been the stage of endless conflicts between the elite and the rest of the population, especially IPLC (Moraes, 2002). The country's (geo)politics is still predominantly controlled by the rural elite. This has reproduced a colonial political model that benefits a few members of the national elite actors as well as international actors that profit from the commodification of Brazil's natural resources to the detriment of the non-elite national populatio. This model has contributed to a lack of social political engagement that is strong enough to prevent social and environmental injustice, and it has reproduced inequalities and the exploitation of this non-elite population, which includes IPLC. As such, the country's governors have insufficiently conceded rights and inadequately supported the needs of IPLC, resulting in intensive land grabbing and violence against these communities to successively occupy their traditional territories by landlords (Little, 1996).

Indigenous land rights were first recognized in the Brazilian constitution of 1988, which succeeded the military dictatorship that had ruled the country since 1964. This constitution concurred with the International Labor Organization's (ILO) (1989) request for national governors to safeguard the needs of Indigenous and local communities. However, land rights for maroons were only granted in 2003 by Luiz Inácio Lula da Silva (decree nº. 4,887/2003), the first left-wing president since 1964. Lula also created the 'National Policy for Sustainable Development of IPLC' (decree nº. 6,040/2007) to broaden the recognition of the ethnic diversity and rights of Brazil's other types of local communities, in addition to maroons and Indigenous peoples. Until then, the needs of these local communities had been mainly addressed by regional policy, science, and non-governmental organizations (NGO) projects (Dayrrel, 2009). However, since the righ-wing elite has resumed power in Brazil, it has denied the relevance of this diversity and rescinded these rights by claiming that they threaten private property rights (Barreto, 2015). The current Bolsonaro presidency is supporting these elite claims[11] – for example, by dismantling the 'Indigenous National Foundation' and the 'Cultural Palmares Foundation' (respectively FUNAI and FCP, acronyms in Portuguese) and the 'Chico Mendes Biodiversity Conservation Institute' (ICMBio, acronym in Portuguese). The FUNAI and FCP grant IPLC rights and the ICMBio creates and inspects national conservation areas (Mendonça, 2020).

[11] For more information on these actions see the constitutional proposition 'PEC 215/2000' and the Law project 'PL nº 191/2020' (Antunes, 2020).

Bolsonaro's actions are contrary to the Free and Informed Prior Consultation by Indigenous People (UN, 2007) and to the 'International Regime on Access and Benefit Sharing' (CBC, 2010). They are also making uncertain the fate of IPLC and of the scholars and practitioners who cooperate with them in Brazil.

2.3.1 Case One: the Malhada Grande Maroon Community

The first case is the MGMC. The area is 864 ha and is located in Minas Gerais (Figure 1) in a transitional area between the 'cerrado' and the 'caatinga', respectively Brazilian types of savanna and dry forests (Ab'Sáber, 2003). The area is situated in the valley of the Gorutuba River sub-basin, and the Verde Grande River basin, a tributary of the right bank of the São Francisco River. Although the river is called Gorutuba, the local population calls it the "Gurutuba" and call themselves "Gurutubanos", which is why the area's maroon community is formally registered with the name Gurutuba. The Gurutuba Maroon, of which the MGMC is part, is the second biggest maroon territory of Minas Gerais and one of the biggest of Brazil. It was formed by escaped slaves from the state's gold and diamond mining areas during Brazil's colonization (Costa Filho, 2008). Although the MGMC's ethnic identity is formally recognized by the government, their territory is not (see Chapter 3).

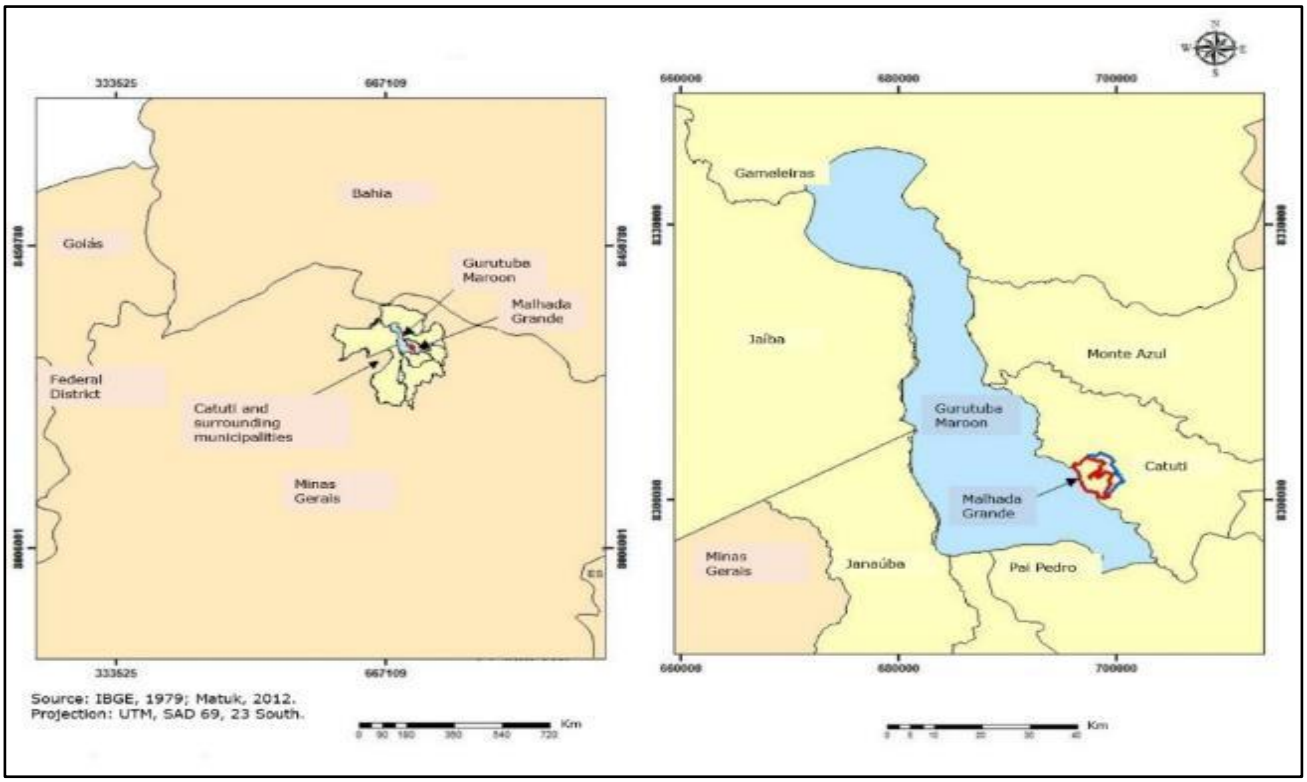


Figure 1. Map of location of MGMC Maroon Community in the municipality of Catuti and shown in relation to the Gurutuba Maroon, to the surrounding municipalities, and to the states of Brazil.

MGMC was selected as a study area[12] first because it is known to draw on local knowledge and to have experienced a history of strong sociocultural and ecological resistance in the poor and semi-arid Middle-Northwest Brazilian region. This region is one of Brazil's regions most in need of political and scientific support (Costa Filho, 2008). It is also known as an area with several IPLC who have

[12] The data of this case study was collected as part of my Master *scientiae* research (Matuk, 2012). The analysis presented in chapter 3 differs from the master thesis in its focus on the legitimacy and effectiveness of the assessment and environmental planning process. I have obtained permission from and included the collaboration of my Master's research partners in Chapter 3.

engaged in grassroots movements and resisted land grabbing and the imposed purchase of lands by cattle landlords, despite living in a region where cattle grazing has expanded over IPLC lands (Duque-Brasil et al., 2013). Second, this study area was selected because it is politically organized as the Quilombola Association of the Gurutuba Maroon of MGMC and has been engaged in the region's NGO projects. Having the support of an NGO was considered relevant to achieve the principles of Ethnoecology. These principles include relying on (non)governmental actors who have worked in synergetic ways with the communities researched to establish first contacts of trust with these communities and to enable the use by these actors together with these communities of data generated during the research after the research is concluded (de Albuquerque et al., 2014). Third, maroons are the most widespread type of local community in the world, which enhances the relevance of understanding their k-p-w and needs.

In conclusion, MGMC case showed good potential to develop an assessment framework to assess k-p-w and to apply it to investigate what scientific and ILK needs to be included in policy-related frameworks and outcomes to ensure that policies align with the needs and contexts of IPLC. I assumed that the knowledge of Indigenous and of local communities have similarities – that is, k-p-w assemblage relations, animism, and strong bond to local livelihoods (cf. Toledo and Barrera-Bassols, 2009; Descola, 2013). As such, I consider that the case study represents ILK diversity and that its findings can support the environmental assessment of other IPLC areas.

2.3.2. Case Two: the Kaxinawá Nova Olinda Indigenous Land

The second study area, KNOIL, has 24,000ha, comprises 5 villages (Nova Olinda, Formoso, Novo Segredo, Boa Vista, and Porto Alegre); and is located in the municipality of Feijó, in the Acre State, in the Brazilian Amazon region (see Figure 4 in Chapter 4). This state has an area of 164,221 km^2. This comprises 4.7% of the area of the Brazilian Amazon which, in turn, covers around 40% of the country (IBGE, 2010). The remote KNOIL area is surrounded by the dense Amazon rain forest and by the Envira River, the watershed surroundings of which comprise one of the biggest populations of remnant isolated Indigenous groups – who have not yet had direct contact with any non-Indigenous society (Iglesias and Aquino, 2005). In addition, while cattle grazing is considered the main economic activity in Acre, the state has conserved about 83% of its original Amazon rain forest cover and also hosts several IPLC, such as the Kaxinawás, who have conserved their traditional practices of fish farming, rubber tapping, among others (Government of Acre, 2010).

KNOIL was selected first because it is the territory of the Kaxinawás, which is one of the various *Huni Kuin* Indigenous communities that belong to the (larger) *pano* ethnicity and are dispersed across the Brazilian and Peruvian Amazon borders (Iglesias, 2008). The community was known to hold ILK and traditional practices and to have fought to maintain its cultural and ecological legacy. As such, I could once again study the assessment of ILK and k-p-w to inform environmental planning, but this time with a specific assess to an Indigenous community and knowledge. Moreover, the community is actively engaged with policy entities. This helped me to garner the support of policy practitioners who have worked with the community to access KNOIL and to make the research outputs usable for both these practitioners and community after the research.

Second, KNOIL is a pilot project for the practitioners[13] of the 'System of Incentives for Ecosystem Services' (SISA) REDD+ policy in this study area (State Law nº 2.308/2010). The pilot aims to further their methodological understanding of how this policy's environmental assessment and ACM planning could be implemented effectively and in a participatory way. This policy drew notoriety, as it builds upon several sustainable development-oriented policies that have included IPLC in Acre[14]; it is the first jurisdictional REDD+ program that operated in the world; and it includes the sociocultural diversity of IPLC and ILK besides the mitigation of climate change and forest degradation that is usually addressed by policies that are linked to this program (Sills et al., 2014). Moreover, the SISA practitioners of the 'Brazilian Public Agricultural Research Corporation' (EMBRAPA, acronym in Portuguese), who act as policy makers and planners in the implementation of this policy in KNOIL, agreed to be partners in the research. Finally, the case allowed me to contrast discourses on nature's provisions and on their relation to nature of Southern practitioners who adopt the ES and NCP (Western) scientific frameworks and of IPLC.

In short, KNOIL and SISA allowed me to study both how worldviews are bridged to enable the inclusion of relational understanding of humans and nature in assessment and planning, and how or to what extent planners and IPLC acknowledge and overcome challenges of uneven power relations during policy participatory processes in practice, respectively research questions 2 and 3 of this thesis.

2.3.3 Comparing the cases studied

During the assessment of the two case studies, I took into consideration that these cases present similarities and differences that enable me to compare them both but also to limit their comparison. While the MGMC case included an assessment by me and my supervision and research partners' team to propose a framework, the KNOIL case was based on the analysis of an environmental assessment and planning of resource management and governance, both of which were made by an "external" group of practitioners. As such, I compare both cases mostly in terms of environmental assessment processes and outcomes.

By studying both Indigenous and local communities, I had the opportunity to analyze both Indigenous and local knowledge systems. While it is not the focus of the thesis to detail the similarities and differences between these communities and their knowledge, these are addressed in the conclusion of the thesis (Chapter 6) with regard to the relevance of science and policy actors accounting for the particularities of ILK in each context of policy implementation and knowledge integration and co-production. It was also considered that the two cases adopted in the thesis refer to two relatively small areas whose representativeness is mostly related to their context. However, the findings and lessons they provided can be extrapolated and linked to other IPLC's experiences and to scholarly and policy debates (cf. Almekinders, et al. 2009).

[13] The planners who have worked in KNOIL are also SISA policymakers. While they contributed as participants in the research, they also co-authored Chapters 4 and 5 and accepted a criticism of their processes and outcomes created with the Kaxinawás by me and the supervision team of the thesis. They, moreover, used an ethnoecological PAR themselves, which enabled me to analyze its application in practice of theoretical and methodological principles of Ethnoecology that I adopt in my research approach.

[14] These policies were triggered by the IPLC grassroots movement against slavery for rubber tapping in Acre that had the nationally acclaimed Chico Mendes as its leader (Schmink et al., 2014)

2.4 Data collection

In this section, I describe the ethnoecological methods that were applied in the case studies during the field visits.

Three visits were carried out for the fieldwork in the MGMC case: December 2010, January 2011, and July 2012. During these visits, I spent my days with the community but slept in a hotel at night. The organization of these visits aimed to include the dry and flood seasons as the landscape, land use, resource management are strongly affected by these different seasons in this semi-arid area. The fieldwork in KNOIL consisted of three parts. The first visit took place in October 2016, in Rio Branco, the capital of Acre and the place where SISA is headquartered. In this visit, I interviewed several practitioners and gained insight into their perceptions on the context of KNOIL and on the processes conducted to implement SISA with the Kaxinawás. The second visit consisted of living alongside the KNOIL community while conducting fieldwork during November 2016. The third visit entitled another month (December 2016) that was spend with the SISA practitioners. This second visit to Rio Branco gave me the opportunity for their feedback on my data, which I then used to complement my data.

The fieldwork in MGMC and KNOIL comprised intense data collection periods. This intensity followed the principle of participatory research, which advocates that the presence of researchers together with IPLC, even when ethnographic research is conducted, must avoid taking too much of the time of these communities and interfering with the time they use to dedicate to labor and other daily activities (Coelho, 2014). Engagement with the communities is expected to speed up the data collection and prevent any time issues. What helped me accomplish this in both study areas is that although I collected most of the data myself in both areas, I relied on the support of soil scientists who helped me to collect soils and to conduct the workshops and who analyzed my soil samples. I also scheduled most activities with political and IPLC leaders in advance. In the case of KNOIL, data collection was intense for several reasons. First, this Indigenous Land is located in an area of the Amazon that is difficult to access and the journey takes about two days by boat on the River Envira (picture 1). Second, it is difficult to stay for a long time in the area because of the high level of insects. Finally, the funding for fieldwork in KNOIL by my scholarship was limited, which required me to mostly use my personal funds to work there so I could go there only once.

The data collection included participant observation; semi-structured interviews; and several workshop activities (de Albuquerque et al., 2014; Coelho, 2014), all of which are detailed below. A first field activity aimed to reach agreements with locals on the research.

Picture 1. Trajectory from Feijó to KNOIL by boat on the Amazon Envira River (KNOIL, 2016).

2.4.1. First research agreements

The first agreements were made during the first meetings with both the leaders and other members of both MGMC and KNOIL and with the SISA practitioners who participated in the research. This technique was used because participatory methods need to make information transparent to the participants in the research and allow them to take part in the reflection and ownership of the data collection and the ensuing results (de Albuquerque et al., 2014). Moreover, these agreements were used to create trust with the participants and to think jointly and creatively of strategies to contribute to and to adjust the research. Accordingly, these meetings were made to carry on a dialogue to identify priorities intended to be addressed and possibly included in the research. Via this dialogue, I presented the research topic and activities proposed for the participants in the research. The planned agreements and adaptations related to these activities were the departing point to start PAR. The expectations from the study and openness for the participants to add demands and flag problems they perceived with the study were important points to rethink and guide the research planning made beforehand.

The first agreements included the following: i) the purpose of the research and possible links between the topic and local needs that the research could support with the data produced; ii) sampling strategies – that is, areas within the communities in which soils, landscape sectors, land use types would be visited, debated, and mapped and the selection of informants. Local leaderships invited all community members to participate in the workshops and also indicated key informants to accompany me closer throughout the data collection process and general informants to be interviewees. These leaders also established when and where it would be convenient to conduct interviews and participatory activities. The selection of interviewees took the following criteria into consideration: i) to have a balanced inclusion of female and male participants and old and young people; ii) to have local experts in a variety of practices recognized by their group; and iii) to include locals who live in different sectors of the landscape. This last criterion aimed to allow the interviews to include visits to the interviewees' gardens and to observe and chat about their environment.

The agreements also included the appointment of two key informants in MGMC, an old female and an old male leader who were considered to possess extensive knowledge on the culture, history, management and governance, and ecosystems of the area. The data to be returned to the community for their contribution to the research included a map of the MGMC territory to be used in their grassroots movements in search for territorial recognition from the government, and a booklet registering their knowledge. In KNOIL (picture 2), it was agreed that the research would rely on three key informants: the "cacique" (male political chief), a female leader, and a local male who had worked closely in the process of policy implementation with the SISA planners and who was elected as an agroforestry knowledge agent and official representative of this policy. We decided that the workshops would take place in the main village of KNOIL: Nova Olinda. It was agreed to give to the community a booklet with the Kaxinawá environmental knowledge registered during the research to be kept as part of their legacy and publications of articles that would support them in gaining international visibility on their needs and contributions to global biodiversity and human well-being.

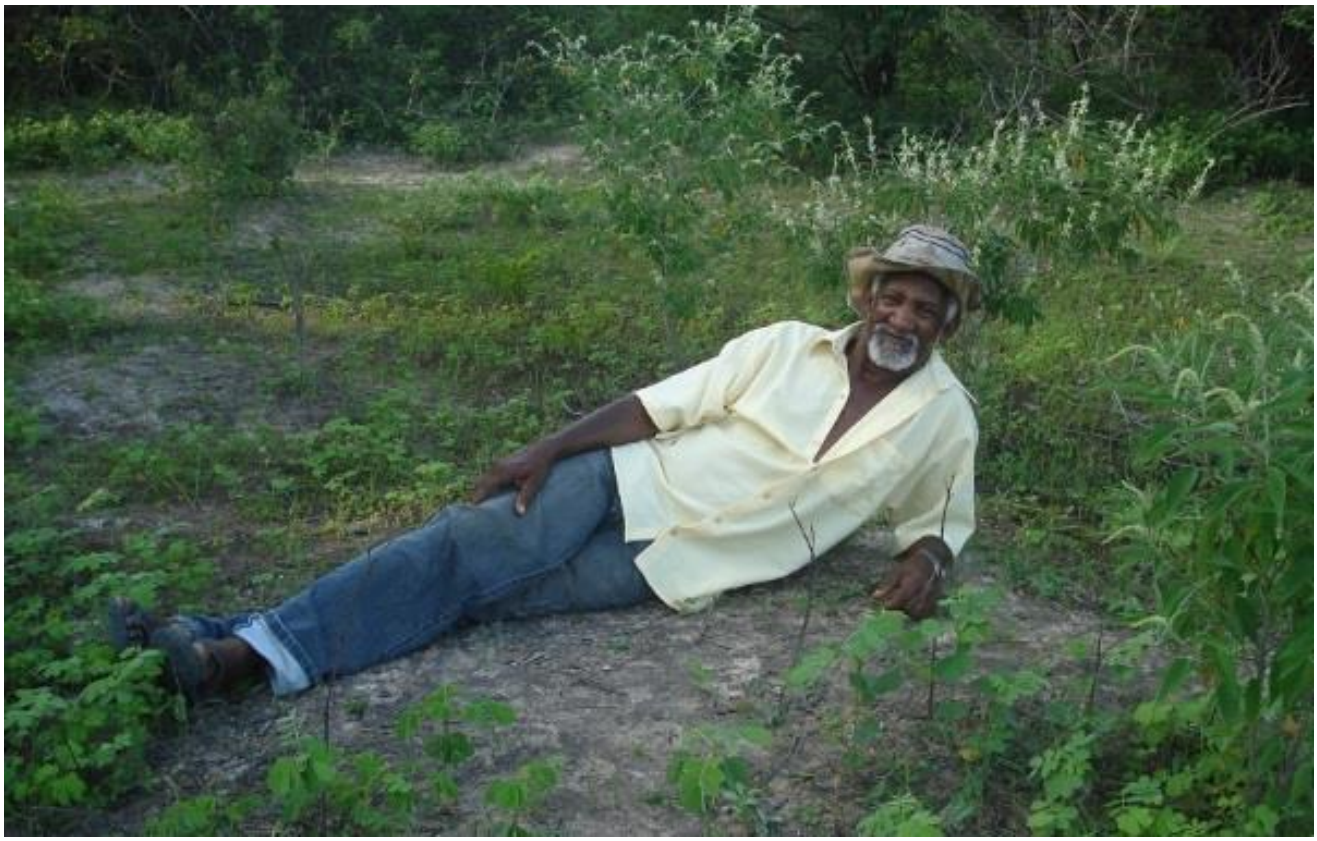
Picture 2. Making first agreements with Indigenous leaderships in a circle of dialogue (KNOIL, 2016).

The first agreements also involved questions around the ethics of the research. All activities were carried out with the community's consent. In the case of MGMC, I submitted to and had my research approved by the Research Ethics Committee of the Federal University of Viçosa (UFV), which adheres to the national law on research with human beings, ILK and genetic resources (Provisional Measure nº. 2,186/ 2001; decree 4,339/2002). In KNOIL, free and prior informed consent was obtained (Brazilian law nº. 13,123/2015). All recordings of interviews and workshops as well as photos that were made during the fieldwork were also authorized for use by signed consent from the research participants. Safeguarding of anonymity of the informants was also taken into consideration. The participants in the research were treated as equals and partners in the generation of data. In addition, out of respect for the community, we stopped data collection in MGMC after some research participants died in an accident that happened during the research period. This event happened at the end of my

research and did not affect my data collection, as we did return one final time to co-validate and return data to the community.

2.4.2 Participant observation

This method was adopted to support the in-depth investigation of the case studies (de Albuquerque et al., 2014). Ethnographical participant observation mediates this indepthness in the data collection by allowing the researcher to gather information on the everyday life of the researched community and to create bonds with different participants in the research who may not be present in the workshops or selected for the interviews (Coelho, 2014). In both study areas, this method consisted of participating in and observing elements that were perceived during everyday life activities, visits to interviewees, workshop activities, and informal interactions – that is, chats, shared meals, and events (picture 3). In KNOIL, it also included the observation of the EMBRAPA planners implementing SISA (picture 4).



Picture 3. A key informant and regional maroon leadership (who sadly died during the research period), relaxing while explaining the entwinement between the maroons and their land (MGMC, 2011).

I also observed the SISA policymakers during their participation in two workshops in Rio Branco. This included, first, my attendance at a workshop organized by the Acrean Climate Change Institute (IMC, acronym in Portuguese). There, practitioners discussed the next steps of SISA to construct a jurisdictional basis that would allow the economic valuation of sociocultural and biological diversity, which are currently addressed with funds obtained via the avoidance of deforestation and related carbon emissions in Acre (see chapter 3). The second workshop was organized by both the IMC and World Wide Fund for Nature (WWF) and aimed to mediate a reflection by these practitioners on how a more sustainable access to resources can be supported by SISA and WWF. These workshops consisted of experiences of observing policy makers working together and discussing their approaches

to IPLC. As a participant, I had the opportunity to raise questions and to clarify doubts on the implementation and focus of the policy with these practitioners.

Picture 4. The participant observation of an activity of the EMBRAPA planners with the Kaxinawás (KNOIL, 2016).

Finally, I observed my own workshop activities (Section 2.4.4). The observations in MGMC, KNOIL, and Rio Branco were noted and then reviewed. A note diary was used to retain and chronologically organize information as data was acquired.

2.4.3 Semi-structured interviews

The method of semi-structured interviews was selected as it allows the researcher to rely on pre-prepared questions that are also used in structured interviews and that enable an objective categorization and comparison between their perspectives of the interviewees on the same subject. However, in addition to its contribution to structured interviews, semi-structured interviews also give space for the interviewer to deviate and zoom in on information that is unexpected but appears relevant for the research. Yet, this semi-structured interviewing technique allows the data to flow as a dialogue and conversations to become meaningful, which enriches the data (de Albuquerque et al., 2014). Correct usage of the technique requires a strong understanding of the research topic and of the historical background related to the region and country of the study area. Additionally, it demands that the interviewer maintain the focus of the study while still allowing the informants to express themselves freely. In the case of IPLC, this form of interviewing was challenging, as their ILK is very tacit[15] and their way of expressing ideas is mostly metaphoric (Ayub et al., 2018). In both the case studies,

[15] Tacit knowledge refers to knowledge that is not entirely understood but is used with certainty by both IPLC or scholars in their practices. For instance, as social actors adopt knowledge from each other and scholars adopt choices to adjust to circumstances while conducting the qualitative analysis or empirical experiments (Collins, 2001).

metaphoric language and analogy were present and were dealt with by using different ways of inquiring on the same subject to re-check information during the interview.

In both study areas, an interview guide was created beforehand (see Appendix 1) and was continually updated with subjects, issues, and doubts that emerged during the meeting with each interviewee. The interviews included 12 maroons in MGMC, and 20 Kaxinawás and 20 practitioners in KNOIL. Overall, the interviews were focused on the ILK related k-p-w contents and meanings; on the needs related to resource management and governance; and on the relations between community members and diverse policy, science, and social actors who have been influencing the communities' context. As the case of KNOIL (picture 5) comprised the SISA policy, the interviews also focused on the power relations established between Kaxinawás and planners during processes that involved integration and co-production of knowledge and bridging of worldviews. The interviews with these planners focused on their perceptions and procedures taken to assess and include Indigenous knowledge, ES and NCP in KNOIL and to plan management and governance. These interviews also covered the achievements and pitfalls that they observed to address local needs together with policy goals and to include scientific and Indigenous knowledge together with relational worldviews in policy processes and outcomes legitimately and effectively.

Picture 5. Interview with a local teacher and member of the community (KNOIL, 2016).

2.4.4 Workshop activities

Three workshops were conducted in MGMC and five in KNOIL. The workshop activities used the methods presented below. All these methods commonly relied on circles of culture, which are called "*círculos de cultura*" in Brazil, where Freire (2000) created this method, and which consist of circles of dialogue. These circles were chosen as they may be applied during any focus group activity in which the bringing out of knowledge, worldviews, and practice-related contents enable joint

reflection and creation of strategies to understand and address problems and contexts. The workshop activities that were carried out in each study area are presented in Table 1.

Table 1. Workshop activities and the location in they were carried out during the fieldwork.

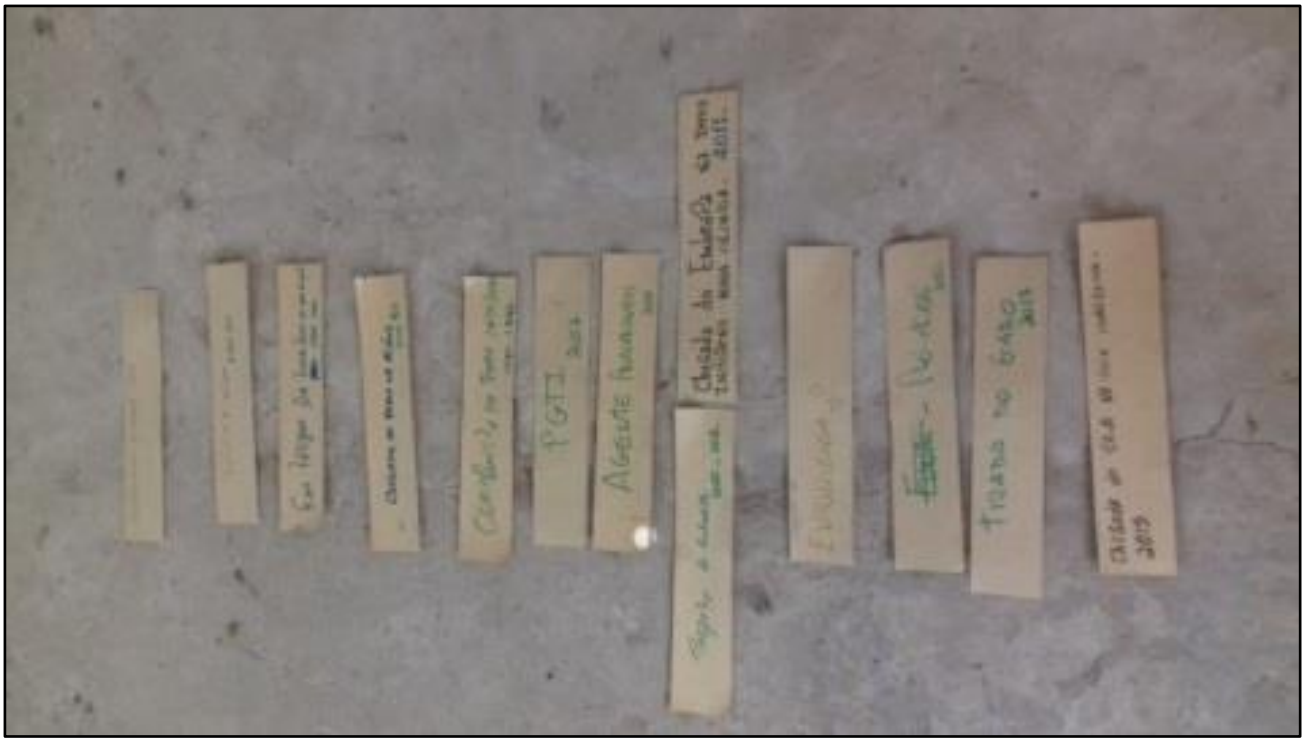
Activity / Local	Historical timeline	Venn diagram	Participatory mapping	Cognitive mapping
MGMC	X		X	
KNOIL	X	X	X	X

The workshops attracted an average of 27 and 35 community members, respectively in MGMC and KNOIL. The data previously gathered in the participant observations and interviews was complemented by different types of information that came out during the dialogues with community members in the workshops, whose activities are presented below.

i) Historical timeline

This method is based on story-telling that is guided by questions of interest in the research. It is especially relevant to gather data on the IPLC histories, which have few written or iconographic documented sources. It also leads to a more in-depth understanding of these communities' historical experiences with natural resources and ILK as well as the reconstruction of their environmental history (Lane, 1997). This method was used as my research partially focuses on understanding social and ecological changes that happened over time related to the territorial and landscape changes, and the accompanying adaptations in both ILK and resource management and governance practices by IPLC. The activity was organized in the shape of a 'circle of dialogue' (Freire, 2000) and was centered around asking the participants to indicate key historical events related to the territorial and landscape changes and to explain the importance of these changes to the local contexts. These events were registered in a dialogue in MGMC and in cards in KNOIL (picture 6).

The activity was facilitated by questions, beginning with questions pertaining to the time when the community was founded, and covering the most important representative events that changed the way they live and use their land that they remembered. The participants were mainly asked about the changes that have occurred in the landscape over time, when they occurred, the nature of the changes, and their causes. In KNOIL, this activity included a debate on changes that according to the Kaxinawás happened since the SISA policy has been implemented in their community. The answers were taken to represent the community's perspective on the historical transformation of their territory, landscape, SES, ILK and related k-p-w contents – i.e. land battles and demarcation by the government, integration in the market, introduction of agroforestry systems, among others. Additionally, this transformation was problematized.

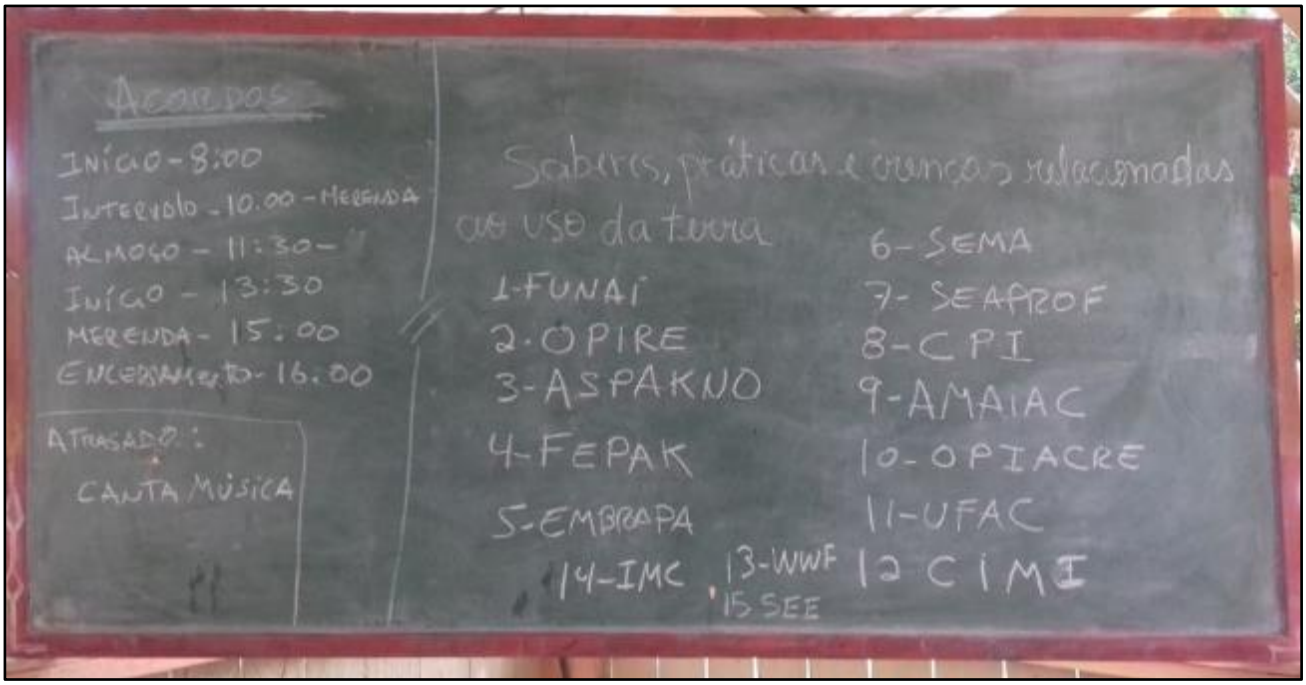


Picture 6. List of the main elements of the historical timeline that led to changes in KNOIL as indicated by the Kaxinawás (KNOIL, 2016).

ii) Venn Diagram

This method was chosen as it supports a detailed stakeholder analysis of the level of power and influence of different policy and other actors on the community and the support of these actors to the community (de Albuquerque et al., 2014). To conduct the activity, a sheet of paper and paper circles of different sizes were used. Participants were instructed that the size of the circles, big or small, represent, respectively, a high or low level of power of the entity over the area (i.e. IPLC's access to livelihoods and practices). In addition, the distances between the circles when placed on the sheet of paper should represent the strength (closeness) of the relationship and the effective support the entity gives to the community. The participants were asked to number the entities cited. I noted the names on the blackboard (picture 7). Both formal and informal entities that directly or indirectly influence KNOIL were taken into account, according to the perceptions of the participants. The group was then asked to place these circles around the local area over the sheet of paper (picture 8). A dialogue on the role of these entities and the pros and cons of their presence in the past and present followed.

Thereafter, the participants reflected on the scenario they wished to have in the future, in relation to the support and influence from the entities they cited – picture 9 (cf. Coelho, 2014; Albuquerque et a., 2014). Thereafter, in a new round of circle of dialogue, the power relations that were established with the planners were discussed. In addition, the community reflected on what changes and strategies would be needed to achieve their desired scenario.



Picture 7. Policy, science, and NGO entities that were cited by Kaxinawá as the most influent on, and/or supportive to the community (KNOIL, 2016).

Pictures 8 and 9. On the left, Venn Diagram indicating the numbers matching the institutions written down on the blackboard that influence and/or support the Kaxinawás. On the right, the institutional scenery aspired to by the community (KNOIL, 2016).

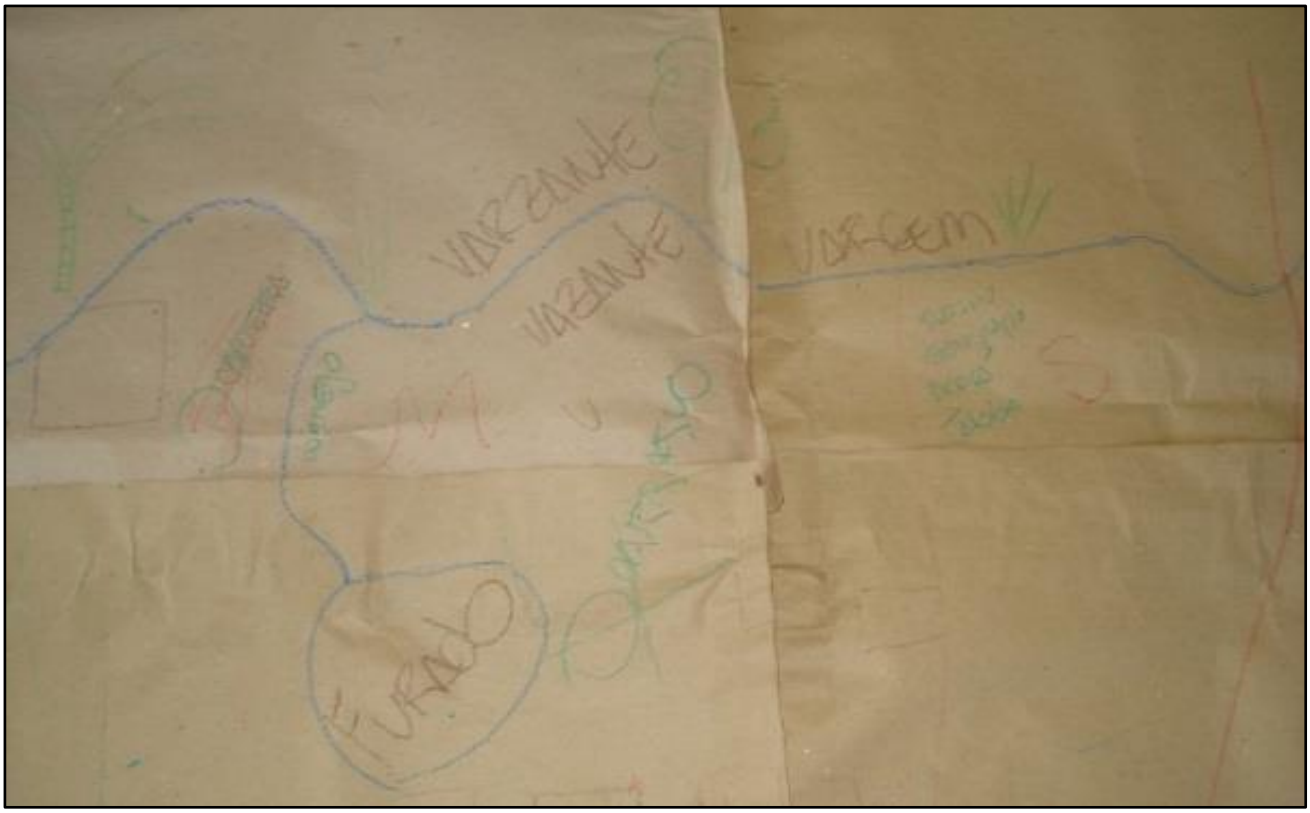
iii) Participatory mapping

This method was used as it is considered an effective tool to gather information on the spatial distribution of diverse elements that are intended to be mapped in study areas (Mejía; 2002). The method was used to gain insight into and map the distribution of the soils and related land use types and landscape sectors in the territories of MGMC and KNOIL. In MGMC, this activity included the mapping of the territory's borders and changes to these borders over history, as this, we agreed, would contribute to the community's needs. In the KNOIL case, the spatial distribution and use of ES and NCP categories were mapped to the associated land uses as part of activity presented in the next subsection.

The participatory mapping started with 'circles of dialogue' (Freire, 2000), in which the participants were asked to draw or sketch the local landscape on a sheet of paper that was put on the ground (picture 10). The procedure started by asking the participants to mark reference points, such as leadership houses, the churches in the communities, the borders, rivers and villages (Mejía, 2002). The

goal was to help them locate and distribute the mapping units of interest on paper. Thereafter, the participants were asked to draw the mapping units (i.e. soils, landscape sectors, and land uses) in relation to these references. Once mapped, the spatial distribution and name of each unit was mapped for each purpose (see pictures 11 and 12), the participants were requested to denote the indicators they use to identify, understand, and manage this spatial distribution. Strategies of land use were discussed in relation to the seasons of the year and characteristics of the ecosystems of their landscapes as well as to economic, political, and cultural aspects.

Picture 10. Participatory mapping made with the protagonism of the marooms (MGMC, 2010).



Picture 11. Drawing made by the maroons during the participatory mapping of the landscape units that are associated with different soils classes and land uses (MGMC, 2011).

Picture 12. Drawing made by the Kaxinawás of the Formoso Village during the participatory mapping of the land uses carried out in the soils and landscape sectors of their territory (KNOIL, 2016).

In a second phase of the participatory mapping, we did guided-tours with the activity's participants (de Albuquerque et al., 2014) – picture 13. These tours were performed to obtain more knowledge about the management related to the mapped areas and to refine the mapping. During these tours we visited the mapped areas, collected soil samples, and observed and talked about the indicators and resources that were mapped (picture 14). The Kaxinawás were asked, for instance, about the reasons why the use and management of the area was configured as it was; on potential uses that could be adopted in KNOIL; and on social and ecological risks and benefits that are associated with their management and related practices. In addition, I used a global positioning system (GPS) device to collect georeferenced points in the areas visited. After the activity was concluded, we overlaid the georeferenced data on satellite images of the study areas by usingArcGis10 software and these overlays were transformed into digital maps to be used as part of the research results.

Pictures 13 and 14. On the left, women who participated in the guided-tour. On the right, joint observation of soils indicators with Kaxinawás (KNOIL, 2016).

iv) Cognitive mapping

This form of conceptual mapping was adopted to complement and further debate the data that was collected during the participatory mapping in KNOIL. This activity started with a first round of 'circle of dialogue' (Freire, 2000), in which we brought out the different conceptualizations and values that the Kaxinawás attribute to nature. The Kaxinawás were asked to write a word to represent what they understood as nature and what it means to them, and to explain why they chose the word they did. The categories cited by them were interpreted as their conceptualization of ES, NCP, and PCN. The participants also spontaneously made drawings that represented the value of nature and handed them to me (for example, pictures 15, 16, and 17).

The second part of the activity involved fuzzy cognitive mapping with the aim to associate the NCP and PCN categories that the Kaxinawás had indicated with the soil, landscape, and land use categories that were mapped previously. To this end, we asked the Kaxinawás about i) which landscape units and natural resources that we had observed during our participatory mapping these categories related to; ii) how these categories related; and iii) which k-p-w they related to (cf. Fagerholm et al., 2012). The Kaxinawás were split in groups and listed these categories and their relations by grouping them in texts (picture 18). This activity enabled me to assess the entwined understanding of the interrelations among these different categories of ES, NCP, and PCN with the resource and practices mapped. It thus allowed me to include these categories in the map that was previously produced.

Pictures 15 and 16. On the left, a drawing representing tress that are used in the construction of roofs of houses and boats and of furniture and as food. On the right, a drawing representing a local ceremony (KNOIL, 2016).

Picture 17. A drawing representing banana and watermelon crops separated by a space in which the drawer added a *kenê*; a graphical symbol that is used in body, clothing, and handicraft paintings that represent the *Huni Kuin* identity and that is based on patterns that the Kaxinawás identify on nature (KNOIL, 2016).

A third part of the activity included another round of 'circle of dialogue'. After I recorded the Kaxinawá's categories of ES, NCP and PCN on the blackboard, I asked them to split into groups and comment on the data in the different categories. We then problematized and reflected on what were the most important categories in the view of the Kaxinawás, for whom and why. By doing this, I could bring out data on values, aspirations, beliefs related to these categories and access a shared understanding of the classifications by the Kaxinawás. I could also gain insight into their relational understanding of people and nature. The conceptualization obtained was later analyzed in regard to its (mis)match to the concepts found in the ES (e.g. MA, 2005) and NCP frameworks (Díaz et al., 2018).

In a fourth and final part, we discussed to what extent the Kaxinawás' categories of nature, values, and other categories that were previously mapped were accessed and included by the SISA planners in their participatory assessment and planning in KNOIL in their diversity and holism. The Kaxinawás were also asked about whether this inclusion was legitimate and effective and supported them in advancing a sustainable management and governance of natural resources that attends to their needs and the social-ecological specifics of KNOIL. Therefore, I analyzed with the Kaxinawás the maps that were produced by the SISA practitioners as the result of their work with them (picture 19).

Pictures 18 and 19. On the left, the listing activity of ES, NCP, and PNC made in groups; and on the right, the evaluation of the participatory mapping that the SISA practitioners did as an outcome of their work with the Kaxinawás (KNOIL, 2016).

2.4.5 Data co-validation and finalizing the fieldwork

In both study areas, my interpretation of the collected data was co-validated with the participants at the end of the fieldwork activities and after each workshop day to check the validity of my interpretations and to clarify any misunderstandings or issues that needed to be further investigated later (Coelho, 2014; de Albuquerque et al., 2014). In the case of MGMC, this co-validation included a final meeting in which the maroons checked the territorial map that we had produced (Figure 2) and the booklet made in collaboration with the research team that was to be given to them[16]. In the case of KNOIL, given the difficulty of returning to the study area (see section 2.4), I presented the analyzed data to the community at the end of the fieldwork phase on the last day of the workshop. I also gave a presentation to the practitioners at the end of my fieldwork with them on the findings obtained with them and with the Kaxinawás. At the end of the research, the data that was to be published was validated online with the practitioners who co-authored papers with me, and the articles were shared

[16] The booklet is found in the link http://www.novoscursos.ufv.br/projetos/ufv/nape/www/wp-content/uploads/cartilha-1-Ambientes-hist%C3%B3ria-identidade-e-plantas-alimentares.pdf

with the Kaxinawás online. The booklet, which is still being written, will be returned to the community for their additions and co-validation before it is finalized.

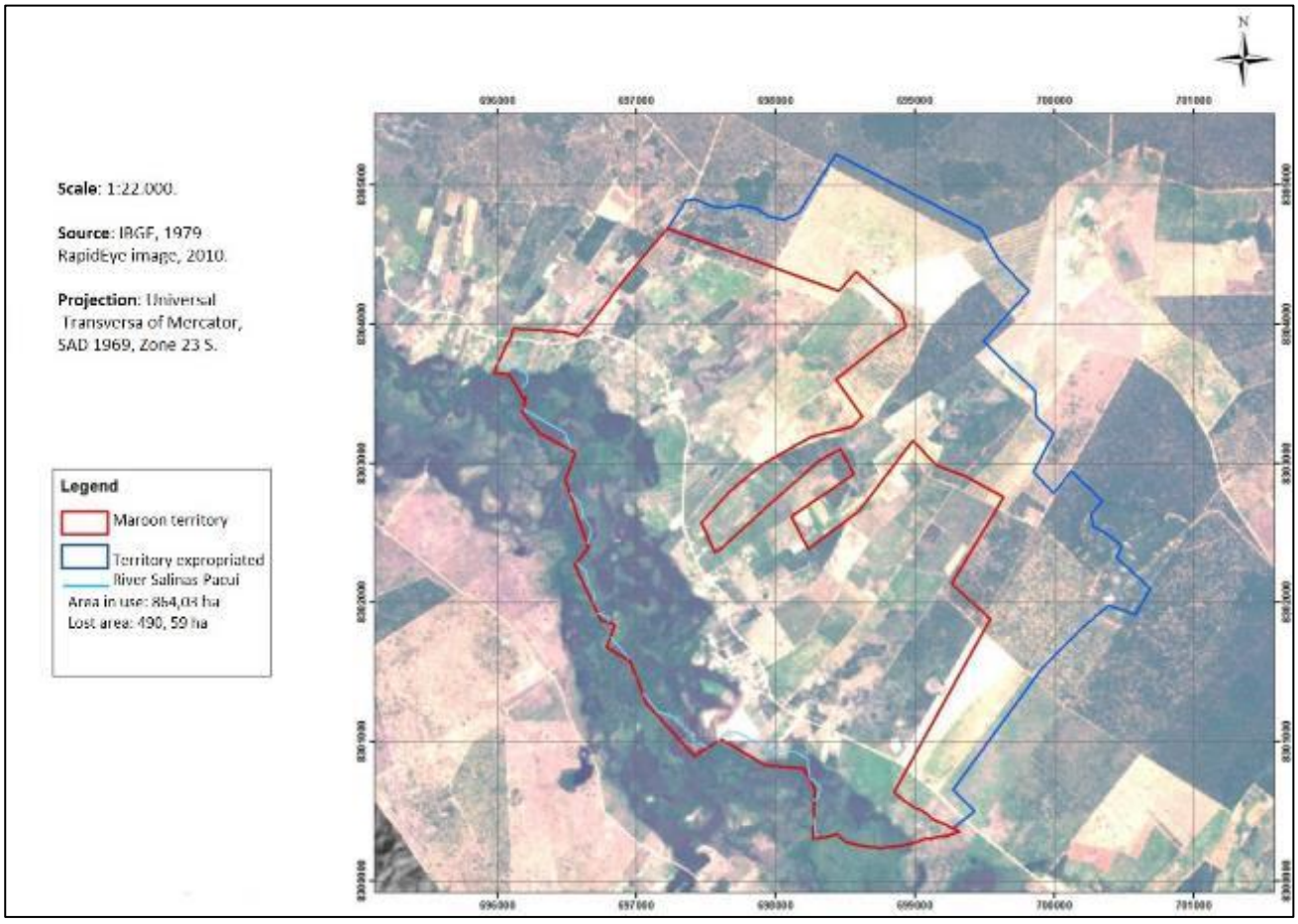


Figure 2. Map of the maroon territory of MGMC, Catuti, Minas Gerais – Brazil (MGMC, 2012).

The field visits in both study areas were finalized with a celebration. In MGMC, the celebration included the participation of the research team in preparing and consuming a traditional a maroon dish (picture 20). In KNOIL, the celebration included a traditional harvesting ritual, which they call *mariri* or *Katchanawa*. We danced together and were surprised by several local games (picture 21). The community's musicians guided the evening with traditional humorous and sacred songs that are used as part of local resource management practices.


Pictures 20 and 21. On the left, starting to prepare food with the maroons (MGMC, 2012). On the right, starting the celebration of the fieldwork with the Kaxinawás (KNOIL, 2016).

2.5 Data analysis

The strategy for data analysis was predominantly qualitative and involved the interpretation of data together with locals (Tromp et al., 2009; Schwartz-Shea, 2015). Considering this, the reliability of the data generated in the thesis was pursued in accordance with the principles of Ethnoecology and PAR that were previously detailed in this chapter, including non-hierarchical relations, reciprocal engagement, trust, intention to produce knowledge that is both scientifically and socially relevant, and data co-validation (Almekinders et al., 2009).

My analytical strategy was informed by the concepts that were identified as relevant to address the research questions and objective. I applied the idea of methodological bricolage to inform my choice for analytical concepts used during the analysis. First, I identified and linked interpretations that were associated with the scientific theories of Ethnoecology and PAR and interpretations that were based on the grounded data generated with the IPLC and practitioners who participated in the research. Second, I sought to cross-fertilize concepts and elements of analytical approaches used in the schools of thought that were explored as part of my analytical framework in the individual articles that make up Chapters 3, 4, and 5 – and address processes and outcomes related to 'knowledge', 'worldviews', and 'power'. Third, I drew on bricolage to link the data related to soil classifications[17] to my study of integration and co-production involving scientific and ILK-related classifications. Finally, bricolage was used to analyze the extent to which planners adopted bricolage themselves, together with other guidelines that were identified in the articles as relevant (see Chapter 3, 4, and 5).

Using the analytical concepts identified through the process of methodological bricolage, the study's qualitative analysis involved rounds of coding of the data. To code the data, I used 'thematic analysis' as a method (Nowell et al., 2017). The data was coded in multiple rounds that involved different levels of complexity. Initial rounds of coding were mostly made by establishing themes in the empirical data, including the notes and transcribed information from audio recordings of the ethnographic participant observations, semi-structured interviews, and workshop activities that I held.

[17] The analysis and the classification of the soils followed standard procedures for morphological, chemical, physical analysis of soils (EMBRAPA, 2011; cf. IUSS Working Group WRB, 2015). This was done in both study areas by the soil scientists who co-authored Chapters 3, 4, and 5.

Subsequent rounds included data from literature reviews, from SISA reports, and from the ES and NCP frameworks that I analyzed. Successive rounds of coding were focused on discourses (Hajer and Versteeg, 2010; Behagel et al., 2017) and on practices (Law, 2009; Turnhout, 2018) that presented a general occurrence of references to the central categories that I focused on in the thesis: 'knowledge', 'worldviews', and 'power'. These references were mainly related to knowledge diversity and usability; to ontologies and (non)relational worldviews; to IPLC's practices in their territory and landscape; and to policy processes and power relations. Final rounds of coding applied more specifically the concepts that are the focus of Chapters 3, 4, and 5 of the thesis (Folke, 2006 Raffestin, 2014; Haraway, 208, 2016).

Finally, the data was triangulated to cross-fertilize and cross-check the validity of the data obtained through different methodological sources, including participant observation, interviews, and workshop participatory activities (cf. de Albuquerque et al., 2014). This triangulation allowed me to identify data that was presented by different participants in the research in different ways (e.g. classification categories and criteria) (Chambers, 2007). For instance, information that was withheld by interviewees but was made explicit during the circles of dialogue was contrasted to find consistencies and incongruences between discourses of community members and between these and policy practitioners. This information was also explored to obtain a shared understanding according to the different sources of data and informants. Information that remained omitted was understood by the research team when it was related to delicate subjects, for example, subjects that dealt with IPLC suffering in the past. In both case studies, the data presented in different ways could be further investigated with this triangulation to identify incongruences that had to do with inconsistency in the data obtained or with the epistemological and ontological heterogeneity that were part of this data.

CHAPTER 3

DECIPHERING LANDSCAPES THROUGH THE LENSES OF LOCALS: THE "TERRITORIAL SOCIAL-ECOLOGICAL NETWORKS" FRAMEWORK APPLIED TO A BRAZILIAN MAROON CASE

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Abstract

Landscape approaches are prominent in current policy debates about how to achieve ecological, economic and social sustainability. These approaches assess local social-ecological contexts to plan adaptive management and often include IPLC. An important aim of landscape approaches is to integrate different scientific disciplines, Indigenous and ILK and Western science, and global and local needs. In practice, such integration tends to favor globalized knowledge models and global needs over local ones. This article introduces the TSEN framework, which is proposed for integrated assessments of landscape settings and dynamics mediate the overcoming of such tendencies. We argue that both scientific knowledge and ILK are entwined with practice and informed by worldviews. Moreover, these assemblages of k-p-w are produced by social and ecological interrelations (or networks) that shape human appropriation of territory. We use an approach of methodological bricolage to apply the TSEN framework to the case of the Brazilian MGMC. The results highlight how social-ecological networks of different space-time scales co-produce landscapes. Trade-offs and synergies between global and local needs are also discussed and used to identify priority needs that can be addressed by a landscape approach in the area. The analysis suggests that the TSEN framework may be used by both scientists and practitioners to perform environmental assessments that are inclusive of social and ecological disciplines, of local and Western scientific knowledge, and of global and local needs in a landscape.

3.1 Introduction

For more than a decade, landscape approaches have been advocated to address ecological, social and economic sustainability in an integrated manner, by addressing multiple disciplines, knowledges, and needs that span science-society-policy interfaces and policy sectors and scales (Agnoletti and Rotherham, 2015; Arts et al., 2017). International organizations, including Food and Agriculture Organization (FAO), among others, increasingly look to landscape approaches to inform policy development and implementation. Landscape approaches make use of environmental assessments of social-ecological local contexts to conduct environmental planning that promotes adaptive co-management. Accordingly, they engage with and reshape pre-existing resource management and governance to achieve sustainability and resilience (Freeman et al., 2015). While doing so, landscape approaches attempt to integrate diverse disciplines, forms of knowledge, and needs of global to local stakeholders, including IPLC (Sayer et al., 2013; Turnhout et al., 2017).

Estimates are that globally, IPLC include up to 2.5 billion people who directly depend on territory for their livelihoods. They manage over 50% of global land surface, while having formal ownership or land use rights for less than 10% of their territories (Oxfam, 2016). Indigenous territories alone cover 22% of the world's surface, and IPLC are custodian of 80% of the global biodiversity (FAO, 2017). IPLC are widely recognized for contributing to biodiversity and ecosystem services via ILK and interconnected practices (Berkes, 2012; Descola, 2013; Nolte et al., 2013; Díaz et al., 2015). However, pressures from agribusiness and other external drivers threaten traditional land use and management practices, land tenure, and access to livelihoods. Such threats highlight the importance of landscape approaches to address land management in tune with ILK (Toledo and Barrera-Bassols, 2009).

Landscape approaches aim to integrate diverse disciplines, knowledges, and needs. First, they consider a landscape as a SES and aim to integrate knowledge from both social and ecological disciplines via interdisciplinarity to assess landscape settings and dynamics and to inform planning (Angelstam et al., 2013). Second, they adopt a participatory approach to integrate diverse knowledges. The idea is that engagement of and trust between relevant stakeholders from global to local scales – including planners, locals and other stakeholders – during implementation allows the integration of their knowledges, practices, and worldviews (Freeman et al., 2015). Third, landscape approaches rely on adaptive co-management to integrate multiple needs and interests of these global, local, and intermediary actors in the constitution of multifunctional landscapes (Allen and Garmestani, 2015; Arts et al., 2017).

Scholars of landscape approaches have identified multiple challenges to achieve integration (Freeman et al., 2015; Sayer et al., 2013). First, landscape approaches have struggled to overcome disciplinary boundaries, which is thought to prevent a full understanding of landscape settings and dynamics (Reed et al., 2016). Second, while trying to integrate scientific and non-scientific knowledges, participatory approaches often struggle to give enough voice to locals, and tend to privilege Western scientific knowledge over ILK (CBD, 1992; Turnhout et al., 2012). This has also prevented ILK to inform planners about social-ecological interrelations that are entwined with landscape settings and dynamics (Escobar, 2008; Turnhout et al., 2012; Díaz et al., 2015). Third, by failing to sufficiently recognize trade-offs and synergies regarding the different global and local needs and interests over a landscape – whether inadvertently or not – landscape approaches have sometimes

run counter to the needs they are expected to address (Cooke and Kothari, 2000; Berkes, 2009; Turnhout et al., 2010; Clay, 2016).

Critiques associated with the challenges above have pointed out that landscape approaches run a risk to become depoliticized and to reinforce power inequalities between stakeholders during subsequent policy development and implementation (Reed et al., 2016). Specifically, scholars have emphasized the incommensurability of different knowledge systems (Nadasdy, 2003; Tengö et al., 2014) and the gap that exists between universalizing tendencies of Western policy models and the diversity and particularity of non-Western or Southern ILK (Escobar, 2008). They also emphasize the importance to comprehend landscape in an integrated way, as entwined with a territorial context, and as a whole or totality of SES (FAO, 2005, 2016; McCall, 2016; Raffestin, 2014). A lack of focus on integration may lead to misrecognition of how certain forests contribute to local food security. Moreover, it may make environmental planning more likely to favor global interests (e.g. use-restricted nature conservation) over local needs (e.g. food sovereignty). In turn, this may lead to the disruption of the resilience of SES' (Bohensky and Maru, 2011; Ayana et al., 2015; Behagel et al., 2017).

To address the above challenges and critiques, scholars have proposed relational perspectives that consider nature and society as entwined, knowledge systems to be co-produced, and global-local scales to be interconnected (FAO, 2005; Latour, 1997; Folke, 2006; Ostrom, 2007; Bodin and Tengö, 2012). We draw on these perspectives to introduce a framework for an integrated assessment of landscapes that focuses on understanding how landscapes are co-produced by social-ecological interrelations (or networks) of multiple space-time scales. Our central argument is that as both ILK and scientific knowledge are entwined with practices and informed by worldviews, they are part of assemblages of k-p-w. These k-p-w result from and are the expression of social-ecological networks that co-produce landscape settings and dynamics. We illustrate the framework with a case study of the MGMC Maroon territory in Brazil. The results highlight how a landscape is co-produced at a local scale and identify priority needs that can be addressed by landscape approaches.

We conclude with a reflection on the potential of the framework to support an integrated assessment and planning of adaptive resource management and governance by landscape approaches that is interdisciplinary, participatory, and inclusive of global-local needs.

3.2 Territorial Social-Ecological Networks Framework

Below, we develop the TSEN framework to inform integrated assessments that focus on understanding landscape settings and dynamics that include IPLC and ILK. We consider this assessment as crucial for providing information for an environmental planning that integrates different disciplines, knowledges, and needs from stakeholders of different spatial scales. We detail the framework by drawing on three bodies of literature: critical Geography and studies on territory (Haesbaert, 2004; Raffestin, 2014), SES studies on ACM (Folke, 2006; Ostrom, 2007, McGinnis and Ostrom, 2014), and Ethnoecology and post-colonial studies (Toledo, 2002; Escobar, 2008; Kincheloe, 2008).

3.2.1 Landscape and territory

Within the TSEN framework, we define landscape as a 'material or visible' dimension of territory that is shaped by social-ecological networks through knowledge, practices, and worldviews

of multiple scales, and that constitutes a totality that includes a mosaic of patches of land use and resource management.

Historic definitions of landscape in the 18th century from the Dutch "landschap" painting style already emphasize visibility, when Humboldt used this word to refer to natural elements of inhabited regions (e.g. seas, valleys, buildings) (Kwa, 2005). Later, Vidal de La Blache (1928) described landscapes as inclusive of both natural conditions and social choices. In the 1970s, critical geographers defined landscape as the visible result of territorial processes that carry social functions and meanings (Santos, 2006). More recently, geographers have explicitly added cultural, cognitive, symbolic, historical, and political dimensions to the understanding of landscape (Ingold, 1993, Lorimer, 2013; Raffestin, 2014). Finally, policy-oriented use of the concepts adds the dimension of agency to landscape. The European Landscape Convention (2000, webpage) defines landscape as "*part of the land, as perceived by local people or visitors, which evolves through time as a result of being acted upon by natural forces and human beings*". The Latin American Landscape Initiative (LALI, 2010, p.5) defines it as "*a whole that human beings conceive as an integral actor in its evolution*".

The defining characteristic of territory is that it is a space that is appropriated or 'claimed' by people (Storey, 2001). This implies that a geographic area consists of both an immaterial sphere (i.e. cognition, worldviews) and a material sphere (i.e. forest, tools) that together produce a specific setting of social-ecological relationships; in other words: territoriality (Raffestin, 2014). Such relationships encompass social and ecological dimensions. These include cultural (i.e. identity, behavior) (Restrepo, 1996), political (i.e. bounded areas, management decisions) (Storey, 2001), and economic (i.e. production, social reproduction) (Harvey, 2011) dimensions, as well as ecological dimensions related to Earth spheres (i.e. biosphere, lithosphere), ecosystems (i.e. services), and ecological renewal (i.e. resilience states) (Raffestin, 2014). These dimensions interact across multiple and porous spatial scales (i.e. place, region, globe) over time (i.e. historical phases, geological ages) (Massey, 2005; Haesbaert, 2004).

We consider landscapes and territories as entwined. They are co-produced by the social-ecological interrelations that define territory as a space appropriated by people and that define landscape as a visible totality that interacts dialectically with this appropriation. These social-ecological interrelations are dynamic and are manifested through concomitant de- and re-territorialization processes. Deterritorialization describes processes of loss of material and immaterial control over territories, for example when modern states expropriate peasants via agribusiness schemes (Haesbaert, 2004). Re-territorialization corresponds to the (re-)gaining of control over territory, for example when IPLC occupy new lands and return to traditional practices (Holmes, 2014; Sletto, 2016). These territorial processes result in landscapes, as visual expressions of territories. We argue that landscapes bring together territorial processes, functioning as a whole or as the synthesis of the social-ecological relations into a SES. Landscapes also influence territorial processes via emergent properties that are proper to its functioning as a whole SES (Ponge, 2005; van Mierlo et al., 2010). These emergent properties provide social-ecological feedbacks that occur in territorial contexts and affect resilience and sustainability, amongst others.

3.2.2 Social-ecological networks

Both social and ecological components of territorial social-ecological networks or TSEN are active agents in the co-production of territory and landscape. Social-ecological networks are arrangements of human and non-human entities (i.e. people, ecosystems, things, practices, ideas) and include social-social, ecological-ecological and social-ecological interrelations (Bodin and Tengö, 2012). While human and non-humans are qualitatively different, non-humans can also have agency and behave as 'actants', as they stimulate and respond to actions (Latour, 1997). For example, both global policies and soil fertility may change over time and each may affect land use change.

As networks are assemblages of different components of multiple spatial scales, they behave in not fully pre-determined ways (Deleuze and Guattari, 1987; Grosz, 1994; Varela, 1999). Local social and ecological components may interact actively with, without necessarily being subsumed to, components of other spatial scales within a landscape (Westley et al., 2013; Folke, et al., 2016). These cross-scale interactions can happen between local resources and external inputs, as well as between local and global institutions, knowledges and needs (Cash et al., 2006; Folke, 2006). In other words, a landscape and a territory are co-produced under influence of networks of different scales. These networks are also associated with global to local needs that can work in synergy or lead to trade-offs. For example, interests in conservation can compete with local needs for food production, but they can also be aligned in win-win processes for different actors in a multifunctional landscape (e.g. sustainable resource management).

Across temporal scales, networks show emergent properties that result from the network as a whole, alternatively organizing themselves as spontaneous or as more hierarchical arrangements (Grosz, 1994). Landscape dynamics follow this emergent behavior through modes of uncertainty and path-dependency. Accordingly, landscape settings may change due to emergence of new agency, and new territorial arrangements (de Landa, 2006). Folke (2006) explains how SES evolve via adaptive cycles that alternate periods of increasing stability with periods of creative destruction, including social-ecological re-organization and renewal. Moreover, SES develop new states of relative stability (or equilibrium) or resilience when they face social-ecological changes whose accommodation is beyond their carrying capacity. Humans act in these adaptive cycles by introducing and responding to social-ecological changes through adaptations of knowledge, perceptions, and practices (Sterling, 2007; Folke et al., 2016). For example, the resilience and dynamics of Amerindian landscapes resemble adaptation of Indigenous knowledge and practices under territorial changes that were shaped over millennia (WinklerPrins and Barrera-Bassols, 2004). Of course, modernity has accelerated such processes. In any case, the continuous territorial reconstruction makes temporal scales and historical phases of a landscape relative to the content of change analyzed.

3.2.3 Knowledges, practices and worldviews

Landscapes of IPLC can be studied by considering how results of interactions between components of TSEN are expressed as k-p-w. Territorial appropriation by IPLC is usually centered on local resource management to obtain food and secure livelihoods (CBD, 1992; Escobar, 2008). According to Toledo and Berra-Bassols (2009, p.41), this management is achieved via ILK that are established by means of a triad of '*corpus*' (knowledge), '*praxis*' (practices), and '*kosmos*' (world-views), or k-p-w. This triad is also understood as an assemblage of knowledge, practices, and beliefs by other scholars (Berkes, 2012; Sterling, 2007). As IPLC are not isolated from society, their k-p-w is

not limited to ILK, but forged in relation to k-p-w of stakeholders across scales. It is increasingly recognized that the divide between scientific and non-scientific knowledges is an artificial construction; and that all forms of knowledge are influenced by worldviews, and shaped in entwinement with practice (Agrawal, 1995; Raffles, 2002). Thus, social-ecological interactions that include multiple k-p-w co-produce the territory and landscape of IPLC. Accordingly, studying k-p-w emphasizes the contribution of human cognition, values, and practices to SES (Westley et al., 2002).

ILK refers to cumulative bodies of k-p-w of IPLC and can include both local, Indigenous, folk, and traditional ecological knowledges (Díaz et al., 2015). ILK are co-produced between people and between people and nature, through social learning, social-ecological feedbacks to experimental practices, and adaptation of knowledge (Berkes, 2012; Toledo and Barrera-Bassols, 2009). ILK are often found to be structured in classificatory systems of landscape compartments (i.e. floodplain, highlands); soils properties (i.e. color, texture, fertility); and vegetation character (i.e. fallow, primary) (Barrera-Bassols and Zinck, 2003). These criteria may correspond to indicators to identify ecosystem services, soils, landscape compartments and lands suitability that are often applied in Western approaches to land use planning and management (Barrios et al., 2012). Transmission of ILK involves acquisition of knowledge, oral exchanges, and empirical demonstrations of k-p-w across generations (Turnbull, 2009; Berkes, 2009). The ILK legacy is associated with maintenance of related values and practices and with access to knowledge resources.

IPLC practices are expressed in specific forms of nature appropriation and environmental behavior (Sterling, 2007). They include adoption and distribution of land use types (i.e. agriculture), and resource management strategies (i.e. shifting cultivation) that shape the landscape setting (Fagerholm et al., 2012). Resource management is important as IPLC relate to lands according to how these provide livelihoods and associated services or contributions for local consumption and development. IPLC also have the agency to adapt practices and by extension k-p-w to social-ecological feedbacks, for example when new leadership in a community lifts customary restriction to harvest fodder in a patch of spiritual forest (cf. Behagel et al., 2017).

Worldviews of IPLC are constructed by a cognitive and affective interrelation with nature (Escobar, 2016). Worldviews include social beliefs, values (i.e. cultural, economic and ecological values developed in relation to nature), and aspirations that influence how IPLC address their needs, engage with nature, and interpret the social-ecological interrelations they experience (Escobar, 2008). For example, spiritual animist values are infused with birds, rivers, and the earth, and are shaped within indivisible social-ecological worlds that generate a sense of place or of belonging to a homeland (Restrepo, 1996; Masterson et al., 2017). IPLC worldviews are also referred to as “cosmovision” because they conceive living and non-living beings and phenomena in a cosmological way – e.g. agricultural, spiritual, and astronomical calendars are often linked (Toledo and Barrera-Bassols, 2009). While worldviews of IPLC are mostly different from Western worldviews, they are often also forged in relation to them (Maturana and Varela, 1987; Descola, 2013).

The TSEN framework schematically presented in Figure represents the landscape settings or SES where landscape approaches intervene in social learning processes, resource management, and ultimately cultural identity. It highlights how TSEN are expressed in k-p-w and how emergent feedbacks on various scales trigger de-re-territorialization processes that co-produce territory and landscape. While integrating global to local scales, the TSEN framework places special emphasis on

the local scale and on local agency. TSEN can be studied via a multitude of variables or components that literature on SES and environmental assessment identify (i.e. Berkes, 2009; Ostrom, 2009; Tengö et al., 2014). Table 2 lists a broad range of these variables. Selection of categories proposed in both Figure 3 and Table 2 may be done according to the needs of with each study and assessment and may include additional categories.

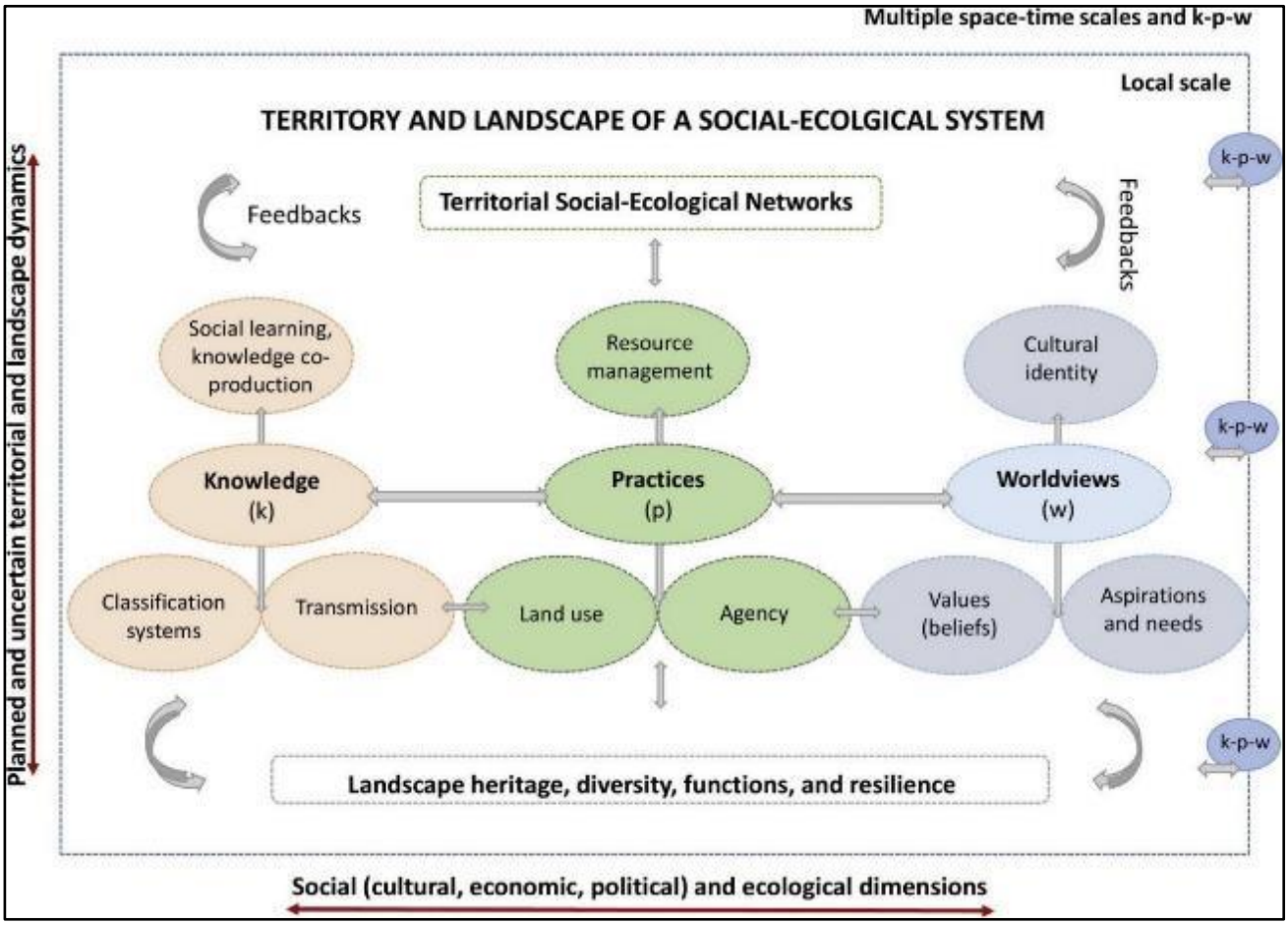

Figure 3. Schematic representation of the TSEN framework proposed by the authors in this paper to be applied for the environmental assessments of social-ecological contexts of resource management of IPLCs. It represents a complex SES that entwines territory (a space appropriated by people that contains components of social – cultural, economic, political – and ecological dimensions), and landscape (conceived as visual emergent wholeness that operates through both path-dependency and uncertainty). The emphasis on networks highlights social-ecological interrelations, and influences of both social and ecological agencies on SES. The focus on k-p-w stresses how these social-ecological interrelations are expressed in a landscape. The framework implies that social and ecological components of TSEN of multiple space-time scales result in diverse k-p-w that interact with local k-p-w. Via k-p-w, these different TSEN trigger territorialization processes, and co-produce the landscape. As a visible sum of parts of the system, the landscape assembles the results of these processes, whose functioning influences TSEN and territorial processes. Moreover, it exposes feedbacks associated with interactions within the system, as well as the resulting heritage, diversity, functions and resilience.

Table 2. Possible variables or components of social-ecological systems associated with k-p-w that can be selected to be investigated when assessing local contexts using the TSEN framework. Variables are presented per scales, per territorial dimensions, and per elements that constitute networks associated with knowledge, practice and worldviews.

Scales

Space	*Time*
Patches, properties	Periods of the day
Landscape, compartments/patches	Daily, seasonal, annual
Local, regional, national, global	Past history, present, future
	Temporal phases

Territorial dimensions

Cultural	*Economic*	*Political*	*Ecological*
Population growth, density and organization	Economic organization	Leaderships, stakeholders (State, NGO, researchers, practitioners)	Assets (geology, climate, relief/geomorphology, soils, flora, water resources, fauna)
Gender	Income, poverty	Agency, conflicts, impositions	Earth spheres, diversity and state
Cultural conjuncture, diversity and heritage	Social-ecological reproduction	Structures of organization	Livelihoods, including food and other associated ecosystem services or contributions to people
Conceptions of contributions to people as ecological benefits or threats	Infra-structures	Institutions, rules, taboos	Ecosystem regulation, functions
Adaptive cycles	Subsistence or self-consumption	Governance, power	Carrying capacity, path-dependency
Social robustness	Markets and trade	Associations, partnerships	Geo-chemical cycles
	Land use, planning	Policies accessed	Resilience and heritage, environmental impacts, sources of diseases and risks
	Crisis, competition	Relation with other stakeholders	
	Social changes, Partnership		

Knowledge networks

Social learning		*Transmission*	Classification systems
Co-production of knowledge	Technology	Knowledge sharing, acquisition, transferences, exchanges within/across generations and genders, and with other stakeholders	Landscape compartments; soils/forests
Cognition, representation	Choices, methods and principles of practices		Water resources; fauna utilities
Response to feedbacks to empirical experimentation, oObservation	Awareness		Lands agricultural suitability
Chosen changes, innovation (e.g. adoption of a crop) across and within genders/stakeholders		Loss of knowledge	Social cultural/ economic/political criteria and ecological indicators
Adaptation,		Innovation	Power
Knowledge systems			Integration, weaving and cross-fertilization of knowledge
			Inter- and transdisciplinarity
			Goals to apply knowledge

Practice networks

Land use		*Agency*	*Resource management*
Conservation	Distribution across relief sectors, soil landscape approaches, and vegetation types of the landscape	Local leaderships	Techniques, labor, labor relations, purchasing power
Agriculture, grazing, hunting, gathering fishing		Associations	Motivations, needs, goals
Leisure, handicraft (e.g. clay ceramics)		Partnerships	Potentials/vulnerabilities
Food system/culture	Land cover	Governance	Adaptation
Land restoration, consumption		Power relations, conflicts	Impacts/sustainability
Ecological behavior and attitudes		Decision-making	Regulations of use and of the access to resources (e.g. taboos of use)
Abandonment of practices		Acceptance and crafting of influences and impositions	Rituals
K-p-w innovation (e.g. agency innovation)			

Worldview networks

Values (beliefs)		*Aspirations and needs*	*Cultural identity*
Values in relation to things/beings, people, nature, gender values	Transformative learning	Wishes and dreams for the future, decision-making motivations, influences	Alterity
Spirituality, religion		Market engagements	Self-determination
Holism, reductionism		Sovereignty, transformability	Ethnicity, tribe
Cosmovision, ontology		Demands for territory, land, food, self-consumption, security, shelter	Knowledge, practices and worldviews
Positioning before the world, nature and people		Livelihoods, identification	Heritage, memory, transmission
Perceptions, conceptions, sense-making to decide			Sense of belonging
Cultural background, understandings of the world			

3.3 Methodological approach

3.3.1 Study area

MGMC is the territory of one of 32 Gurutuba Maroon communities in the Brazilian Northern Minas Gerais State. It is located in the municipality of Catuti, in the São Francisco Depression (Egger, 2006), on the transition between the Caatinga tropical dry forest and the Cerrado savannah (2003). The area is characterized by a calcareous geomorphology and by fertile soils that are associated with deciduous seasonal forests (Arruda et al., 2013); and it includes the degraded version of "carrasco" vegetation, which was forged by historic human fire management (Andrade-Lima, 1981). While IPLC are a regional majority, large-scale cattle grazing dominates as a land use, making this the most conflict-prone area of Minas Gerais (D'Angelis Filho, 2009). Semi-arid climate, vulnerability to desertification (PAE/MG, 2010), and poverty together threaten the food sovereignty of IPLC in the area (Londres, 2014). Political mobilization of IPLC has nonetheless resulted in public policies that address their land tenure, food security, and co-existence with drought.

3.3.2 Methodological principles

We applied three key methodological principles to apply the TSEN framework to assess social-ecological contexts. The first principle was to safeguard participation of locals. Local actors were explicitly encouraged to (pro-)actively contribute to data collection. This principle builds on the recognition that ILK is crucial to inform about local settings and to support environmental planning that is attuned to them. Ensuring separate engagement of locals (without other stakeholders being present) in part of the assessment helps to guarantee the inclusion of local needs.

The second principle was to be sensitive to diversity. This entails an ethical concern to understand and include the diversity of k-p-w that influences each context, recognizing that different needs and interests can be favored differently by information assessed. It emphasizes that different power dynamics and political ecologies co-exist in a landscape, and that policy agendas should align with local needs (Escobar, 2008). The third principle was to use methodological bricolage (Kincheloe, 2008). This entails allying participatory methods with social and natural sciences and ILK, seeking a bottom-up and transdisciplinary dialogue to integrate ILK, and carrying out a holistic analysis with flexibility. In this case, we used an ethnoecological action-research approach, based on collection and validation of data with locals, and on the cross-checking of data collected with different methods (Almekinders et al., 2009; Toledo and Barrera-Bassols, 2009; d).

3.3.3 Data collection

With a multidisciplinary team and having community previous informed consent (Brazilian Law nº 2186/2001), we performed an ethical immersion, where we encouraged maroons trust and engagement by establishing horizontal power relations (Freire, 2017), and by clarifying and negotiating research contributions and activities with locals and local leaders. We applied the TSEN framework following the steps below.

In a first step, we carried out circles of dialogue conversation in a focus group. During these circles, we facilitated maroons to identify and list the main changes lived in the territory associated with resource management, and observed in the landscape settings and dynamics, as well as their causes (from the remembered past until the present). We also facilitated dialogue about the main temporal phases that locals recognize along these changes until the present as having. We problematized planned

and unexpected changes, including the needs and interests of multiple stakeholders that guided them (Coelho, 2014).

A second step used focus groups, individual interviews (with old and young females and males from different landscape sectors), and ethnographic participant observation (of everyday life and fieldwork), to investigate separately knowledge, practices, and worldviews and TSEN associated with them, as well as their interplays. To deepen understanding of landscape history, we focused on the main: i) social-ecological changes and adaptation of k-p-w regarding the categories highlighted in the Figure 3 (knowledge transmission, agency, aspirations and so on) along historical phases previously identified; and ii) social and ecological components of TSEN from local to global scales that exercised agency in those changes.

The third step of data collection was geared towards comparing ILK with scientific types of classification systems. In multiday workshops, we performed participatory mapping, guided-tours, and interviews (Barrios et al., 2012; Fagerholm et al., 2012) to assess maroon classifications of landscape, soils and lands suitability. In parallel, we developed scientific classifications of landscape (Tricart and Kiewitdejonge, 1992), of soils (Lemos and Santos, 1996; dos Santos et al., 2013; IUSS Working Group WRB, 2015), and of lands suitability (Ramalho Filho and Beek, 1995) following standardized methodologies. To make sense of this data, we integrated the local and scientific classifications by contrasting and combining their convergence/divergences (Krasilnikov and Tabor, 2003).

3.3.4 Data analysis

We carried out a qualitative data analysis through a coding process of interviews and scientific literature that was focused on identifying landscape components following the TSEN framework. We searched in particular for examples of material and immaterial appropriation of territory or loss thereof; and for interrelations between social-social, social-ecological, and ecological-ecological components of networks of different spatial scales over time that have influenced local k-p-w.

We connected the coded data to the three steps of data collection. We did so to be able to reconstruct a historical timeline of (more or less) separated phases of territorialization associated with landscape settings identified. Moreover, we focused our analysis on the identification of the role of specific agencies of social and non-human components of SES in the shaping of landscape dynamics. We also coded our data to identify the main needs and interests of locals and of other stakeholders that have influenced their landscape. We identified and counterbalanced synergies and trade-offs between these needs, and selected priority needs that could be addressed by landscape approaches in the area, to be used when planning adaptive co-management.

3.4 Results

Below, we first report on the historical phases and on TSEN that have co-produced the landscape of MGMC. After that, we discuss each dimensions of k-p-w separately – so knowledge, practice, and worldviews – to highlight how various social-social, social-ecological, and ecological-ecological networks contribute to co-produce landscape settings and dynamics.

3.4.1 Assessing landscape history

The origins of the population from MGMC dates back to the 18th century, when African slaves escaped from gold and diamond mercantilist mines and forged the Gurutuba Maroon in the Gorutuba River's shores and *Jahyba* valleys – a Tupi term for inhospitable wetlands. There, calcareous sinkholes and fluvial dissection favored the presence of malaria and kept black people as well as the Caiapó, Xacriabá, and other Indigenous ethnicities who inhabited the region isolated from white colonialist people, who are less resistant to the diseases (cf. da Mata-Machado, 1991; D'Angelis Filho, 2009). In the 1940s, malaria was eradicated to allow the passage of state railroads, and both white settlers – cattle farmers who bought or grabbed lands – and other traditional peoples (farmers, gatherers and fishers) introduced new k-p-w in the Gurutuba (Costa Filho, 2008). Maroons whose lands were grabbed moved from the Gurutuba and constituted the MGMC territory in surrounding lands. There, a first historical phase remembered by maroons as the "loose time" (in allusion to a period when cattle/people were free) was characterized by having a landscape setting similar to the one of the Gurutuba Maroon, with: relative isolation of any institutional networks of "white" people; political autonomy based on collective decisions; and on property transferal based on kinship and "compadrio" (marriage-based political loyalty); local consumption based on local livelihoods; and a collective and traditional land use and resource management.

The maroons from MGMC reported that they were impelled by government entities to adopt the Green Revolution technological package of cotton monoculture. This matches with when, in the 1970s and 1980s, the Northern Minas Gerais was integrated in the national development project as a meat exporter region. As it happened with all Gurutuba communities (Costa Filho, 2008), networks with land grabbers and farmers changed maroons' lives. A second temporal phase recognized by locals: the 'cotton time' was installed with a 'dual economy' (Toledo et al., 2003, p.9), with a production for local consumption and a capitalist market trade that reduced time dedicated for traditional practices. In the 1990s, a fall of the cotton price and a pest outbreak provoked maroons to become financially indebted, the abandonment of cotton monoculture, land sale, and migration. MGMC was then reduced to 64% of its previous area, leaving the current 864.03 ha, which are distributed among 50 family residences (around 13 ha/family) and communal areas. Despite population growth, the available labor decreased, because of children's access to formal schooling; permanent migration of young people who cannot access lands and are attracted by the urban life; and seasonal migration of married men to the Minas Gerais and São Paulo States to complement the family income. Moreover, temporary adoption of *Eucalyptus* monoculture to sell charcoal regionally, and to pay off debts, led to increased forest/land degradation and water scarcity. This interviewee from the maroon community reports changes experienced from the loose time to the cotton time:

> "*Everyone was suffering* […] *Only sometimes did we buy soap, salt, coffee, or meat. When my mother died, no one had a retirement allowance. A neighbor would kill a cow, he would share. People would plant rice and fish together. Everybody slept peacefully* [...] *Then we picked up a loan with the government to plant cotton and became indebted. Many people sold land. Today people live more individually, the plantation became difficult because the rain is less and the land is harder. There is no land for all the population, and many people go to the city*" (Interview, 4).

Maroon's adaptations to new TSEN gave rise to a new and more recent territorial configuration and landscape setting that is reported by locals as the "rescue time" and continues till today. These

include the territorialization of the dam Bico da Pedra on headstreams of the river Salinas-Pacuí to supply agribusiness, which changed the landscape and had as feedback a reduction in the river's level of water. Moreover, a strong drought, which was reported by locals and was associated with climate change (Eiró and Lindoso, 2014), has affected local ecosystems and intensified agricultural losses. During rescue time, maroons engaged with national grassroots movements of IPLC that fight for recognition of rights and resonate with the global recognition of commons' rights in the 'Indigenous and Tribal Peoples Convention n.169' (ILO, 1989). These movements culminated in the promulgation of the Art. 68 of Transitory Constitutional Provisions Act (ADTC, acronym in Portuguese), in the Brazilian constitution of 1988, for which the State must legitimize identity and territorial rights to remnant maroon communities. Engaged in these movements, maroons have tried to repair the social-ecological disruption caused by monocultures, land grabbing and externalities, by rescuing and reinforcing traditional k-p- w.

3.4.2 Knowledge networks

In the "loose time", the MGMC Maroon and the Gurutuba Maroon were at close proximity and had similarity of territorial conditions of climate, vegetation, relief, and soils. Moreover, the two maroons shared cultural, political and economic organization, practices, aspirations. These similarities and interactions with other spatial scales enabled maroons to maintain the knowledge inherited from the Gurutuba. This knowledge was obtained via social learning before feedbacks of natural resources manifested in the landscape, and before relations with animals, plants, and so on changed (Table 3). During the "cotton time", the reduced dedication to traditional practices to focus on the cotton monoculture, and unfamiliarity with monoculture, delayed maroons' perception of social-ecological impacts. Eventually, however, maroons noticed that sediments from eroded soils started causing respiratory diseases; and that pesticides changed the soil quality and caused stomach diseases. Forest and land degradation had already changed the resilience of the landscape, preventing the perpetuation of agricultural practices. These social-ecological impacts led to changes in knowledge co-production, and the "rescue time" saw maroons re-establish an attentive monitoring of nature's feedbacks.

The knowledge co-production associated with social learning relied on adaptation of African and colonial knowledge, with support of knowledge exchange with regional Indigenous people – e.g. cassava, which is one of the main maroon foods, is an Indigenous heritage. Maroons also co-produced knowledge with farmers to reinvent cattle grazing on monocultures, and adopted management techniques of IPLC to fit them in their landscape setting. In the "cotton time", knowledge co-production was mainly top-down and influenced by government stakeholders such as the 'Technical Assistance and Extension Agency of Minas Gerais State' (EMATER-MG, acronym in Portuguese). The EMATER-MG transferred the technology to produce cotton monoculture to maroons. Since the "rescue time" maroons have retrieved and reinforced their traditional knowledge, incorporating agroecological techniques, with support of IPLC and of the NGO 'Centre for Alternative Agriculture' of the Northern-Minas Gerais (CAA-NM, acronym in Portuguese). This NGO has mediated between maroons and other social networks, including actors from national universities to global institutions such as FAO (Londres, 2014), by using participatory approaches to promote environmental conservation and resilience.

Table 3. Knowledge networks of the maroons from MGMC, and landscape configuration per territorial historical phase (Catuti, Minas Gerais – Brazil).

Knowledge networks	**Loose time**	**Cotton time**	**Rescue time**
Social learning	Reproduction of the traditional Gurutuban maroon knowledge Based on the experimentation of land use and resource management, and developed under close observation of social and ecological feedbacks to practices	Maintenance of the traditional Gurutuban maroon social learning and related practices, but with less attention to nature feedbacks, as maroons predominantly dedicated to monoculture The unfamiliarity with monoculture and the maroon trust in the Green Revolution technological package delayed the perception of monoculture feedbacks of environmental degradation	Re-establishment of the traditional social learning and practices Experimentation of new practices to restore the landscape resilience with support of the NGO CAA-NM
Co-production	During knowledge generation and transmission Based on the community social learning with nature's feedbacks Among maroons and regional IPLC	Remained as secondary among maroons, as reproduction of existent knowledge and acquisition of scientific Green Revolution knowledge via government projects predominated	Among maroons and Gurutubans, IPLC, and the NGO CAA-NM (using agroecology) An indispensable means for restoring the landscape resilience, and rescuing and adapting traditional k-p-w
Transmission	From old to young people of the same gender and across generations Through acquisition and exchange of knowledge among maroons, with Gurutuban maroons and IPLC By farmers who hired maroons to work daily on cattle grazing	Traditional transmission was maintained for traditional land use/resource management Predominant top-down knowledge transmission by government entities, with transference of the Green Revolution technological package of cotton monoculture	Knowledge transmission within and across genders Bottom-up exchange of knowledge with the NGO CAA-NM, integrating the local and scientific knowledge, and considering local needs
*Classification systems**	The landscape classification considered the criteria relief (geomorphological sectors), soil classification and vegetation types The soil classification considered subsequently mostly soil morphology criteria (e.g. color, texture, consistence, structure properties), but also physical (e.g. drainage, porosity), chemical properties (fertility manifestation in the shape and size of crops), and soil formation processes (e.g. addition, removal, laterization) The lands suitability classification included as criteria (indicators) related to climate, season, distance of water sources, and of residence, accessibility, susceptibility to flood, and soil classification (color, texture, consistence, structure)	The landscape and soil classifications were maintained the same The lands suitability for different uses included classification criteria used by government institutions, based on the national lands agricultural suitability system (SAAAT) – e.g. mechanization was adopted as criteria to decide where the cotton monoculture would be cropped during this period	The maroon landscape classification adopted nomenclature that expresses ecological changes (e.g. the classification *Bush cover* represents Sandy belts of difficult accessibility, whose forests were maintained conserved in detriment of generalized deforestation in other landscape sectors) The soil classification added emphasis to the hard consistence of the soils associated with their degradation (erosion and densification) Maintenance of the lands suitability classification as it was in the "loose time"; however, with recognized intensification of water constrains for the use of soils

*We did not identify classifications used in each historical phase because they tend to take a long time to change (Toledo and Barrera-Bassols, 2009), and because they are articulated with traditional practices that were mostly maintained.

Knowledge transmission involved a knowledge acquisition between generations, a broader oral exchange, and a transference between maroons and diverse stakeholders. Locally, individuals who live in different landscape sectors have specialized themselves differently regarding resource management, and have added knowledge from different spatial matrixes to the maroon body of knowledge. Since the "loose time", knowledge transmission has happened mainly within genders, through stories, rituals, everyday practices, and chants – defined by Machado Filho (1985) as African *vissungos* that guide collective practices. When the government transmitted knowledge to maroons, in the "cotton time", knowledge related to abandoned practices was lost, similar to what Dayrell (2009) reported to have happened in the Gurutuba Maroon. For instance, replacement of traditional short-pile cotton by arboreal cotton led to abandonment of short-pile cotton and related practices (weaving cotton clothes, bedding in manual looms, and extracting vegetable pigments) – i.e. jenipapo (*Genipa americana* L.),

and urucum (*Bixa orellana* L.). This caused a loss of related knowledge among maroons. As part of the "rescue time" efforts, because of migration and a lack of labor, women added male practices (i.e. provision of livelihoods, and territorial protection) to their customary tasks (i.e. domestic works, home gardening, and children upbringing). Then, knowledge transmission started happening more across genders.

The above networks of social learning and transmission have resulted in rich classificatory systems of nature that maroons hold. When deciding on which land uses and management to adopt, maroons rely on soils, geomorphology and vegetation as indicators to differentiate eight landscape compartments. We present these combined with the landscape compartments our research team has found in the Table 4. Maroons distribute land uses in eight soil classes that occur associated with landscape compartments, and which we found as associated with the thirteen soil classes the research team identified using scientific classification systems. Contrasting local and scientific knowledge we notice that maroons emphasized soil related morphological properties (e.g. color, texture, and consistence), physical/chemical properties (e.g. porosity, drainage condition, and fertility); and pedogenetic processes (i.e. soil horizons, and addition/removal) that science emphasizes. Finally, both maroons and the research team classification of lands suitability converged significantly, and pointed to water scarcity or excess as the main constraining criteria of land use (Table 4). Nonetheless, criteria disregarded by science are locally relevant (i.e. distance of the house/river, shortage of lands, and food sovereignty). We understood that while maroons classifications express landscape changes (e.g. "hard soils" and "bush cover" refer respectively to degraded soils and remaining forests), they remain mostly unchanged because maroons maintain most traditional land uses and management.

3.4.3 Practice networks

The agency of local maroons played an important role in building practices and in responding to changes while interacting with agencies of other spatial scales; even when changes were only partially under their control. The agency of ecological components of the landscape has also underpinned the adaptation of land use and resource management. During the "loose time", regulation of access and use of resources was restricted to local rules whose practice was ensured by local leaderships. In the "cotton time", maroons adopted the cotton monoculture as a political strategy to become less dependent on obtaining food and other livelihoods from their territory under the semi-arid climate. Modernization introduced networks (state, farmers, and land grabbers) that interfered with both land availability, social-ecological resilience, local diversity, and sovereignty. However, it also invigorated solidarity bonds among maroons and IPLC, and triggered additional changes in the "rescue time" (Table 5).

During the "rescue time", maroons reshaped their agency by engaging with the political mobilization of other IPLC to attempt to restore their traditional k-p-w and landscape resilience, and to claim territorial rights. The anthropologist Aderval Costa Filho assisted the maroons from MGMC, and other Gurutubans to access the Law 'Transitional Constitutional Provisions Act' (ACDT, acronym in Portuguese). Despite obtaining recognition as maroons, the territory of MGMC was not formally recognized, as maroons moved from the Gorutuba watershed – which is considered the rightful original border of the Gurutuba Maroon by the 'National Institute of Colonization and Agrarian Reform' (INCRA, acronym in Portuguese) – in the 1940s. This is because the decree 4.887/03 conditions territorial recognition to maroons' territories formed during the Brazilian Empire (until 1888) that were

kept occupied until the ACDT promulgation (1988). Maroons disagree with this time frame, as the ACDT was the first Brazilian law to protect rights of slave's descendants, and they were forced out by land grabbers to move from their original territory. Additionally, despite that the ACDT states that the state will reattribute lands grabbed from maroons, these have not been reinstated either, as the rural elite owners contests this state intervention. INCRA plans to legitimate lands to be the maroon territory within the Gorutuba watershed, and maroons intend to send community members to those lands and keep others in MGMC, to claim this territory.

Despite the legal impasse, maroons' cooperation with regional and national networks of IPLC towards rights recognition and enforcement of traditional k-p-w led to a new form of agency manifested in the political Association of the Gurutuba Maroons. This raised engagement with syndicates, and access to public policies, including a 'Food Acquisition Program' (PAA, acronym in Portuguese) that grants sale of agricultural goods to local public schools; and the Garantia-Safra policy, which reimburses semi-arid crop losses. Furthermore, maroons started a partnership with the NGO CAA-NM to restore traditional knowledge, practices, and environmental conservation. Many of these policies have been defunded under the govern of the president Michel Temer, since the 2016 ouster of president Dilma Rousseff, as part of a neoliberalist agenda, and this state configuration suggests uncertainty about maroon rights.

In the "loose time", maroons adopted diverse land use types to access livelihoods (Table 5). In the "cotton time" many of those were maintained, but cotton took more central attention. With the cotton plague, and adoption of Eucalyptus monoculture, large deforestation intensified fluxes of matter and energy that unbalanced the soil quality and disturbed chemical and water cycles of the maroon landscape. Consequently, sandy/silted soils of highlands of tops and slopes became densified and could not be used for annual crops and planted grazing anymore. The same uses were abandoned in the clayey soils of the tops because their water storage in the drought became scarce, and the plains solodized soils became irreversible unsuitable for agriculture. Most lakes disappeared and fish farming decreased. Moreover, small cash incomes prevented maroons to recover degraded soils using machinery, and to irrigate soils of tops and depressions to restore previous uses. It is striking that most of farmers' lands are allocated in the landscape tops with suitability for planted grazing under irrigation. Additionally, purchase of goods in the Catuti market and lack of labor stimulated reduction of laborious rice cropping, medicinal plants cultivation, and cattle grazing.

Table 4. Ethnoecological integration of the maroon and scientific knowledge on the landscape, soils and suitability of the lands of MGMC (Catuti, Minas Gerais – Brazil).

Landscape classification		**Soil classification**		**Land's suitability classification**		**Calssification[1] criteria**	
***Local**	**Scientific**	***Local**	**Scientific**	***Local**	**Scientific**	***Local**	**Scientific**
"*Topo da alta*" (Highlands' Tops)	Flattened tops	"*Terra vermelha*" (Red earth)	FRxady	Natural grazing and gathering	Goof for planted grazing	*Distance of water sources*, presence of "carrasco" vegetation	Fertility deficiency
			LXro/xa[2]	-	-	-	-
"*Baixa do topo*" (Lowlands of the top)	Top depressions with PTce [2]	"*Barro branco duro*" (White hard clay)	PTce[2]	-	-	-	
"*Furado*" (Dolines with degraded earth)	Endoreic depression with PTceeu and PLha2	"*Barro branco mais duro*" (White harder clay)	PTceeu PLha[2]	Natural grazing, fish farming	Good for planted grazing	*Season, soil classification (color, texture, consistence, structure)*	Water deficiency
"*Alta*" (Highlands)	Pediment slopes with ARha (Typical)	"*Terra branca*" (White earth)	ARha (Typical)	Houses, annual crops and natural grazing	Restricted for natural grazing	Non-susceptible to the flood; close to water sources; soil classification (color, texture, consistence, structure)	Water deficiency
"*Baixa da Alta*" (Lowlands of the Highlands)	Slope depressions	"*Barro branco*" (White clay)	PTce[2]	-	-	-	
"Capão" (Bush cover)	Sandy belts	"*Terra branca mais cultura*" (More crop white earth)	RGeu	Environmental conservation	Restricted for natural grazing	*Difficulty of access in the rainy season, remaining seasonal deciduous forest patches*	Water deficiency
"*Vargem*" (Highest riverbed)	Flatland partially flooded	"*Terra preta dura*" (Dark tough clay)	PLhaeu, PTha[2]	Natural grazing	Moderate for natural grazing	*Season, soil classification (color, texture, consistence, structure)*	Oxygen deficiency
"*Vazante*" *(*Lowest riverbed)	Flood plain	"*Terra preta*" (Dark earth)	PThaeu (Typical)	Planted grazing, rice, sugarcane, environmental conservation	Restricted for crop	Season, soil classification (color, texture, consistence, structure), food security, labor; seasonal semi-deciduous riparian forest	Oxygen deficiency
			FLha[2], GLha[2]	-	-	-	-

Rxady: Dystric Xanthic Ferralsols (Clayic); LXro/xa: Rhodic/Xanthic Lixisols; PTce: Clayic Plinthosols; PTceeu: Eutric Clayic Plinthosols (Abruptic); PLha: Haplic Planosols; ARha: Haplic Arenosols (Typical); RGeu: Eutric Regosols (Typical); PLhaeu: Eutric Haplic Planosols (Solodic); PTha: Haplic Plinthosols; PThaeu: Eutric Haplic Plinthosols (Typical); FLha: Haplic Fluvisols; GLha: Haplic Gleysols. * Local classification (in italic) with maroon vernaculars (in Portuguese) in italic, and scientific classifications in non-stylized letter ; using reference of classification of landscape, based on Tricart and Kiewitdejonge (1992), of soils (dos Santos et al., 2013, and IUSS Working Group WRB, 2015), and of lands suitability (Ramalho-Filho and Beek, 1995).1 The System of evaluation of agricultural suitability used considers the main land use constrain criteria related to climate, relief, vegetation, soil, which are: management type, water, fertility or oxygen deficiency, water excess, erosion susceptibility; impediment to mechanization; whereas maroons consider all criteria as equally important. [2]Soils of rare occurrence have only morphological description and thus no land's suitability classification.

Table 5. Practice networks associated with the resource management of the maroons from MGMC, and landscape configuration per territorial historical phase (Catuti, Minas Gerais – Brazil).

Practices	**Loose time**	**Cotton time**	**Rescue time**
Agency	Autonomy to shape and regulate the local knowledge, practices (e.g. land use) and worldviews with collective decision-making under leadership of elderly male leaders Conflict with land grabbers Sale of lands, and of labor to farmers Absence of the State political support	Acceptation of knowledge transference by government institutions to maroons, and adoption of modern values and practices via monoculture Interference of State laws in the maroon territory (e.g. the Forest Code – law 7.511/1986 – regulating logging activity, and conservation of riverside lands)	Articulation with Gurutuban maroons, regional and national IPLC, with an anthropologist researcher, and with the NGO CAA-NM Emergence the Association of the Gurutuba Maroon; Association of Gurutuba Maroon Women; and Association of MGMC Residents and women leaderships Mobilization to regulate maroon land titles, identity recognition, Rescue of territorial sovereignty, and of traditional k-p-w, blended with agroecological scientific knowledge
Land use - types and distribution per landscape compartment below			
Flatted tops	Natural/planted grazing, gathering	Natural grazing, gathering	Natural grazing
Top depressions	Natural grazing (fish farming)	Natural grazing,	Natural grazing
Endorheic depression	Agriculture (annual crops of cassava, beans, corn, sorghum)	Agriculture (annual crops)	Agriculture (annual crops)
Pediment slopes	Residences, home gardens, self-consumption agriculture (annual crops), subsoil water tanks	Residences, home gardens, reduced self-consumption agriculture (annual crops, except from short pile-cotton), arboreal cotton and eucalyptus monoculture, channeled water	Residences, inclusion of fruit trees in home gardens, self-consumption agriculture (annual crops), channeled water
Slope depressions	Natural/planted grazing, and agriculture (annual crops), fish farming	Natural grazing, and reduced fish farming	Natural grazing, and reduced fish farming
Sandy belts	Conservation	Conservation	Conservation
Flat land partially flooded	Natural/planted grazing, and agriculture (annual crops)	Natural grazing	Natural grazing
Flood plain	Planted grazing, and agriculture (sugarcane and rice)	Planted grazing, and agriculture (sugarcane and rice crop)	Planted grazing, and agriculture (sugarcane and reduced rice crop)
Resource management	Traditional, with alternating seasonal land use; with use of hoe to plow lands, of cow as transport, and of fire to maintain the degraded semi-deciduous seasonal forests (“carrascos”) Familiar labor Communal and collective land use Predominant livelihoods sovereignty, including food and other associated services or nature’s contributions to people	Shorter dedication to traditional practices in areas of traditional land uses Predominant dedication to monoculture, with adoption of Green Revolution modern techniques (large deforestation, use of GMO, of pesticides, and of rented machinery) Familiar labor and hired daily workers Less communal and collective land use Dual economy and reduced food sovereignty	Abandonment of monoculture Trade of agricultural surplus Restriction of deforestation to small areas of planted eucalyptus for self-consumption Limited use of tractor and of pesticide Environmental conservation, with restoration of the local agrobiodiversity (with a bank of natural seeds); with reforestation of springs, riverside, and “carrascos”; and with the revitalization of agroforestry home gardens Processing of good for trade, including cassava flour, and bakery Rescue of livelihood sovereignty

In the “rescue time”, land use changes reinforced traditional practices for food and livelihood security and sovereignty. Reduction of the diversity of beans species cropped led to a decrease in its agrobiodiversity among maroons. With access to public policies, maroons replaced the Eucalyptus monoculture as a source of income by the trade of agricultural surplus (i.e. sorghum, milk, and vegetables) to public urban schools; and received water supply from the state. This made the consumption of water of soil water table during the drought obsolete. Finally, the CAA-NM has supported the reintroduction of cotton short-pile, and adoption of beekeeping.

The maroon traditional resource management in the “loose time” included alternating seasonal dynamics; predominant familiar labor; collective production; use of hoe to plow lands, of cow to transport livelihoods, and of fuel for domestic use and to maintain the “carrascos” suitable for gathering and grazing. When the “cotton time” introduced Green Revolution techniques (Table 4), maroons incorporated the incidental use of agricultural external inputs and the hiring of daily workers. The collective production decayed. However, since maroons have had the CAA-NM support in the “rescue time”, deforestation has been restricted to small areas. Furthermore, community leaders have disseminated rules to re-establish the traditional management of soils to maintain their quality (e.g. instituting a regulation taboo that “pesticide is poison for people and earth”).

Currently, maroon land uses are distributed in the MGMC territory (864 ha) and also in part of the territory expropriated from maroons that belongs to farmers (491 ha); as farmers allow maroons to use the carrascos of the landscape tops. The land use is concentrated in highlands of the pediment slope (10.36% of the used area), where sandy Regosols are strategically close to water resources of the plains, and do not flood in the summer (rainy) season; allowing annual crops (i.e. beans, watermelon, pumpkin) and permanent residences/home gardens. In the dry season (January to October), seasonal rivers and lakes disappear, and the water table of poorly-drained soils of tops and slopes becomes these land units’ water sources (Planosols/Gleisols). Thus, the land use becomes concentrated in the plains. Floodplain’s soils that conserve humidity for longer term (Gleisols/Plintosols) are used with sugarcane, rice, and planted grazing (13.3% of the used area), and with conservation of riparian forest (2%). Landscape changes associated with the river lowering level have waterproofed Planosols of partially flood plains, restricting its use with natural grazing. In the wet season (October to February), plains become flooded, and river/lakes of top and slope depressions are used with fish farming. Tops’ “carrascos” are used with natural grazing and gathering (9.34% of the used area), and top depressions with natural grazing (15%).

3.4.4 Worldview networks

The MGMC population was originally recognized by IPLC to whom they interrelated as “Gurutuban”: people who live in the *Jahyba* wetlands of the Gorutuba watershed (called Gurutuba by locals). Those IPLC, who also developed cultural identities and territorialities based on their relationships with their landscapes, as reported by Dayrell (2009) and D’Angelis Filho (2009) include: “Caatingueiros”, smallholders descendants of Italians and Portugueses who occupied the dry forests of the Serra do Espinhaço’s hilly outskirts (regionally recognized as Caatinga) when these were free from the malaria; “Geraizeiros” from the Cerrado savannahs of the Espinhaço tops, regionally called “Gerais”; and “Vazanteiros”, people from intermittent riverbeds of the “sertões”, or semi-arid São Francisco Depression’s dry regions, called “Vazantes”. In the “loose time”, when maroons moved to MGMC, which is closer to the Espinhaço outskirts, they became recognized as “Gurutuban Catingueiros”, as they conserved the Gurutuban territoriality and identity. Maroons kept recognizing

this identity during the "cotton time", as despite embracing modern Western values, they have conserved many traditional values and beliefs (Table 6).

In the "rescue time", the identity of Catingueiros was reformulated as maroon, or "quilombola" (in Portuguese), articulating it with national and global networks linked with the recognition of maroon rights. The community's identity was legitimated as maroon in the 21th century, by accomplishing ADTC (Brasil, 1988) criteria: African physical traits; typical cultural heritage (i.e. preparation of food with pestles); and syncretism of animism with the colonial catholic religion. The identity reformulation encompassed external and internal reconstruction, similar to what happened in the rest of the Gurutuba Maroon (Costa Filho, 2008); and the slave past was erased from the collective memory. Halbwachs (1992) explains that obliterating a subaltern past is proper of social groups to enforce social resistance. Accordingly, the afro-ascendant ethnic identity is a "resistance identity" (Castells, 1999; Arruti, 1997), as it was embraced at the cost of the previous territoriality towards a political justice.

The maroon cultural identity is underpinned by worldviews embedded in beliefs, values, aspirations, and needs. These elements synthetize the local ontology and epistemology embedded in maroon k-p-w that incorporate and tailor ontologies/epistemologies of k-p-w of stakeholders of other spatial scales. Accordingly, since the "loose time", but mainly during the "cotton" and "rescue" time, maroons have interacted with IPLC who have ILK and diverse territorialities; with Western actors whose k-p-w tend towards universalizing and colonial thinking (i.e. state and farmers); and with networks that travel across these universes and embrace plural rationalities (i.e. CAA-NM, policies that address communities' needs). Thus, maroons' worldviews encompass plural k-p-w inter-exchanges with stakeholders of global to local scales.

Values that have forged the maroon identity since the "loose time" carry holistic animist beliefs (Clodd, 2017), for which all things and beings have a sacred spirit, consciousness, and soul. As nature is seeing by maroons as an entity to which they are part of, and not as an external 'resource', it is respected for the intrinsic value maroons attribute to it. Thus, differently from predominant Western-centered worldviews, maroons perceive nature as inseparable from society (Table 6). Socio-cultural values attributed to nature provisions for their social-ecological reproduction also stand out in maroon interrelations with nature and the landscape heritage. These values manifest via practices, symbolisms, and thinking that aim at a harmonic co-existence with nature. The capitalist economic value that nature has for locals assumed a centrality in the "cotton time", as maroons believed that the monoculture trade would ensure their food security with higher safety than solely subsistence agriculture. However, the non-capitalist economic value of nature has predominated in maroons' practices since the "loose time". Moreover, when landscape feedbacks showed that the environmental degradation was depleting the maroon social-ecological reproduction (e.g. compromising the provision of ecosystem services), maroons reinforced traditional values they carried regarding a harmonic coexistence with nature, and abandoned monocultures; making space for the "rescue time". Thus, besides the perception of environmental impacts from monocultures, the confrontation of maroons' values with modern practices, led to their abandonment:

Table 6. Worldview networks associated with the resource management of the maroons from MGMC, and landscape configuration per historical territorial phase (Catuti, Minas Gerais – Brazil).

Worldviews	**Loose time**	**Cotton time**	**Rescue time**
Beliefs	Religious syncretism combining the African animism with the Catholicism acquired during slavery Unity among people, nature and the abiotic environment Maintenance of the Gurutuban kinship and cultural bonds	Religious syncretism Modern beliefs Trust that monoculture could increase food security Conquest of higher independence of the semi-arid climate	Reinforcement of ancestral values and beliefs that connect maroons with nature Rescue and reinforcement of traditional k-p-w, with new alliances towards a territorial and identity recognition
Values	Respect for people, nature, abiotic environment and people as sacred beings provided of soul Predominance of intrinsic values of nature, socio-cultural, and non-capitalist economic value of nature	Maintenance of traditional values Preponderance of the capitalist economic value of nature (e.g. adoption of remunerated labor and sell of agricultural goods)	Rescue of traditional values for nature Reduction of the valorization of the capitalist economic value of nature (e.g. replacement of monoculture by traditional land use practices, with trade of agricultural surplus)
Aspirations	Reproduce social-ecological relations experienced in the Gurutuba Maroon	Reduction of the dependence on local natural resources to provide food security, in face of the water scarcity and agricultural losses caused by the semi-arid climate	Enforcement of the traditional k-p-w Articulation with IPLC from the region and country Restoration of soils, forests, springs, and of the agrobiodiversity of seeds and crops Retrieving of both livelihoods and territorial sovereignty Conquest of political visibility, identity and land rights
Needs	Maintenance of the local social-ecological reproduction to access ecosystem services (e.g. territory, livelihoods, with emphasis for food security, using local resources Maintenance of the ecological resilience state to supply the current and next maroon generations	Supply of local needs of the past, through trade and complementary consumption of food and goods, instead of supplying local needs autonomously with local natural resources	Improvement of the environmental conservation and resilience Retrieving of food security, and of the territorial and livelihoods sovereignty Engagement with communities and others stakeholders for security
Cultural identity	Afro-descendants, Gurutuban “Catingueiros”, recognized in a relation of alterity with regional IPLC	Gurutuban “Catingueiros”	Gurutuban “Catingueiros” maroons, recognized in relation to regional communities and to the country
Landscape outcome (change)	Access to greater territorial extension Stronger harmony between the maroon territoriality and landscape resilience Collective structures (e.g. houses, and mill) Gurutuban social-ecological heritage	Disruption of the local territoriality Access to reduced territory, fragmented by farms Community and family fragmentation Community individualization And incorporation of urban/modern elements (money, access to pension, daily employees, market goods, schools, automobiles, home appliances)	Removal of monocultures Re-establishment of traditional territoriality elements (e.g. social collectiveness) Reinstallation of collective structures (e.g. association’s headquarters)

> "*The trees, fishes, earth and community, everybody needs to be in harmony to survive. Nature always gives to you if you give back to it. But if you start only taking from it as we did with the cotton, it starts not giving livelihoods to you anymore*" (Interview, 1).

Maroons' worldviews are also shaped in relation to needs (e.g. water and livelihoods) and social aspirations for change. In the "loose time", maroons got isolated in their territory because of the threat from global and national interest in slavery. As lands were abundant, but maroons were isolated and dealt with the drought using traditional techniques (e.g. consumption of water from soils water table), people aspired to ensure better basic livelihood needs for social reproduction. When the state had an interest in expanding the Green Revolution to the maroon territory, this converged with the maroon interest to become less vulnerable to the semi-arid climate. This worldview embodied an aspiration that endorsed new knowledge-practice networks that installed a transition for the "cotton time". Similarly, the adoption of the Eucalyptus monoculture was a vehicle for a need to pay off debts and achieve the aspired permanence in the territory. The maroon perception that the monoculture was threatening the resilience of the landscape stimulated them to search for maintaining their territory and identity, and to confront the power imposed by land grabbers and the government over their livelihoods. This aspiration converged with regional grassroots movements of IPLC for identity recognition and land tenure, and with the support offered by the CAA-NM NGO for environmental conservation. According to maroons: the land is getting 'harder'; the drought is 'increasing'; the dust is 'invading' their houses, and the lands are 'enclosing'; however, the need of belonging to an identity supports their struggle for the territory.

3.5 Discussion

3.5.1 Co-production of the landscape

The results show how TSEN of multiple space-time scales are expressed in specific k-p-w and co-produce landscape as entwined with territory. Both human actors and ecological actants have exercised agency to influence the constitution of TSEN and k-p-w in MGMC. This agency, including what Folke et al. (2016, p. 41) refers to as 'stewardship', led to several changes that constituted the landscape settings in the Gorutuba Watershed over time. While the role of social agency was clearly visible (e.g. government laws, local governance), ecological agency played an equally important role. As the results showed, for instance, malaria provided shelter from colonizers; the climate and soils affected land use; forests compounded cultural identities; and the carrying capacity of resources greatly conditioned resilience.

The interplay of k-p-w assemblages of different stakeholders and spatial scales highlights the crucial role of local agency in accepting or crafting imposed changes introduced in their territory. As Anthias (2017) argues, IPLC agencies and those of other stakeholders may exist simultaneously in a single landscape, that as a result will show emergent properties. Indeed, our results showed how national and global economic and ecological interests, political contexts, and cultural thinking manifested via k-p-w of governmental entities, as well as of NGO and grassroots movements, constituted local k-p-w. These cross- scale network influences co-produced the landscape. Across time scales, the emergent properties of networks were also observed to dynamically shape the landscape by simultaneous adaptation and renewal of landscape contents and dynamics, exhibiting both qualities of path-dependency and uncertainty.

Each temporal phase identified in the results showed both processes of deterritorialization and reterritorialization, which influenced the material and immaterial appropriation of the territory. These processes involved the abandonment of k-p-w, and social-ecological losses (deterritorialization) and re-visitation, reinforcement and renewal of territorial and landscape contents (reterritorialization). In this sense, the landscape evolved alternatively as a spiral of continuous historical reconstruction (Toledo and Barrera-Bassols, 2009) and as adaptive cycles of 'creative destruction' (Folke, 2006). Path-dependencies were expressed in the maintenance and restoration of traditional k-p-w settings, in relation to new technologies, management practices and perceptions of reality adopted by maroons. Uncertainties were manifested in un- expected feedbacks to planned actions and in emergent dynamics, including the appearance of new components in the SES.

TSEN of different space-time scales co-produced landscape settings as a mosaic of patches with specific land uses, social-ecological aspects and related to specific temporal phases. Landscape dynamics led to a multidimensional and multifunctional totality, linked with territorial functions, meanings, heritage, diversity and resilience of the SES. The territorial appropriation and constitution of the territory followed specific paths and shifts; including social-ecological patterns such as the maintenance of a small-scale farming focused on subsistence agriculture and resilience. Considering the landscape as an integrated whole allowed for the visualization of feedbacks and changes. Such feedbacks were manifested in de- and reterritorialization processes and were seen to trigger emergence of new social-ecological conditions that were mediated by social learning and agencies manifested in local k-p-w.

3.5.2 Global-local priority needs

Diverse needs, demands, and interests were manifested in the social- ecological settings of MGMC. These were associated with multiple k-p-w of local and other actors, and presented synergies and trade-offs regarding the multiple functions they require from the landscape. Local needs were associated with functions that include provision of food and other livelihoods, social-ecological reproduction, security, sovereignty, conservation, and a sense of belonging. Local needs have historically been guided by a central aspiration: to live in relative harmony with nature, while maintaining local identity and territory. Along the three historical phases we studied, local needs were mostly in synergy, driving territorial processes towards conservation, modernization, and restoration. However, certain local needs also led to trade-offs; for instance, between an increasing demand for food by the local growing population, and an increasing land scarcity; and between the aspiration to remain in the territory, and the migration of maroons.

When observing the needs between locals and other stakeholders, trade-offs predominated. These trade-offs were shown to derive from the different ways in which stakeholders cognize, value, and use the landscape. Values associated with mercantilism and modernization practices mediated global needs that went counter to local interests in maintaining the traditional identity and territoriality. These needs presented trade-offs in relation to global and regional interests of government and farmers in expanding agribusiness in the region and advancing national neoliberalism. However, needs did converge with the maroon need to ensure food security by engaging in the market. Even so, trade-offs between market dynamics and the financial losses and environmental degradation that maroons faced made them return to their aspiration of surviving in harmony with nature while having territorial sovereignty and access to supportive policies. Synergies were thus found between interests of maroons

and NGOs in environmental conservation; in global-local interests for rights recognition; and in national policies that address the maroons' rights and livelihoods.

We agree with Fletcher (2012), for who trade-offs between global and local needs are not insurmountable, and they must be aligned to reconcile environmental conservation and human well-being in a sustainable way. In the MGMC maroon, we found two specific needs that are able to make this global-local alignment and that may serve as a basis for integrated environmental planning via adaptive co-management. These needs are: (1) to co-produce knowledge with maroons for a sustainable resource management and economic development that enhances environmental conservation and resilience in coherence with local k-p-w; and (2) to strengthen the maroon political organization and engagement with (non)governmental entities and IPLC to better access policies and rights. Addressing these needs will link global interests in sustainability and resilience, social empowerment and rights recognition with local needs for territorial and livelihoods security and sovereignty.

3.6 Conclusion

We showed the application of the TSEN framework as a theoretical-methodological support to perform an integrated assessment of landscape settings and dynamics, which in turn may be used as a basis for integrated environmental planning such as adaptive management. By doing so, the article sought to strengthen a relational understanding of how landscapes are constituted at a local scale in entwinement with territory within a SES, and in association with multiple space-time scales. We argue that this understanding supports landscape approaches to assess and plan the use of landscapes while integrating different disciplines, knowledges, and needs. Specifically, a focus on cross-scale k-p-w interrelated networks emphasizes how both social and ecological components of SES exhibit agency, and that social-ecological interrelations are key to this. Apparent dichotomies (social-ecological, scientific-ILK, global-local) are shown to be entwined in the actual landscape, making it seems that whether to privilege the preponderance of one or another is often like thinking of who came first: the chicken or the egg. Furthermore, by placing attention to both social and ecological agency, the framework showed the role of power and of a political ecology in producing sustainability and resilience. The framework thus supports a simultaneous analysis of landscape as scale, arena, multifunctionality, and cultural construction; aspects often studied separately by different disciplines. Additionally, the study of landscapes dynamics on the ground gives planners an idea about how specific contents of landscapes can be reinforced in order to enhance sustainability and resilience.

The use of bricolage and Ethnoecology to apply TSEN in an interdisciplinary and participatory way showed to favor a broad data collection strategy that emphasizes the incorporation of local knowledge. In our case, the integration of local and scientific classifications enriched the understanding of the resource management within the local landscape, and of the criteria that influences its sustainability. These findings indicate that bottom-up participation empowers both IPLC and planners to comprehend the local context, to draw lessons from local social learning, and to better deal with uncertainty in planning. We recognize that the present study had mainly an illustrative character and that several aspects of the framework could be further explored, including trade-offs, synergies and priority needs within the landscape. We also recognize that the framework includes broad concepts that may be adjusted and further specified to suit individual assessments and contexts.

We are confident that the TSEN framework may be used by scientists and practitioners that perform environmental assessments to inform and develop landscape approaches, as well as to

complement other environmental assessments. In particular, its application may assist to establish a dialogue to understand landscape settings and dynamics over time. Moreover, when planning adaptive co-management and governance of landscapes, it helps to systematically consider social-ecological components and networks (cultural, economic, political and ecological), and synergies and trade-offs between local-global needs.

We conclude by reiterating our belief that landscape approaches should consider land use interdependencies, and should be attentive to particular roles and interdependencies between different actors and k-p-w. While it is tempting to reproduce the customary scientific-technical superiority and dichotomized thinking, we like to stress to be careful when translating how locals cognize, value, and use their landscapes through their own “lenses” to scientific models to “decipher” their landscapes.

CHAPTER 4

INCLUDING DIVERSE KNOWLEDGES AND WORLDVIEWS IN ENVIRONMENTAL ASSESSMENT AND PLANNING: THE BRAZILIAN AMAZON KAXINAWÁ NOVA OLINDA INDIGENOUS LAND CASE

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Abstract

The concepts of ES and NCP inform environmental frameworks that set out to include ILK systems and worldviews in policy and planning processes. These frameworks aim to enhance biodiversity conservation and human well-being in a legitimate and effective way. In this article, we explore how the concept of PCN is complementary to NCP. We use it to investigate challenges that planners and locals face in realizing the legitimate inclusion of diverse knowledges and worldviews that account for people and ecosystems in a relational way. We introduce a case study where planners drew on ES and NCP and used participatory methods to implement a REDD+ policy in KNOIL (Acre-Brazil). We find that both Kaxinawás and planners emphasize both NCP and PCN in their discourses. Nevertheless, differences between knowledge systems and disciplines, uneven power relations between Kaxinawás and planners, and an underconsideration of PCN by global frameworks challenge the legitimate inclusion of the Kaxinawá knowledge and worldviews to craft assessment and planning. We conclude that by explicitly addressing these challenges, science-policy interfaces can further advance knowledge legitimacy and policy effectiveness.

4.1 Introduction

Scholars have advocated the use of frameworks based on the concepts of ES and NCP (Díaz et al., 2018; Pascual et al., 2018) for global environmental policies to better account for the mutual dependencies between people and nature, to enhance human well-being, and to further biodiversity and nature conservation. ES are conceived as all benefits that people obtain from ecosystems (MA, 2005) whereas NCP build on this concept to stress the central role that culture plays in underpinning the relations between people and nature (Díaz et al., 2018). These ES and NCP frameworks are largely used in environmental assessments that inform the resource management planning of IPLC. IPLC include a wide variety of communities (Skutcsh and Turnhout, 2018), most of whom depend on local natural resources for their livelihoods (Turnbull 2009). IPLC also contribute to the management of up to 80% biodiversity of the planet (FAO, 2017). Many IPLC are recognized for holding ILK systems that are considered valuable for the conservation of biodiversity and sustainable land use, among others (Barrera-Bassols and Zinck, 2003; Barrios et al., 2012).

The IPBES proposed the NCP framework to be inclusive of ILK and IPLC. At the same time, the NCP framework maintains the concept of ES in terms of the ecological, economic, and socio-cultural values on nature (MA, 2005). The NCP framework thus emphasizes the inclusion of context-based ILK and worldviews in policies, as they co-produce biodiversity and human well-being together with nature. The NCP framework is also careful not to prioritize scientific knowledge on ecological functions and economic values over diverse knowledges, worldviews, and values, as the previous iterations of the ES framework tended to do (Martín-López et al., 2014). With the adoption of the concept of NCP, IPBES thus stresses the need of science-policy interfaces to advance the legitimate inclusion of diverse knowledge systems in assessments and planning, to achieve well-being, conservation, and sustainable use (Pascual et al., 2018).

An important criterion for legitimate knowledge is that it is inclusive of diverse worldviews and knowledge systems of different stakeholders, including their different aspirations, values, and classification systems (Tengö et al., 2017). This understanding has led to the adoption of participatory methods where planners and IPLC bridge and co-produce knowledge and worldviews on nature that include both scientific knowledge and ILK systems (Irvine et al., 2016). It has also informed the development of interdisciplinary approaches to understand the social and ecological interplays involved in resource management (van Oudenhoven et al., 2012). Participation and interdisciplinarity are especially necessary to include ILK systems that are shaped by cosmovisions – holistic worldviews that integrate biophysical and cultural phenomena (Toledo and Barrera-Bassols, 2009). For instance, Fairhead and Leach (1996) show that planners who did not account for the relations between African IPLC and their forests misinterpreted forest mosaics as the result of unsustainable practices of these communities. A later interdisciplinary understanding of the practices of these IPLC led planners to comprehend that these mosaics resulted from conservation practices of these IPLC.

In practice, the integration of ILK in knowledge production has faced challenges (Chan et al., 2012; Fagerholm et al., 2012; Díaz et al., 2018). First, there is a tendency of scientists to consider science as superior to ILK (Agrawal, 1995). This tendency leads planners who use scientific frameworks to resist making shared decisions with IPLC. It also leads to the extraction of decontextualized bits of knowledge from ILK to fit scientific frameworks, rather than to the bridging of knowledge systems (Klenk et al., 2017). Second, different disciplinary backgrounds make it difficult

to establish common knowledge about the various social-ecological interplays that make up and affect biodiversity (Carpenter et al., 2009). This difficulty obscures insight in the mutual interactions and relations between people and nature. Third, ES and NCP frameworks tend to emphasize how humans depend on and benefit from nature, that is, NCP (Kenter, 2018; Peterson et al., 2018) and focus less on PCN.

The concept of PCN stresses that people interact with natural processes and together with these processes condition the state of ecosystems and biodiversity (cf. Díaz et al., 2015,; Peterson et al., 2018). This literature mostly highlights people's values and classifications of ES or NCP as impacting nature in this way (Chan et al., 2012; Kenter, 2018). We emphasize that both people's knowledge, worldviews, and practices are important dimensions of PCN, and that these dimensions can be explored further (cf. Toledo and Barrera-Bassols, 2009; Matuk et al., 2019). Moreover, accounting more explicitly for both PCN and NCP in environmental assessment frameworks can help policies advance a legitimate and relational understanding of how ecosystems and people affect and co-produce each other and offer better insight into local social-ecological contexts to inform planning in practice.

This article explores the challenges that environmental planners and IPLC face to include legitimate knowledge and worldviews that account for people and ecosystems in a relational way in assessment and planning. We use a case study in Acre state (Brazilian Amazon) that was part of the implementation of the regional REDD+ policy called SISA. The case illustrates an attempt to include ILK and cosmovisions in assessment and planning by drawing on both the ES and NCP frameworks. Our analysis shows how knowledge and worldviews on nature include aspirations, classification systems, and values that are manifested in global to local discourses, as well as how these discourses come together in participatory processes. The discussion explores the extent to which the SISA assessment and planning processes resulted in legitimate and relational knowledge and other outcomes. We conclude by reflecting on the challenges that planners and Kaxinawás faced to include ILK in assessment and planning and draw lessons for other contexts.

4.2 Conceptual framework

4.2.1 Knowledge and worldviews

In the 19th century, modern 'Western' science established that the world should be explained by 'universal' and value-neutral scientific truths, and that natural and social disciplines should address material and non-material phenomena separately (Lévi-Strauss, 1966). This conceptualization relies on and reproduces two dichotomies: one between scientific and ILK knowledge systems, and another between social science and natural science disciplines. Post-structuralist, post-humanist, and post-colonial schools of thought have argued against these dichotomies. They argue that reality is multiple and that it can be understood by 'pluriverses' of knowledge (Escobar 2016, p. 13). In this article, we adopt the perspective that knowledge is entwined with worldviews and is derived from dialectical interactions between people and nature (Latour, 2004, 2010).

The entwinement of knowledges and worldviews can be studied via the discourses of knowledge holders of different knowledge systems and disciplines. These discourses include different elements of meaning that comprise classifications, values, and aspirations, and that form a coherent whole (Foucault, 1972). Classification systems consist of categories that reflect those items that people value and that they identify with (for example nature as ecosystem or as commodity), which influence

what knowledge is considered valid or legitimate (Fisher et al., 2009). Values include qualifications that people use to signify phenomena and to guide actions. Aspirations include ideal images associated with needs and objectives that people and policies prioritize such as the conservation of nature (cf. Díaz et al., 2015). Analysis of the discourses of actor groups can thus reveal resonances and incongruences between these classification systems, values, and aspirations. It can also show how specific discourses affect policies and their outcomes (Hajer and Versteeg, 2005).

Discourses are found to be performative and tend towards the reproduction of themselves in practice, while resisting other discourses (Law, 2009; Behagel et al., 2017). This leads to challenges to accommodate and include diverse knowledges and worldviews. Those challenges may persist even despite intentions otherwise or the use of participatory methods to integrate knowledge. Thus, the performativity of discourse affects the inclusiveness, legitimacy, and effectiveness of knowledge (Behagel et al., 2017). An example is when local knowledge is either excluded or extracted from its meanings to fit 'universal' classification schemes (Turnhout et al., 2016; Klenk et al., 2017).

The tendency of discourses to reproduce themselves calls for sensitivity to power dynamics in environmental assessment and planning during the bridging and co-production of knowledge (Turnhout et al., 2019a, 2019b). This sensitivity should lead to the creation of shared understandings of both the social and ecological dimensions of resource management contexts and to the inclusion of a legitimate and relational understanding of NCP and PCN (Chan et al., 2012). In this paper, we explore the role of an intercultural approach (Rist and Dahdouh-Guebas, 2006) in achieving this purpose. This approach is based on an attitude of humility to recognize that knowledge systems and disciplines can enrich each other (Jasanoff, 2003). This attitude is exercised by respecting the integrity of meanings and terms communicated in discourses of different knowledge holders (Haraway, 2016; Tengö et al., 2017; Díaz-Reviriego et al., 2019) and by being flexible to reflect on and adapt scientific frameworks and worldviews to include ILK (Kincheloe, 2008; Toledo and Barrera-Bassols, 2009).

4.2.2 Ecosystem services- and nature's contributions to people- related discourses

When analyzing the discourses of the ES and NCP frameworks from the perspective outlined above, we find that they represent distinct discourses that differ in terms of classifications, values, and aspirations. Still, both discourses are part of one overarching discourse that aims to enhance human well-being, nature conservation, and biodiversity. Moreover, both discourses seem to offer compromises for the inclusion of diverse and relational knowledge and worldviews. The ES and NCP discourses are schematically presented in Table 7 and discussed below.

The ES discourse is strongly expressed in the Millennium Ecosystem Assessment (MA, 2005), The Economics of Ecosystems and Biodiversity (TEEB, 2010), and the Common International Classification of Ecosystem Services (CICES) (Haines-Young and Potschin, 2017). These frameworks aim to offer guidance for policy and planning processes to foster multifunctional landscapes and ensure that ecological processes and functions as well as their economic, socio-cultural benefits and values are accounted for (Levin et al., 2009). The ES discourse is based on a classification that includes different categories of ES: 1) support services that provide the conditions of life and (re)production (e.g. genetic diversity); 2) regulation services that regulate ecological processes (e.g. soil quality); 3) provision services that include the products and benefits that address human needs more directly (e.g. 'food'); and 4) cultural services such as spirituality, art, and recreation. The ES classification is recommended because of its presumed ability to elucidate synergies and trade-offs between land use

options and decisions on priority ES to be targeted in planning. Yet, while some articulations of the ES discourse highlight both ecological processes and functions and their economic and socio-cultural benefits and values (de Groot et al., 2002; Costanza et al., 2014), many ES assessments in the past have given more emphasis to monetary values (de Groot et al., 2010; Peterson et al., 2018). Critiques of the ES discourse thus argue that the term 'service' inevitably holds an explicit utilitarian economic interpretation and that in practice economic values continue to dominate ES debates, among others because they are easy to quantify (Turnhout et al., 2014; Martín-López et al., 2014). Cultural ecosystem services have often been excluded because they are not "*associated with the production and valuation of tangible things or conditions* […] and *involve the production of experiences that occur in the valuer's mind*" (Pascual and Muradian (2010, p. 7). The economic and monetary associations of the ES concept and its shortcomings in incorporating cultural or non-material values were important factors in the emergence of the NCP discourse.

The NCP discourse is expressed in the IPBES framework (Díaz et al., 2018; Pascual et al., 2018) and recognizes that different NCP and values are interrelated according to the specifics of each context. Díaz et al. (2018, p. 270) explain that "*the NCP approach recognizes the central and pervasive role that culture plays in defining all links between people and nature*". This role refers to the influence of people on biodiversity and the way in which biodiversity is co-produced by people and nature, for instance, under the influence of IPLC and policy aspirations. To address people and nature in their relationship, Díaz et al. (2018, see also Supplementary materials) propose a general classification that includes 18 subcategories of NCP. These subcategories are associated with three central categories of NCP which are: 1) 'regulation' (e.g. habitat maintenance and pollination); 2) 'material' (e.g. food); and 3) and 'non-material' (e.g. learning experience). Here, the NCP regulation category resonates with the ES support and regulation categories, the NCP material category with provisioning ES, and the NCP non-material with cultural ES.

In contrast with the ES discourse, NCP includes a subcategory called 'maintenance of options' which gives space for a more anticipatory and precautionary approach and allows for the inclusion of other categories indicated by IPLC that do not fit its general categories. IPBES moreover calls for the bridging of ILK and scientific knowledge on NCP and proposes a diverse valuation approach to prioritize NCP that elucidates and includes plural values that are relevant for different stakeholders – i.e. economic; biophysical; health; socio-cultural; and holistic values (Pascual et al., 2018). The NCP framework thus invites policy assessment to link these plural values to NCP categories and to explicitly recognize 'intrinsic' and 'relational' values (which can include animal welfare and rights, and Mother Earth). Moreover, IPBES aims to be inclusive of IPLC cosmovisions that consider Mother Earth as a self-regulating system that is simultaneously an extension of people and an entity that integrates people and (non)living beings.

Table 7. Categories of aspirations, classification, and values presented in the discourses of ES and NCP frameworks.

Aspiration		**Ecosystem classification**		**Values**	
Categories		**Categories – subcategories (examples)**		**Categories (criteria) – subcategories (examples)**	
ES	**NCP**	**ES**	**NCP**	**ES**	**NCP**
Enhance ES; biodiversity, human well-being, ecological resilience Promote environmental sustainability and conservation by highlighting the economic value of nature and relying on scientific knowledge	Enhance ES, biodiversity, human-well-being, cultural and ecological resilience Weave and bridge ILK based NCP classifications with scientific NCP classifications	*Support and habitat* – Soil formation; Maintenance of biodiversity and nursery-services (gene pool protection); Lifecycle maintenance (photosynthesis); Primary production; Nutrient cycling *Regulating* – Air quality (air purification); Climate (carbon sequestration); Clean water (water treatment and natural purification); Water flows (drought mitigation); Geo-chemical cycles (of carbon, nitrogen, and oxygen); Disturbance prevention (flood mitigation); Clean soil (soil regeneration); Soil regulation (erosion and fertility); Pollination (bees); Biological control (pest regulation, seeds dispersal); Human disease control *Provisioning* – Food (seafood, fruits) Water (fresh water, presence of water resources); Raw materials (timber, fibers); Genetic material (or resources); Fuel and energy (biomass fuels); Drugs and pharmaceutical (medicinal resources); Ornamental resources (decorative and handicraft use)	*Regulating* – Habitat creation and maintenance; Pollination, dispersal of seeds, and other propagules; Regulation of air quality; Regulation of climate; Regulation of ocean acidification; Regulation of freshwater quantity; Location, and timing; Regulation of freshwater and coastal water quality; Formation, protection, and decontamination of soils and sediments; Regulation of hazards and extreme events; Regulation of organisms and biological processes *Material* – Energy; Food and feed; Materials; companionship, and labor; medicinal, biochemical, and genetic resources	*Ecological* (sustainability and intrinsic related) – Carrying capacity of ecosystems; Plants and animals have value for themselves and non-use value for people); Integrity and resilience of nature to maintain production; habitat functions (complexity, diversity, and rarity) *Economic* (anthropocentric, monetary and instrumental values) – Direct market valuation of goods' prices associated with carrier functions of landscapes for markets and human land use practices of cropping among others; Indirect market valuation based on a willingness to pay or to accept compensation for the availability or loss of ES; Contingent valuation based on a willingness to pay before hypothetical scenarios; Group valuation to deliberate around monetary values and shared priorities	*Intrinsic* (Non-anthropocentric or focused on nature) – Animal welfare and rights; Gaia and Mother Earth; Evolutionary and ecological processes; Genetic and species diversity *Instrumental values* (anthropocentric or focused on NCP) – Habitat creation and maintenance, pollination and propagule dispersal, and regulation of climate; Food and feed, energy, and materials; Physical and experiential interactions with nature, symbolic meaning, and inspiration
Include diverse worldviews and address diverse needs	Include diverse knowledge and worldviews in assessments	*Cultural* – Cultural diversity (heritage and inspiration for culture, art, and design); Knowledge systems (information for cognitive development and stimulation); Spiritual and religious value and experience; Aesthetic values and information (beauty); Recreation and eco-tourism	*Non-material* – Learning and inspiration; Physical and psychological experiences; Supporting identities; Maintenance of options	*Socio-cultural* (related to non-material well-being) – Historical (sense of belonging to place and community; Cultural diversity (inherited identity); Spiritual (worship of holy forests, trees or animals; Scientific (medicinal research); Educational (social learning and knowledge systems); Artistic (painting and folklore) Physical and mental health Aesthetic (scenic beauty roads of and landscapes); Recreational (tourism and enjoyment); Educational	*Relational values* (anthropocentric and focused on the quality of life) – Physical, mental, and emotional health; Way of life; Cultural identity and sense of place; Social cohesion

4.2.3. Peoples' contributions to peoples further explored

Scholars have criticized how the NCP framework (Díaz et al., 2018) gives limited space to the role of people in shaping nature (which we refer to here as PCN) (Peterson et al., 2018). This may compromise the IPBES's ability to advance the inclusion of diverse knowledges and worldviews in policy assessment and to give centrality to culture as a key factor in defining and conceptualizing nature, and the linkages between people and nature (Kenter, 2018). Díaz et al. (2018) recognize that NCP are co-produced by nature and people, and this shows that the NCP framework includes PCN to a certain extent. Nonetheless, the term 'contributions' in NCP may give the suggestion that nature provides people with 'gifts' without people having a role to play in the provision of those gifts (Kenter 2018, p. 41). Furthermore, despite the central emphasis of the NCP discourse on culture, only a few subcategories of NCP are directly associated with it (e.g. labor). Moreover, the relation between those NCP subcategories that have a cultural content and those that have an ecological content is difficult to make concrete in certain contexts. For instance, Díaz et al. (2018, p. 271) stress that '*the non-material dimension of regulating NCP is not as widely recognized across cultures.*' Failing to sufficiently account for the role of people in supporting (or undermining) services or contributions from nature can prevent a political discussion of the role of different actors in resource management and nature conservation. This specifically applies to the knowledges and worldviews that various actors introduce to environmental assessments and are used to inform the planning of resource management.

With our conceptualization of PCN, we look beyond knowledge and worldviews to also include practices. These three forms of PCN affect the state and regulation of ecosystems and can both support and undermine specific NCP or ES (cf. Raymond et al., 2017). Practices correspond to the material dimensions of people's culture entangled with non-material values and knowledge, which are all important for assessments to address the diversity comprised in social-ecological contexts in a relational way (Matuk et al., 2019). This broad conceptualization of PCN is suggested to advance assessment frameworks in linking these material and non-material PCN to nature's provisions (cf. Chan et al., 2012) and to further feasible planning strategies towards nature conservation.

4.3 Material and methods

4.3.1 Study area

KNOIL is located in Feijó, in the Brazilian State of Acre (Figure 4). Acre has an area of 157,490 km^2 (approximately the size of Bangladesh), of which 88% is covered by Amazon rain forest (Sills et al., 2014). Several governmental and non-governmental entities cooperate to address the various Acrean IPLC, including Indigenous ethnicities, fish farmers, and others. These entities employ participatory methods to co-design and implement policies that aim to enhance the biological and cultural (bio-cultural) diversity of their territories (Iglesias, 2008). KNOIL covers 27,000 ha and is home to 492 people who speak Portuguese and the Kaxinawá language *Hãtxa Kuin*. Similar to about 6.000 Kaxinawás and other Amazonian ethnicities that live close to the Brazil-Peru border, the Kaxinawás of KNOIL have animist holistic worldviews that consider all biophysical entities, including humans, to be linked and sacred (Maná Kaxinawá, 2002). The Kaxinawás have lived in KNOIL since remote times that are not registered in the literature. They practice a traditional form of resource management that includes practices such as shifting cultivation, collecting, hunting, fishing, and handcrafting, which do not rely on external chemical inputs or machinery and aim mainly at subsistence (do Amaral et al., 2015).

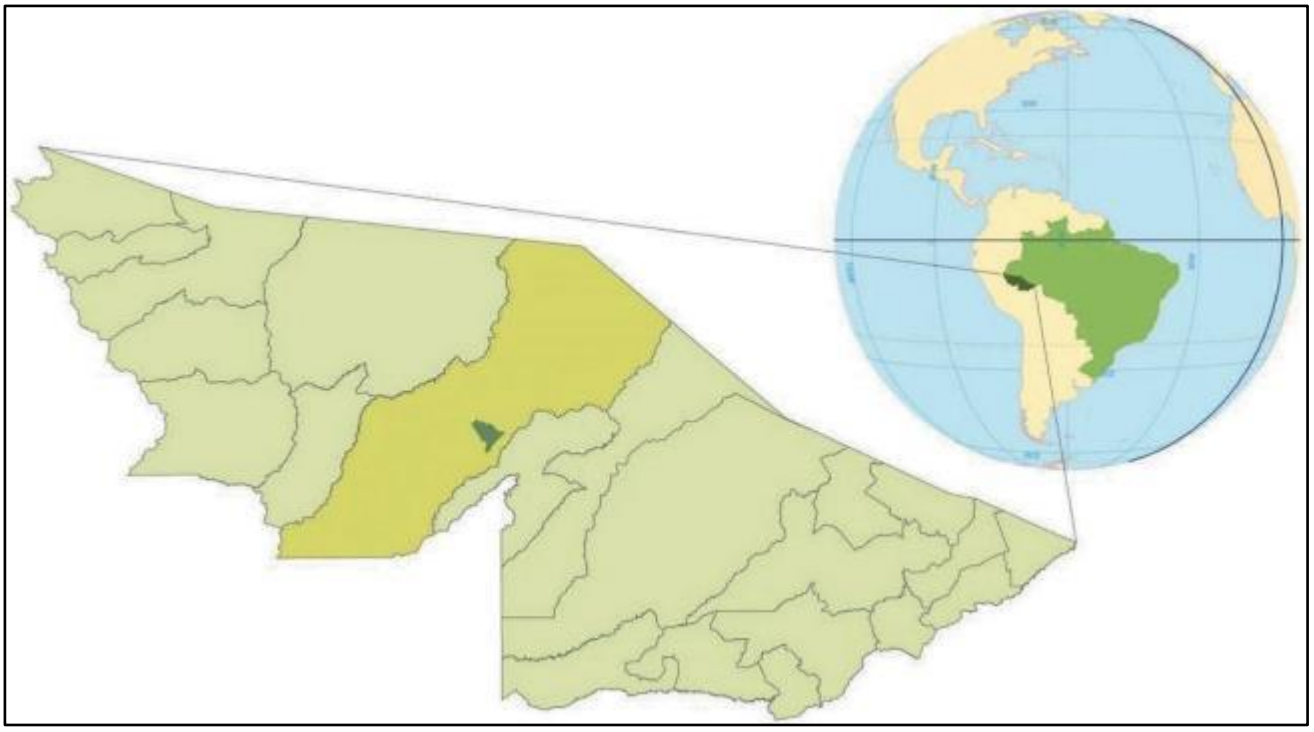

Figure 4. Map of the location of Kaxinawá Nova Olinda Indigenous Land in the municipality of Feijó, shown in relation to the State of Acre, to Brazil, and to the globe.

The planners of EMBRAPA started implementing the SISA policy in KNOIL in 2011 as a pilot project to further the participatory implementation of this policy. This project comprised a broad participatory assessment of the social and ecological characteristics of the KNOIL territory, which informed ACM planning with Kaxinawás. While SISA was mainly designed as a REDD+ policy that targets ES, the assessment and planning processes of SISA included both scientific knowledge on ES and explored the concept of NCP with Kaxinawás to assess and include their aspirations, classification systems, and values on nature. To this end, the planners used an intercultural and interdisciplinary approach (do Amaral et al., 2015).

4.3.2 Data collection and analysis

Data collection took place in KNOIL and in the city of Rio Branco (SISA headquarters, capital of Acre state). The first author collected data in collaboration with the fourth and fifth co-authors (who had previously implemented SISA in KNOIL) and analyzed data with the other co-authors. Data was collected in Portuguese and co-validated with participants at the end of the fieldwork. Free and prior informed consent was obtained from the Kaxinawás of KNOIL (Brazilian Law nº 13.123, 20/05/2015). We stress that while the Kaxinawás of KNOIL are not co-authors of this article, they are co-producers of this research, as an ethnoecological research accounts for participants as research partners in data collection, analysis, and validation (see de Albuquerque et al. 2014).

Data for the discourse analysis included: publications on ES (de Groot et al., 2002, 2010; MA, 2005; Haines-Young and Potschin, 2017) and on NCP (Díaz et al., 2018; Pascual et al., 2018); planners' reports (do Amaral et al. 2014, 2015); the SISA framework described in the state Law nº 2.308 (Government of Acre, 2010); and interviews. Interviewees included 20 SISA practitioners – policy makers and planners of (non)governmental organizations who participated in the design of SISA or in its implementation in KNOIL; and 40 Kaxinawás from KNOIL of varied ages and gender who participated in the local SISA assessment and planning processes. In the interviews, we probed both

planners and Kaxinawás on their aspirations, values, and classification systems and we asked them how they perceived the participatory processes to implement SISA and how they were able to influence the inclusion of knowledge and worldviews. Thus, interviews also provided data to analyze how discourses of planners and locals interacted, and how they resonated with discourses of ES and NCP.

Data from interviews was cross-checked with data from participant observation of a four-day workshop (including 35 Kaxinawás and two planners who implemented SISA in KNOIL). In the workshop, we traced back the contents that were prioritized during the SISA assessment and planning and how decisions were made during these processes. During the workshop, we conducted circles of dialogue (Freire, 2000) where we conceptually mapped Kaxinawás' knowledge and worldviews by inquiring on their values, aspirations, and classification of NCP. We also conducted a participatory mapping (de Albuquerque et al., 2014) where Kaxinawás presented to us (in drawings and in the field) the spatial distribution of NCP and PCN categories in landscape units that they recognize as having different land uses, relief, and soils and that they used to plan resource management with planners. Finally, we problematized the contrast between our findings with findings reported by Kaxinawás and planners in interviews and SISA reports, and the challenges and achievements found by them when bridging and co-producing knowledge and worldviews to implement SISA. All data was registered in notes, recordings, and transcriptions.

To support the discourse analysis, we used qualitative coding of the documents and interview data to analyze expressions of aspirations, values and classifications systems. We analyzed the way in which different forms of knowledge were articulated in relation to each other in order to identify knowledge dichotomies and uneven power relations. Finally, we contrasted the discourses we found with one another to highlight differences and similarities. We also analyzed how discourses shaped assessment and planning processes by contrasting how different interview respondents and participants in the workshop reported about the extent to which they were able to influence the participatory processes and its outcomes. This enabled us to identify whether and how knowledge differences present in different discourses influenced power dynamics and affected the inclusion of diverse and relational knowledge and worldviews.

4.4. Results

In this section, we present the discourses of SISA planners and Kaxinawás in relation to discourses of ES and NCP, and the implications of the encounter of these discourses during participatory processes for the inclusion of diverse and relational knowledge in the SISA assessment and planning.

4.4.1 'System of Ecosystem services' discourse

The SISA discourse expresses aspirations to enhance bio-cultural diversity and reduce deforestation and forest degradation in alignment with the knowledge, aspirations, and worldviews of IPLC (see Table 8). The discourse also expresses the idea that IPLC are 'forest guardians' and the aim to reimburse IPLC for their past contributions to maintain the rain forest cover at 88% of the territory of Acre. The commitment of SISA policymakers to the REDD+ donor German Bank KfW involving IPLC is thus to provide shared benefits for IPLC that strengthen the conservation of their culture, livelihoods, and territory as well as the sustainability of their resource management (Government of Acre, 2010). Therefore, SISA builds upon IPLC's worldviews, ILK, and resource management:

> "[…] *We know that the cultures of the indigenous people and other Acrean communities are dynamic, and they wish to maintain their traditional knowledge and practices* […] *We know also that their resource management is usually more sustainable than that of other stakeholders. Thus, we build on their knowledge and needs to help them adapting resource management*" (Interview 3).

The SISA practitioners hold that if environmental assessment is to inform adaptive collaborative planning with IPLC, it must be adapted to the Acrean context and enable the bridging of scientific and local knowledge and worldviews. Accordingly, these practitioners have relied on global frameworks (MA, 2005; Díaz et al., 2018; among others) and on several workshops with IPLC from Acre to select the ES categories that SISA addresses (see Table 8). SISA's classification of ES was designed with the participation of IPLC and is inclusive of ILK, culture, and sociocultural diversity (Table 8). It emphasizes the contributions of PCN represented by both ILK, worldviews, and practices of IPLC's for ecosystems. The quote below expresses this idea:

> "*We assess ES, but also the influences of Indigenous and local communities on nature* […] *We consider for instance their cultural worldviews, knowledge, and practices for the regulation and provision of ES and vice-versa* […] *When we asses ILK classifications of ecosystems we use the concept of NCP because this is easier for the communities to connect with. This approach has enabled us to develop a holistic understanding of ES*" (Interview 7).

Table 8. Categories of aspirations, classification of ES, and values manifested in the discourse of SISA policy makers and planners.

Aspirations	ES classification categories	Values
Maintain the rain forest cover at 88% of the territory of Acre and reduce forest degradation	Carbon services	Stewardship with locals to understand their social-ecological context and to plan resource management and governance via interdisciplinary and participatory approaches
Enhance and strengthen ES, human well-being, bio-cultural diversity and social-ecological resilience	Water resources services	Humility to respect diverse cultures and related knowledge and worldviews of IPLC via an intercultural approach
Craft global and SISA frameworks to align with IPLC knowledge, worldviews, practices, and contexts, and needs	Climate regulation services	Ethics and solidarity with IPLC's well-being, aspirations, cultural diversity, and needs
Provide shared benefits for IPLC (i.e. infra-structures; seeds, cultural rescue, and capacity building of indigenous knowledge leaderships to become SISA "agroforestry" knowledge agent officials)	Soil services	
	Natural beauty patrimony	
	Culture and ILK	
	Sociocultural (bio-cultural) diversity	

The SISA practitioners stressed that they became aware of the importance of assuming an intercultural approach to reflect on their own values and respect IPLC's culture, values, and knowledge after having worked on policies that address these communities since the 1990s (see Sills et al., 2014). They also consider interdisciplinary collaborations between planners with backgrounds in social as well as natural sciences indispensable to address NCP and PCN to biodiversity simultaneously and to include ILK and cosmovisions holistically. IPLC's multiple knowledges and values on nature, as well their livelihood needs are conceived to both influence and to be influenced by ES, as explained in the following quote:

> "*Communities develop their culture via social learning with nature … This influences how they decide practices. These practices affect the regulation of ecosystems and biodiversity, and also support the provision of ES … For instance, the Indigenous people*

> *management of hunting aims to maintain hunting species available for their descendants*" (Interview 1).

The SISA discourse shows that the planners prioritize knowledge and worldviews in assessments that are relevant to plan management. This requires reflection with IPLC on the prioritization of ES and values that can be addressed in practice to enhance bio-cultural diversity in alignment with local aspirations. The planners hold that ILK and worldviews are usually oriented to sustainable practices. Moreover, cultural values underlie the creation of ecological and economic value:

> "[…] *The cultural values of Indigenous and local communities are usually concerned with generating income with resource management that complements their subsistence and that also maintains natural resources available both for future generations and natural entities* […] *Thus, cultural values inform decisions on practices and labor of these communities and they determine what economic and ecological values are generated in their territories* […[*SISA aims to embrace local values and knowledge that support the continuation and improvement of community sustainable practices. This goes far beyond prioritizing economically-oriented decision-making* […] (Interview 15).

4.4.2 Kaxinawá discourse

The Kaxinawá discourse articulates aspirations that link cultural and biological diversity. Accordingly, the central Kaxinawá aspirations (food and livelihood security and territorial sovereignty) (Table 9) are considered in resonance with the needs of natural entities:

> *"Our culture is our spirituality and is centered on our food. We have learned with nature and with the ancestors that all beings, people, soil, and plants are sacred and must have their needs respected* […]" (Interview 47).

The Kaxinawás explain that, to understand their knowledge and worldviews, we need to know their history and social-ecological context. The Kaxinawás reported that by maintaining collective land use, food traditions, the *Huni Kuin* language, and spiritual values, they have been able to safeguard their social-ecological heritage. However, changes have threatened this heritage. These changes date back to the development of the Amazon region via Brazilian government projects which introduced slavery for rubber-tapping and alcoholism in KNOIL in the 19th century. The Kaxinawás became visible to the government and had their identity and land rights recognized in the 1980s by engaging in grassroots movements (see Iglesias, 2008). However, the fixed boundaries of their territories, combined with population growth, have required them to adapt their traditional resource management. Moreover, some Kaxinawás have found support in a protestant religion to fight alcoholism since 2010. This created political and cultural fragmentation from other Kaxinawás who maintained their traditional spirituality. The Kaxinawás emphasize that this spirituality involves the shamanist ritual use of *Ayahuasca*, a forest brew prepared by shamans that mediates spiritual awareness to steward self-existence and resource management with nature. Simultaneously, more intense contact with urban spaces has stimulated the Kaxinawás to migrate in search for study and health care. The Kaxinawás highlight that these changes make the support by scientific knowledge via policies relevant for them to adapt their knowledge and practices in such a way to conserve their socio-cultural legacy and ecological sustainability.

The Kaxinawás indicated diverse NCP and PCN categories during our interviews (Table 9). For instance, the linked subcategories of soil – and forest – related NCP to livelihoods subcategories (i.e. raw materials and fibers used in boats, and clothing that integrate their cultural identity). Figure 5 visually illustrates part of the diversity comprised in the Kaxinawá knowledge and cosmovisions on NCP and its relational consideration of people and ecosystems. Although the Kaxinawás consider all NCP categories to be important, we organized them in (sub)categories to facilitate their representation. Therefore, we relied on the emphasis given in Kaxinawá discourses to link specific subcategories with specific social and natural resources (e.g. knowledge and soils). Likewise, although the Kaxinawás mentioned several indicators they use to manage resources and adapt knowledge and practices, we presented in Table 9 the indicators they mentioned most – e.g. the thickness and height of secondary forest trees indicates when fallows can be cleared and crops can be planted in shifting cultivation areas. Moreover, these (sub)categories are all referred to as intertwined with PCN and linked with each other. As such, forests are considered simultaneously as a pool of life; as identity; as homeland; as source of medicinal plants; and so on.

Figure 5. NCP and PCN identified by the Kaxinawás: (a) feathers of birds used to produce 'cocares' (headdresses) that symbolize the Kaxinawá cultural identity and political hierarchy); (b) palm leaves used to produce a boat ceiling; (c) handicraft made of latex made with technology adapted from rubber-tapping introduced in the past of slavery; (d) agrobiodiversity of corn species linked to the land use heritage; (e) (rattle) instruments produced with different wood and raw materials; (f) Kaxinawá knowledge agents (SISA officials) responsible for maintaining and supporting KNOIL in adapting the Kaxinawá knowledge legacy; (g) bridge and house made of wood; (h) shifting cultivation with banana and cassava; (i) ceramics produced by women using Kaxinawá spiritual rituals and knowledge.

Table 9. Categories of aspirations, classification, and values presented in the Kaxinawá discourse.

Aspirations (PCN linked with NCP)	**Classification of NCP (includes entwined PCN) Categories – Subcategory (examples)**	**Values (PCN linked with NCP) Categories – Subcategory (examples)**
Enhance food and livelihood security and territorial sovereignty Enhance social-ecological sustainability and resilience Conserve the *Huni Kuin* language and the Kaxinawá culture (i.e. knowledge, values, and resource management and governance practices) Prevent migration Find/strengthen partnership with (non)governmental entities to find support of scientific knowledge and policy fund' to adapt practices in face of social-ecological changes	*Forests* – Life pool; identity; homeland; sense of belonging; collecting; shadow to soften the warmth in the-houses; food; medicinal plants; palm leaves to make the ceiling of boats, ink for body and handicraft; fiber for clothing fuel; wood (houses, rowing, bow and arrow); source of learning indicators for using and managing resources (thickness and height of secondary forest trees indicates when fallows can be cleared and crops can be planted in pre-existent shifting cultivation areas) *Soil* – Shifting cultivation (cassava, banana, corn, yam, taioba, peanuts, agroforestry with fruit tress); clay for ceramics; associated to landscape units with specific vegetation, relief, and land uses; shelter; habitat for (non)human species; clay (ceramics); water spring source (regulation of clean water); Kaxinawá land; territory; homeland; indicator (when soil fertility and crop's yields decline indicates that shifting cultivation areas must be left to become fallows and soil quality auto-regulation can take place; several indicators for land suitability for crops such as texture, consistency, taste, and humidity) *Water* – Learning experience to contribute with the nature regulation of the river life pool; landscape builder (water causing soil erosion and crating river arms called regionally as *igarapés*); food provision via soil humidity; softening of the warmth; domestic consumption; fishing; means of transport (KNOIL is surrounded by river and forest); leisure; rituals; contemplation; territory; indicators (regulation of soil fertility and humidity indicates the suitability of lands for crops; water regulates forest growth) *Fauna* – Presence of species suitable for hunting and fishing; flora and fauna medicine; companionship; chicken; pork, and cattle production (this later was introduced by colonizers and has been abandoned by most Kaxinawás); feathers for 'cocar'(headdress) which is part of the Kaxinawá cultural identity; means of communication via bugle made of horn (only used by the cacique chief) *Climate* – Rain and humidity to soften the warm; regulation of humidity; changing; seasons; indicators (weather and seasons are forecasted by species) seasonal distribution of land use practices *Geographical reference* – Time (birds and moon indicate respectively times of the day and time for cropping); weather (nature signs indicating rain, location (rivers and landscape features); space (historical social-ecological heritage, availability of resources, cultural legacy) Knowledge – Social and transformative learning via experimentation with nature; knowledge sharing and co-production with (non)governmental entities and IPLC; nature is a teaching entity; resource management wisdom/knowledge; emphasis is put on medicinal shamanic wisdom and food production knowledge (both linked with health; spiritual balance; survival; respect for nature; learning); social-ecological reproduction and survival *Governance* – Political ecology formed by reciprocity via a co-stewardship with nature where (non)human agents influence decisions via their response to Kaxinawá practices; traditional and legal territory; defense of territorial boundaries from eventual hunters;--male domination-but recent-women leadership to support cultural rescue; marriages soon after puberty ensure a familiar labor-basis and independency between children and elders; political attitude of maintain-traditional-culture-(knowledge,-practices, values); the spiritual and medicinal shaman chief and the political and educational cacique chief maintain and adapt this culture;-rules to use and manage common use resources and lands, including time, place in the landscape,-and technique used (the Kaxinawás know that their rare use of electricity implies in less need to exploit nature to obtain income to pay for it as well-as-avoids deforestation which affects the regulation of soil humidity, fertility, and fauna habitat) *Economy* – Subsistence (sovereignty, self-consumption); maintenance of nature regulation processes and enhancement/maintenance of sustainable practices; capitalist relations and trade (of crop surplus and handicraft) Spirituality – Rituals to practice agriculture, handcrafting, among others; consumption of healthy food and of diverse substances from the forest to raise personal balance and strength to work; ethical habits; medicine from the forests; friendly co-existence with nature; sacred plants that enlighten people with perception and wisdom and that protect (non)human and non-living beings) such as Banisteriopsis sp. and Psychotria sp. (used to produce Ayahuasca); and 'samauma' or *Ceiba pentandra* (giant tree used to produce rape and considered a spiritual authority that contributes to the ancestral wisdom of shamans on traditional medicine) *Cultural identity* – Kaxinawá identity; affective bonds with forest/river landscape (nature is a caring entity but gives lessons to correct the Kaxinawás when they do not respect its limits of renewability of soil quality and forest regeneration; nature's entities represented in body-painting and handicrafts; Kaxinawá ancestry from animals including their traits and skills that ancestors perceived (jaguar, tapir) Folklore tradition – artistic representations that teach ethical social interactions; recreation; *Katxanawa* where Kaxinawás thank nature for harvesting; *nixi pae* ritual where the Kaxinawás drink *Ayahuasca* to find spiritual wisdom and envisions personal and political learning to govern nature *Art and handicraft* – Cotton for clothing; feathers and jaguar teeth for jewelry; latex from *Hevea brasiliensis* trees to produce the regionally important rubber "vegetal leather" ("encauchados"); musical instruments; inspiration (nature informs art and provide raw materials for handicraft, people's handicrafts transmit values of nature)	"*Mother Earth*" – Kaxinawás and nature are an indivisible and a self-regulating interdependent unit that links sacred biophysical entities, including man (animist worldview) *Spiritual* – Respect for biophysical Earth's entities; indicator (reduction of crops and hunting provision indicates need to rethink practices and values); medicinal healing; social learning; enlightenment; and adaptation of cosmovisions; knowledge; and practices; the protestant religion is perceived as not conflicting with the Kaxinawá animism but as conflicting with the use of *Ayahuasca* *Informational and educational* – Nature orients social learning and adaptive management and governance (constraining access to resources) *Ethica*l – Humility and moral responsibility, and solidarity towards all (non)human entities; co-existence with nature *Economic* – Subsistence non-capitalist values (subsistence) and monetary values (not yet quantified-income generated with agricultural surplus and handicraft) *Stewardship* – Agency of nature and people; people-ecosystems governance; compassion between people and nature *Individuality and community* – Self-identity; sense of-interdependence with others; gender and age differences; social roles; marriage (it is made early to ensure that families provide their subsistence together); family (share of duties, care) *Cultural identity* – Kinship with nature and people (identity relation with jaguars); sense of belonging to the *Huni Kuin* ("true people") ethnicity and to the Amazon forest and landscape (Kaxinawás seen themselves as "forest and water people"); territory; community *Recreational* – Leisure; relaxation; contemplation of the natural aesthetic beauty *Artistic* – Music; clothing; poetry; tales, education

The Kaxinawá discourse is based on an understanding that people, ecosystems, and biodiversity are entwined, as this Kaxinawá expresses: 'It is not only nature that works for us. We work together with nature' (Interview 24). The Kaxinawás stress that this is why they have adapted their resource management so that it is not only in accordance with their culture but also responsive to ecological processes and functions. For instance, the Kaxinawá management of hunting and fishing is both associated with the Kaxinawá food culture and aims to contribute to fauna reproduction cycles (Table 9). Thus, according to the Kaxinawás, the different subcategories of NCP are not only interdependent but also inseparable from each other. The following quote illustrates how the Kaxinawás use their knowledge of how their practices affect and are affected by the support, provision, and regulation of biodiversity in the temporal and spatial distribution of their resource management:

> "*When we notice that the birds are disappearing in an area, we know we are clearing forest for cropping too much there and not leaving enough food for the birds. Then, we leave at least part of that area to remain as a fallow* […] *In turn, the birds come back and keep cheering us with their singing*" (Interview 22).

The Kaxinawá discourse is also based on an animist worldview of 'Mother Earth', which means that all Kaxinawá values are formed in relation to nature and its intrinsic values, and in relation to their knowledge, practices, and aspirations (see also Maná Kaxinawá, 2002). For instance, stewardship values are expressed in tales used by the Kaxinawás to register and transmit their knowledge – e.g. rats have taught women to give birth and squirrels have taught man how to grow crops). Co-existence with nature thus includes values of reciprocity, ethics, and solidarity towards all (non)human entities. This quote shows how the Kaxinawá socio-cultural, intrinsic, and economic values are interconnected:

> *"We do as the ancestors did. We sing sacred songs to ask permission and bless the nature entities before fishing, hunting, clearing forests, and harvesting. We also prepare our minds and body, by watching our thoughts, food, and sexual behavior* […] *If we do not respect the care that nature requires and the needs it has for its own sake, we can feel unwell and not get the livelihoods we need"*. (Interview 33).

Finally, the Kaxinawá values inform the Kaxinawá's governance and resource management decisions via an understanding of the world that considers nature to have agency. Accordingly, the Kaxinawás' understanding of the impacts of their practices on nature informs changes in their resource management towards a co-stewardship with nature where people and ecosystems play a role in shaping management strategies and biodiversity. The spiritual and medicinal chief (shaman) and the political and educational chief (cacique) ensure that the use and access to resources follows this co-stewardship.

4.4.3 The shaping of policy processes by different discourses

The SISA and Kaxinawá discourses interconnected during the SISA implementation process and particularly during the dialogues between planners and Kaxinawás to assess local needs, values, and classification systems and gain insight on how they could be accounted for in the planning of resource management related practices. This dialogue was initiated by the planners participating in Kaxinawá practices to interconnect with their culture. These included: harvesting, meals, and spiritualistic rituals through which Kaxinawá women extract clay to produce ceramics and Kaxinawás do the *Katchanawa* (see Table 9 for an explanation). For a proper interdisciplinary dialogue with Kaxinawás and an appropriate interpretation of their interactions with nature, the planners of EMBRAPA with a background in soil science also relied on input of planners who have a social science

background. Kaxinawás reported that the engagement of planners in their practices demonstrated that planners considered their knowledge and culture as relevant. This was very important to establish mutual trust and provided a solid basis to proceed with the joint planning of resource management.

The intercultural approach adopted by planners mediated a respect for the diversity and relational thinking comprised in the Kaxinawá knowledge and worldviews during both assessment and planning. The Kaxinawá and SISA discourses resonated insofar that planners gave the Kaxinawás voice to express their knowledge and worldviews and to make decisions. During the SISA assessment of the KNOIL territory, the Kaxinawás contributed by eliciting priority categories of aspirations, of NCP, and of values; and by helping planners to find common objectives involving Kaxinawá aspirations and SISA aspirations (both of which focused on enhancing bio-cultural diversity). To include these categories in their diversity, planners asked the Kaxinawás to indicate associations among aspirations, NCP, and values. These associations were made via a reflection on management options that benefit all Kaxinawás. Planners thereafter weaved these categories with their own respective categories without the participation of the Kaxinawás in an identification-key containing the SISA and Kaxinawá aspirations, classification systems, and values assessed (Table 10). Besides this result of the assessment, the planners also generated with the Kaxinawás a participatory mapping in which Kaxinawás elicited the distribution of the most representative NCP and PCN in each landscape unit they recognize in KNOIL. The planners also represented this mapping graphically without including the Kaxinawás (Figure 6). During the subsequent planning of resource management, planners facilitated Kaxinawás to decide on management options that addressed both SISA and Kaxinawás objectives. This part of the process was not focused on values anymore, as planners argued that these management options had already been designed while taking account of Kaxinawá values. Finally, planners systematized the resultant planning of strategies for adaptive collaborative management (Table 11).

Table 10. Correspondences and complementarities between the aspirations, classifications, and values of Kaxinawá and planners that were prioritized in the SISA assessment (KNOIL, Acre – Brazil).

Aspirations		**Classification systems**	**Values**		
Kaxinawás	**SISA**	**Kaxinawá NCP and PCN categories (considered linked)**	**SISA ES categories (considered linked)**	**Kaxinawá categories (considered linked)**	**SISA categories (considered linked)**
Social-ecological sustainability and resilience with a focus on strengthening food and other livelihoods security, and on territorial sovereignty	Enhance ES, bio-cultural diversity; social-ecological resilience and the Kaxinawá resource management sustainability with a focus on reducing deforestation and forest degradation, mitigating climate change, enhancing soil and water conservation and human well-being	Forests, soil, water, fauna, and climate geographical reference, knowledge, governance, economy, spirituality, cultural identity, folklore tradition, art and handicraft (all related with the support to the provision of natural resource, biodiversity and cultural diversity, of habitat, of the regulation of their provision, and livelihoods); emphasis on food, medicine, and other livelihoods that are part of the Kaxinawá culture, resource management, and governance, and that mediate the Kaxinawá economy (subsistence and trade)	Carbon, soil regulation; water resources; climate services; and natural beauty patrimony	"Mother Earth", political ecology of stewardship with nature, governance, economic (subsistence and trade – not quantified yet), recreational, and economic subsistence	Stewardship with locals to assess their social-ecological context as well as knowledge, practices, and values; and to plan resource management and governance that addresses Kaxinawá needs and nature conservation in KNOIL
Cultural conservation (traditional medicine, land use, resource management, and governance), prevent migration, political attitude to maintain subsistence and culture Strengthen partnership with (non)governmental institutions	Conserve and strengthen the local bio-cultural diversity; and provide shared benefits for Kaxinawás	Social-ecological heritage, cultural identity, territory and habitat for flora and fauna, folklore, traded handicraft, art	Bio-cultural diversity (including cultural local knowledge, worldviews, practices, and needs as well as ES and related livelihoods)	Cultural identity, community, family, Gender and age values, spiritual, art	Ethics and solidarity with the Kaxinawá well-being, aspirations, cultural diversity, and needs
Bridge and co-produce knowledge with (non)governmental entities in tune with the local social-ecological context, existent Kaxinawá knowledge, cultural legacy, and resource management and governance top face social-ecological changes	Craft the SISA framework to embrace the Kaxinawá knowledge, worldviews, practices, and context; via participatory assessment and planning, and by funding benefits that can be shared by all Kaxinawás (i.e. activities, infra-structures, and capacity building) as part of the planning of resource management and governance with Kaxinawás	Traditional knowledge, spirituality, and ancestral wisdom	Culture and ILK services	Informational; educational; ethical	Humility to respect the Kaxinawá culture, including knowledge, worldviews, and practices

Table 11. Planning strategies based on the bridging of aspirations and classifications of Kaxinawás and SISA planners (KNOIL, Acre – Brazil).

Aspirations	ES (including NCP and PCN)	Planning strategy
Social-ecological resilience; Kaxinawá well-being, with a focus on food and other livelihoods security, and on territorial sovereignty	Forests; water; soil; climate regulation; habitat, with a focus on the provision of food and other livelihoods, land use, and on resource management and governance	Optimize the sustainability and productivity of the shifting cultivation to increase the food productivity in fallows by: reducing deforestation in pristine forest areas to enhance in combination the intertwined forest, soil, water, and climate services; using cropping areas as more robust agroforestry systems to continuously provide litter and nutrients for soils (i.e. intensifying the use of legumes which fixate nutrients in the soils and benefit other cropping species with soil fertility); and allocating precisely cropping species in soil and landscape units that better attend their nutritional demands; Reduce the pressure of fishing on NCP, by increasing the hunting activity in different areas of KNOIL over the year to mitigate their impact; and by installing fish farming ponds Rely on the SISA provision of shared benefits by providing seeds for the installation of a seed banking for agroforestry systems – the installation of ponds will be considered as possibility in the future as it is hard to transport machinery to by boat KNOIL and it is surrounded by the river
Biophysical and cultural diversity with a focus on the Kaxinawá culture and economy (including subsistence and complementary trade practices)	Social-ecological heritage, cultural identity, territory; folklore; cultural and natural patrimony Handicraft and agricultural self-consumption and trade; economy (subsistence and trade)	Rescue and conserve the Kaxinawá cultural knowledge, practices, and values, to prevent migration and maintain the social-ecological legacy Rely on the SISA provision of shared benefits via the funding of expeditions for knowledge interexchange with other Kaxinawás on painting, handicrafts, and resource management practices Quantify the income obtained with the trade of agricultural surplus and handicraft, and the agricultural goods needed to supply the Kaxinawá self-consumption; expand the production of handicraft for a better economic organization towards well-being and sustainability – with support of EMBRAPA (via the continuation of projects with the Kaxinawás) and of the resorted Acrean (non)governmental entities
Bridge and co-produce knowledge via SISA knowledge agents and via partnership with (non)governmental entities of Acre in tune with the cultural legacy	Knowledge; spirituality; ancestral wisdom; political ecology of a governance in stewardship with nature	Apply the knowledge on soils and ecosystems co-produced by planners and Kaxinawás to adapt the Kaxinawá resource management and governance in KNOIL – with the support of Indigenous agroforestry knowledge agents capacitated as SISA officials along the implementation of the policy as well as of the cacique and shaman local leaderships Rely on the SISA provision of shared benefits via the funding of Indigenous agroforestry knowledge agents as disseminators of knowledge and practices agreed during the SISA planning Resort to diverse Acrean (non)governmental institutions –specially the Commission Pro-Indigenous peoples of Acre (CPA-Acre, acronym in Portuguese), and the Secretary of Familiar Production (SEAPROF, acronym in Portuguese) – to quantify the income obtained with the trading of agricultural surplus and handicraft; potentiate the handicraft trading; and raise awareness of young Kaxinawás on cultural values and maintenance of the *Huni Kuin* language via dialogues with the KNOIL community and formal lectures in schooling spaces

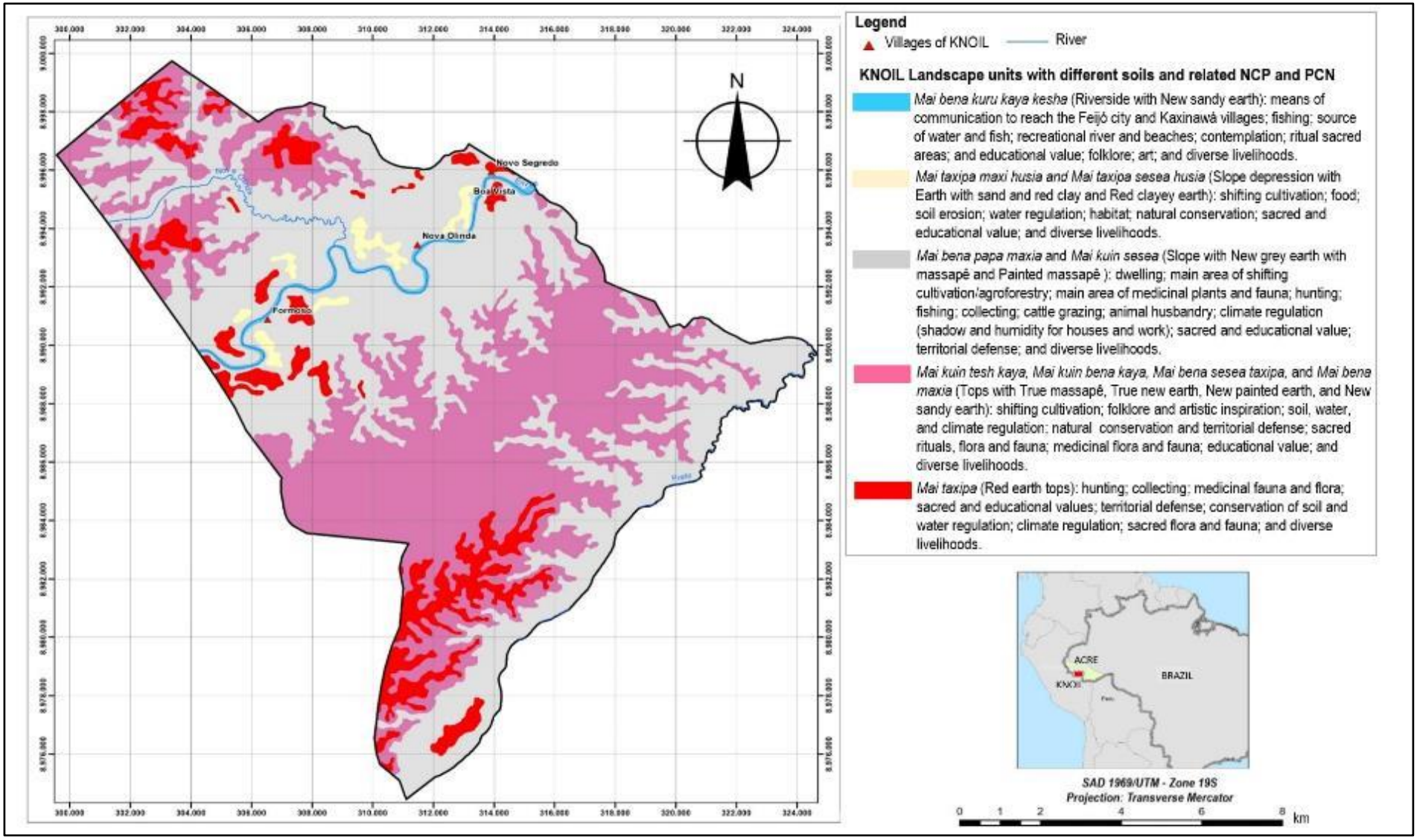

Figure 6. Distribution of the main NCP and PCN categories that occur in each landscape unit and respective soil type of KNOIL (in *Huni Kuin* and translated to Portuguese), presented in accordance with the Kaxinawás knowledge.

The SISA implementation processes showed strong efforts to include both scientific and local knowledge and worldviews in the outcomes of the assessment and planning processes that account for NCP and PCN in a relational way. However, there were also challenges. While both Kaxinawás and planners, including those with a background in soil sciences and in social sciences, participated in decisions on what knowledge should be prioritized during the assessment and planning; only the planners with a background in soil sciences participated in the elaboration and validation of the graphical outcomes presented in the SISA reports. This happened because most of the EMBRAPA planners had a background in soil science and preferred to weave correspondences and complementarities between their and the Kaxinawá knowledge and worldviews to compose the SISA outcomes on their own. Planners explained that they decided not to include the Kaxinawás in this part of the process because they considered that scientific classifications involve complexities and particularities that are not relevant and that do not need be taught to the Kaxinawás, who rely on their oral and contextualized knowledge to manage resources. Moreover, the inclusion of the planners with a background on social science in the creation of SISA outcomes was considered unnecessary and challenging, as these outcomes were mainly produced to be shared with practitioners of EMBRAPA who are mostly not acquainted with the terms and methods of social sciences. These challenges resulted in a reduced representation of the content of the Kaxinawá knowledge and worldviews. This reduction becomes clear when we compare Table 9 (which includes our assessment of the Kaxinawá discourses on those contents) with the outcomes of SISA (Tables 10 and 11, and Figure 6). Nevertheless, the contents included in the SISA outcomes do account for interplays between NCP and PCN in a relational way.

Both Kaxinawás and planners considered the process to be legitimate, despite the challenges to include knowledge and worldviews associated with different knowledge systems and disciplines. There are a number of reasons for this assessment. First, the planners with a background in soil science based their work on previous processes of co-production which resulted in shared understandings of local aspirations, classifications, and values. Second, the Kaxinawás considered the outcomes to be in accordance with their decisions on what information was to be prioritized during the SISA assessment and planning. The Kaxinawás explained for instance that they had a dialogue with planners about the landscape unit *Mai bena kuru kaia kesha* (Figure 6), to think of several NCP and PCN under influence of the river Envira (i.e. 'means of transport' and 'fishing') during planning. The Kaxinawás did make the reservation that they wish they had had access to the outcomes reported by planners and more awareness of the greater picture of the inclusion of their knowledge in these outcomes, so that they could for instance use these outcomes.

In addition to the above, we also identified challenges in the knowledge co-production processes that nonetheless do not appear to have led to the exclusion of diverse knowledges and worldviews. First, the planners explained that no emphasis was given to the ES discourse when interacting with the Kaxinawás, as SISA was implemented by departing from the Kaxinawá knowledge and cosmovisions on people and ecosystems which resembled more the NCP concept. However, the planners did recognize that the focus of ES on ecological processes incorporated in the SISA discourse helped them to assess NCP with the Kaxinawás with an orientation to think of planning practices to address both SISA and Kaxinawá aspirations. Second, planners stressed that it was difficult for the Kaxinawás to clearly express socio-cultural values and regulation services. Rather, values were found to be tacit and deeply rooted in identity, and regulation services involved causalities and explanations that are not

directly assessable. Data on these values and services was then made via inquiries about reasons and criteria (it means, indicators) that drive locals to adopt and adapt practices. Moreover, planners stressed their concern with avoiding relabeling Kaxinawá values. An example was that while the Kaxinawás do not use the term 'Mother Earth' to refer to their animist values, these are implicit in their discourse and were treated as 'the Kaxinawá belonging to and having respect for nature'.

Finally, the interconnection of the Kaxinawá and SISA discourses involved a co-production of new knowledge and worldviews to plan resource management. The planners and Kaxinawás stressed that, in some cases, planning was easily constructed by linking an aspiration with a planning strategy – e.g. 'to resort to (non)governmental entities to access policies' (Table 11) 'to find support of scientific knowledge and policy funds' (Table 10). In other cases, planning required additional knowledge and transformation of worldviews to adapt practices. For instance, the planners suggested to Kaxinawás that addressing food/livelihood security and nature conservation would require adapting their shifting cultivation practices. The Kaxinawás' shifting cultivation relies on the use of fire to clear pristine forests, and on a manual clearing of fallows (secondary forests) previously cleared. While pristine forests maintain the soil fertility to produce food for 4 years, fallows maintain it usually for 2 years. The Kaxinawás had noticed that the continued deforestation of pristine forests impacts more NCP (i.e. habitat and presence of species for hunting) in comparison with the re-use of fallows. However, only with the support of the planners the Kaxinawás decided to give preference to fallows instead of pristine forests and to turn fallows into more productive agroforestry systems. This and other strategies (Table 11) have been effectively adopted in KNOIL and are considered by planners and locals to be enhancing nature conservation and both biophysical and cultural diversity. There was also a case in which different aspirations of the Kaxinawás compromised the inclusion of diverse worldviews in planning and consequently the adoption of change in the local resource management. When planning the management of hunting to mitigate its impacts on biodiversity, planners suggested to redistribute hunting in different areas of KNOIL (Table 11). Different community members disagreed on possible hunting areas to be adopted when these were distant from their houses. This example illustrates that despite transparent negotiation to respect diverse worldviews, the inclusion of such diversity can be constrained by trade-offs and different aspirations of participants in decisions.

4.5 Discussion

Our case study offers an example of how policymakers and planners aligned global discourses of ES and NCP with those of the Kaxinawá Indigenous community in the context of the implementation of the SISA policy. Particularly important was the way in which these practitioners were able to recognize and incorporate Indigenous knowledge and worldviews which are based on a relational understanding of NCP and PCN. This approach was mediated by a joint negotiation of aspirations and values and a co-production of shared understandings that supported planners and Kaxinawás to consider the SISA outcomes as legitimate (cf. Irvine et al., 2016; Turnhout et al., 2016). For these reasons, we understand that the SISA assessment and planning processes showed signs of overcoming dichotomist thinking between science and local knowledge and between social and natural disciplines, which resulted in legitimate outcomes (Tengö et al., 2017). This was possible because practitioners adopted an intercultural approach that was sufficiently flexible and open to link correspondences and complementarities between the knowledge and worldviews of the Kaxinawás and of the planners and to respect different classification systems (Kincheloe, 2008; de Albuquerque et al., 2014). This

flexibility enabled planners to pay attention to the meanings and structure of interrelation among categories of aspirations, classification systems, and values as elicited by the Kaxinawás.

Analyzing the resonances and contrasts between discourses, we found that the ES and NCP discourses resonated with the SISA and Kaxinawá discourses because they both address human well-being and biodiversity simultaneously and give space for PCN, which affect the nature's benefits for Kaxinawás. We also found differences. The ES discourse ended up being more dominant in the SISA implementation during the prioritization and assessment of ecological process and functions to be targeted in planning. However, the ES discourse did not resonate with the SISA and Kaxinawá discourses when it emphasized universal types of economic values or material benefits in detriment of socio-cultural, ecological, and economic values that are relevant for the Kaxinawás. In that sense, the discourses of SISA and Kaxinawás resonated more strongly with the NCP discourse which recognizes the multiple values and benefits of nature and their context-dependency. Moreover, the ES and NCP discourses list categories and values that have mainly an ecological or a cultural content separately instead of linking and listing them side-by-side as Kaxinawás and SISA practitioners did. The ES and NCP discourses are not directly aimed at management and planning and therefore do not link these categories and values to aspirations and practices as strongly as SISA did (cf. Chan et al., 2016; Kenter, 2018; Matuk et al., 2019).

We stress that the SISA discourse moved closer to the Kaxinawá discourse by explicitly recognizing the relationality between people and ecosystems, and by acknowledging that people not only benefit from but also contribute to nature and biodiversity. SISA did so by including not just NCP but also PCN and the linkages between these. This entailed envisioning that culture comprises non-material and material contributions that people provide to nature respectively via their knowledge, values, aspirations, and their practices. This matched the Kaxinawá discourse on how they account for both their cultural values and ecosystems to manage the provision and regulation of NCP.

We found that in participatory processes for environmental assessment and planning, the challenges to overcome knowledge dichotomies between knowledge systems and disciplines and to include diverse and relational knowledge are mostly related to sharing of power. The way in which soil science planners justified the exclusion of Kaxinawás and of social science planners from part of the process by claiming that this did not concern or was not relevant to them, indicates that existing power inequalities and perceptions of differences between knowledge systems remained present. This resulted in a reduction of the diversity of knowledges and worldviews in the outcomes which could have been prevented if power had been shared more equally along the process among planners and with the Kaxinawás (cf. Agrawal, 1995; Nadasdy, 2003). We also saw that power was imposed by planners when they did not consult locals about their interest in using the SISA 'graphical' outcomes. Finally, we observe that while SISA outcomes were overall considered legitimate by the Kaxinawás, because they reflected discussions on local priorities and needs, a stronger voice of locals to shape processes could have resulted in a more comprehensive representation of diverse knowledges and worldviews, as well as in an enhanced legitimacy, validity, and relevance of policy outcomes.

4.6 Conclusion

This paper has shown that incongruences and resonances between global to local discourses related to different knowledge systems, disciplines, and worldviews affect how diverse and relational knowledge and worldviews are included in policy processes and outcomes of environmental assessment

and planning. We also showed that despite differences between discourses, their encounter during participatory processes can enable inclusive and legitimate outcomes. Each discourse contributed to these outcomes in different ways. While the ES discourse contributed to the inclusion of ecological processes in the planning of resource management, the NCP discourse stressed the role of both culture, ILK, and of different values on ecosystems and biodiversity. Accordingly, a cross-fertilization between the ES and NCP discourses facilitated the inclusion of ILK and cosmovisions in their diversity and holism. On the other hand, both NCP and ES assessment frameworks still insufficiently account for PCN. To include PCN during the assessment was however crucial to include the interplays between people and nature while adapting resource management practices towards biodiversity and human well-being.

The first lesson we draw from our analysis is that science-policy interface processes taking place at different levels and scales, including ES and IPBES scholarship and practices, can advance the legitimacy of environmental assessments, and the effectiveness of policy and planning that is informed by these assessments. They can do so by recognizing the interrelations between nature and people and by assessing how material NCP are entwined with PCN via both the non-material (knowledge and values) and material (practices) dimensions of people's culture. The second lesson we draw is that the effectiveness of assessments can be enhanced if they are more directly connected with planning and management practices and if they connect classification categories and values associated with ES and NCP frameworks to concrete local (and extra-local) needs, priorities, aspirations, and existing practices. Both these lessons can be supported by science-policy interfaces explicitly accounting for and incorporating diverse knowledge systems, disciplines, worldviews, and practices comprised in environmental assessment and planning contexts.

Our final conclusion concerns participatory processes. We have seen in our case that the intercultural approach employed provided the openness, engagement, and trust that are necessary for a reciprocal, interdisciplinary, and participatory collaboration, and for the co-production of legitimate policy outcomes. Assessment processes can benefit from investing into participatory processes to enhance the appropriate inclusion of ILK in ways that respect its holistic as well as contextual character. Flexibility is an important attribute of these processes. This flexibility depends on the degree to which planners with different disciplinary backgrounds are able to share power among themselves and with IPLC. Our study suggests thus that the legitimacy and effectiveness of environmental assessment and planning can be improved when actors on the science-policy interface facilitate participation and engagement that gives voice to participants who hold different knowledge systems and disciplines, that focuses on common objectives, aspirations, and priorities which account for both people and ecosystems' roles, and that connects assessment to planning and practice.

CHAPTER 5

ALLYING KNOWLEDGE INTEGRATION AND CO-PRODUCTION FOR KNOWLEDGE LEGITIMACY AND USABILITY: THE AMAZONIAN SISA POLICY AND THE KAXINAWÁ INDIGENOUS PEOPLE CASE

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Abstract

Environmental policies that aim to enhance nature conservation, biodiversity, and well-being of IPLC rely on knowledge integration and co-production processes that include both science and ILK systems. While these processes are expected to safeguard the diversity of knowledge systems, uneven power relations among participants often prevent them from achieving this, which can affect the legitimacy and usability of the outcomes of these processes. Using a case study in the Acre state (Brazil), where policy practitioners implemented the SISA (REDD +) policy in KNOIL, we investigate how participants manage challenges to safeguard knowledge diversity and usability during policy assessment and planning. Our findings show how, despite the use of participatory approaches, the inclusion of knowledge diversity ended up being compromised because policy practitioners were insufficiently attentive to power asymmetries and their implications. This, however, did not compromise the usability of the knowledge outcomes produced. Rather than focusing on the perfection of participatory methods, we call for a practical ethics that relies on culturally and ethically sensitive dialogues and that includes continuous reflection. Such reflection will enable planners and locals to exercise adaptation and improvisation to be able to respond adequately and timely to emerging power dynamics, thereby ensuring both the legitimacy and usability of the outcomes of knowledge integration and co-production.

5.1 Introduction

Global environmental policies and instruments such as IPBES and the Convention on Biological Diversity (CBD) emphasize the important contribution of IPLC to enhance global environmental conservation, biodiversity, and human well-being (Tengö et al., 2017). IPLC support up to 80 % of the planet's biodiversity (FAO, 2017) and the sustainable management of natural resources in their territories is of the utmost significance (CBD, 2016). Therefore, policies are needed to support IPLC in maintaining their ILK and contributions to biodiversity. In this context, scholars have argued for the importance of co-production of knowledge that includes policy practitioners with which we mean those involved in policy making, planning and implementation and IPLC and that aims at the integration of ILK and scientific knowledge in the assessment of resource management (Tengö et al., 2017). Scholars have also argued for the importance of ACM, which allows for participation, reflection, and learning to enable the adaptation of management practices in response to changes in local SES (Berkes, 2009). A core concern recognized in literature on knowledge integration and ACM is that participatory processes and outcomes must ensure the diversity and integrity of knowledge systems of different groups of participants, so that knowledge legitimacy and usability are safeguarded (Cash et al., 2003; Dilling and Lemos, 2011).

Knowledge legitimacy is achieved when all participants (policy practitioners as well as IPLC) consider the outcomes of knowledge integration and co-production to be valid according to the diverse meanings and contents of their knowledge systems (Tengö et al., 2017). This means that this diversity is respected and remains recognizable. As this diversity is also linked to practices, contexts, and needs of knowledge holders, legitimacy also implies usability (Lemos et al., 2018). Policy practitioners have faced challenges to safeguard knowledge diversity and usability when integrating and co-producing knowledge with IPLC (Turnhout et al., 2020). Different knowledge systems use different methods and styles of reasoning and the boundaries between them can be difficult to be overcome. Nonetheless, shared objects, concepts, areas, or problems can serve as boundary objects and points of encounter for the integration of knowledge systems (Carlile, 2002). While integration is the departing point to interrelate different knowledges, so that knowledge can be co-produced (Pohl et al., 2010), the diversity these systems comprise can be jeopardized, if uneven power relations among participants result in the prioritization of certain forms of knowledge over others (Turnhout et al., 2019). In integration and co-production processes this is a regular occurrence since scientific knowledge is still often conceived as superior to ILK (Latulipe and Klenk, 2020). When these processes are guided by this conception, there is the risk that ILK is either excluded or stripped from its meanings and translated into scientific terms to fit dominant policy frameworks. This form of 'extraction' of knowledge (Klenk et al., 2017, p.1) affects knowledge diversity and usability.

In this article, we investigate how participants in processes of knowledge integration and co-production manage challenges to safeguard knowledge diversity and usability during policy assessment and planning. We use an in-depth case study in the state of Acre (Brazil). In this case policy practitioners from EMBRAPA were tasked with the implementation of a the SISA policy. As part of this process, these policy practitioners collaborated with Indigenous people from KNOIL to integrate and co-produce knowledge about soils and landscape as part of the planning of ACM in that area. The SISA policy is part of the global REDD+ program and is committed to respecting the diversity of ILK and enhancing conservation and well-being (Sills et al., 2014). This study contributes to the burgeoning field of scholarship on co-production in three ways. First, while much of the literature focuses on

science-policy-society interactions in a Western context (Leith et al., 2014; Posner and Cvitanovic, 2019), this study focuses on interactions between Western science and ILK systems (e.g. Matuk et al., 2020). Second, we explicitly address the role of power and the challenges of co-production, thereby complementing existing literature that predominantly focuses on best practices and methods (Turnhout et al., 2020). Third, we offer an in- depth exploration of what happens when knowledge systems meet. In so doing, our analysis provides valuable insight into the practice of knowledge integration; on how integration can involve the bridging of knowledge systems, and on what methods and attitudes can support this. These contributions support the further development of innovative approaches, such as the multiple evidence-based approach (Tengö et al., 2017) and the ILK approach proposed by IPBES (Hill et al., 2020), which aim to avoid forms of integration that reduce diversity.

5.2 Knowledge integration and co-production

The drive to knowledge integration in the domains of environmental policy and nature conservation stems from the recognition that resource management happens within complex social-ecological systems; that assessing these systems is important to inform policy and planning; and that these assessments must be based on knowledge that is co-produced by actors who hold different knowledge systems (Tengö et al., 2017). Processes of knowledge integration and co-production have been studied in different fields, including science and technology studies (Jasanoff, 1998), social learning (Berkes, 2009), and Ethnoecology (Toledo and Barrera-Bassols, 2009). This literature highlights that a prevailing dichotomy between scientific and non-scientific forms of knowledge (i.e. ILK) has prevented these processes from resulting in legitimate and usable knowledge outcomes.

Although universally valid definitions of scientific knowledge that demarcate it from other forms of knowledge are mostly absent (Gieryn, 1983), scientific knowledge is still often seen as neutral, universal, and credible whereas ILK is depicted as value-laden and context-based. Criticisms of this dichotomy have argued that all forms of knowledge, including science, are shaped by values and worldviews and are embedded and produced in local contexts and practices (Raffles, 2002; Ludwig, 2016). This does not mean that there are no differences between different traditions and cultures of knowledge, but rather that these differences are not set in stone (Turnhout et al., 2019). From this perspective, no knowledge system is a priori superior to another. Yet, integration and co-production processes are often characterized by uneven power relations that prevent their participants from appropriately managing knowledge diversity together. This shapes these processes in ways that reproduce knowledge dichotomies and compromise the legitimacy and usability of their outcomes in local contexts. Such relations unfold from power asymmetries between (elite) government and science actors and (non-elite) IPLC actors, for example when policy practitioners depoliticize participatory processes, when they fail to adequately respond to power dynamics, or when they prioritize scientific knowledge that aligns with policy over ILK (Turnhout et al., 2020).

We suggest that integration and co-production processes have to meet two objectives to deliver legitimate outcomes, both of which require sensitivity to power relations among knowledge systems and holders. The first is to safeguard knowledge diversity (Tengö et al., 2017). Processes should facilitate IPLC to mobilize those contents and meanings of their knowledge that are relevant to include. This process of mobilization is a critical part of the process and it refers to the process "*to bring out and articulate knowledge into a form that can be shared with others*" (Tengö et al., 2017, p. 18). Subsequently, by means of processes of dialogue, synthetization, and translation, new knowledge can

be created, while conceptualizations and categorizations of both ILK and scientific knowledge are integrated (Bowker and Star, 2000). This ensures that this new knowledge is legitimate, relevant, and in accordance with knowledge holders' practices, worldviews, values, and needs. A central premise here is that knowledge is not just representational but an inextricable dimension of so-called k-p-w assemblages (Toledo and Barrera-Bassols, 2009; Matuk et al., 2019). When knowledge fails to account for the classification categories, criteria, or indicators that are used to express local values and relationships, it will not be legitimate and it will be unable to inform actual practices. This brings us to the second objective: to safeguard knowledge usability. Ensuring this usability requires care to elicit the different contexts in which knowledge will be applied and to ensure that knowledge meets the needs of policy practitioners and IPLC (Dilling and Lemos, 2011).

To achieve the objectives of knowledge diversity and usability, processes of knowledge integration and co-production must involve a levelling of power relations among participants (Tengö et al., 2017). This can be achieved via an 'intercultural approach' (Rist and Dahdouh- Guebas, 2006, p.473). This approach can be enacted by means of 'technologies of humility' (Jasanoff, 2003, p.376); methods and attitudes that help participants to recognize and reflect on power and knowledge differences. To exercise humility towards IPLC, scientists and policy practitioners need to interconnect with the cultures of IIPLC and make sense of their contexts and knowledge systems (Echeverri, 2005). Respect for knowledge differences can also be enacted via 'methodological bricolage' (Kincheloe, 2008, p.4). This notion suggests that, instead of merely using pre-designed methods or frameworks, policy practitioners improvise and adjust their approaches and methodologies. In so doing, policy practitioners are able to attend to the unfolding of participatory dynamics and facilitate mutual learning and articulation of knowledge differences. In this approach, knowledge integration is done by means of dialogue which helps participants to contrast knowledge systems and identify knowledge correspondences and complementarities side-by-side (de Albuquerque et al., 2014). This integration involves both the translation of different categorizations (without prioritizing the nomenclature and meanings of one knowledge system over the other) and the co-production of new categories that knowledge holders recognize as meaningful.

The central ethic is one of power sharing among participants which enables them to "reason together" (Jasanoff, 1998, p.173) and create common meanings. To do so, policy practitioners need to listen to locals, be aware of uneven power relations that take place in knowledge processes, and transparently negotiate knowledge. Finally, the co-validation of knowledge outcomes (e.g. bridged classifications) is vital to enable the correction of misunderstandings and ensure that outcomes reflect the different categories and indicators that formed the basis of the integration and co-production (Bowker and Star, 2000). Such ethical sensitivity is also important to achieve the objective of knowledge usability (Rist and Dahdouh-Guebas, 2006; Klenk et al., 2017). This ethical sensitivity requires not only an understanding of the relevance of the diversity of the knowledge systems but also of the risks of extractive modes of knowledge integration (Hill et al., 2020). This understanding can be facilitated by creating space for the 'reflexive questioning' by all participants of possible hidden assumptions, emerging dynamics or nontransparent decisions and courses of actions (Klenk et al., 2017, p.6).

In this section, we have presented a number of guidelines which combine attitudes (humility and ethical sensitivity) and methods (methodological bricolage, reasoning together and reflexive

questioning) that help to create the conditions that foster the development of these attitudes and ensure legitimate outcomes. We will use these to analyze and reflect on our case study and particularly on the ways in which the policy practitioners from EMBRAPA and the Kaxinawás navigated the challenges of knowledge integrations and attempted to produce legitimate and usable knowledge outcomes.

5.3 Material and methods

KNOIL is located in Feijó (Acre state - Brazil). It covers 27,000 ha and comprises 492 Kaxinawás who speak Portuguese and *Hãtxa Kuin*, and who obtain subsistence mainly from local livelihoods via traditional practices such as hunting, agriculture, gathering, and fishing. KNOIL is a priority Amazon area of biodiversity where policy practitioners from EMBRAPA have been involved in the implementation of the SISA policy since 2011. This policy has been applied in KNOIL as a pilot project and is dedicated to respecting ILK and the needs of IPLC. It follows from a longer history of Acrean environmental policies that have addressed IPLC since the 1990s (Sills et al., 2014). This study reports on the implementation of SISA with Kaxinawás.

Free and prior informed consent was obtained from Kaxinawás in accordance with the Brazilian regulation on Genetic Heritage and ILK (Law nº.13,123; 2015). This entailed a signed approval of Kaxinawás for this research. The first three authors and the fifth author collaborated with the EMBRAPA co-authors in analyzing the data to evaluate the legitimacy and usability of knowledge outcomes of SISA. Data was collected via an ethnoecological approach of action-research that links social and natural sciences and includes locals in the data collection an validation (de Albuquerque et al., 2014). Data was collected in KNOIL and in Rio Branco (city of the SISA headquarters), and included:

- Participant observation while living in KNOIL for a month. During this time, the first author engaged with the Kaxinawá's daily resource management and governance practices and with the practices of the policy practitioners as part of their work with the Kaxinawás;
- Interviews with 40 Kaxinawás of varied ages and genders, and with 20 SISA policy practitioners;
- Multiple workshops with an average of 35 Kaxinawás present. Workshops included: i) circles of culture (Freire, 2000) where locals had rounds of dialogues to report and evaluate policy processes; and ii) participatory mapping made via dialogues and transects in KNOIL with the Kaxinawás (i.e. types of soil classes; landscape units that present common characteristics, and land uses) (de Albuquerque et al., 2014).

The interviews and workshops were organized to track and analyze the knowledge processes and methods that the policy practitioners used to integrate and co-produce knowledge with the Kaxinawás, and to find out how decisions were made about the selection of knowledge that would inform planning; by whom; and on the basis of what criteria. Interviews were semi-structured, allowing respondents to freely and openly share their views on the processes and their outcomes. They were taped and transcribed. The interviews were made while visiting the houses of Indigenous families and their different areas of resource management. This data supported the facilitation of the dialogues during the workshops. During these workshops, data from observations and interviews was deepened and cross-checked with the group of participants – for example to gain insight into impasses that occurred during the processes of knowledge integration and co-production.

We undertook qualitative coding of data transcribed from interviews and workshops, and of SISA reports (i.e. do Amaral, 2015) to identify the extent to which our guidelines (Section 5.2) could be identified in the case study. We used the method of thematic coding (Nowell et al., 2017) in two rounds. First, we analyzed transcripts, workshop notes, and reports for the general occurrence of references to knowledge diversity and usability. For example, when a interviewee made a statement about land use, we checked if we could identify any knowledge dimensions in that statement. In a second round, we used thematic coding to more specifically identify the reference to or the practicing of the guidelines we discuss in Section 5.2. Finally, we analyzed whether the policy practitioners and Kaxinawás were able to navigate challenges of power asymmetries – as far as these were present in the experience of these actors – to manage knowledge differences and to co-produce outcomes recognizable as legitimate and usable by both of them.

5.4 Results

The knowledge processes involving the implementation of the SISA policy in KNOIL consisted of two main steps: assessment and ACM planning. Below, we present our findings for each of the steps.

5.4.1 Assessment

The assessment started with policy practitioners and Kaxinawás getting acquainted with each other. The policy practitioners invited the Kaxinawás to participate in the selection of informants and sampling areas, to build trust, and to show respect for their authority. The policy practitioners used an intercultural approach to interact with Kaxinawás, by expressing an interest in knowing the Kaxinawá culture and by participating in community activities. The quotes below attest this approach:

> "*We know that our work involves a complex intercultural interference. This is why we were concerned with constructing an open dialogue with Kaxinawás, to understand the most diverse criteria and meanings of their resource management* […]" (Policy practitioner, Interview 2).

> "*The policy practitioners spent time with us… They wanted to understand our knowledge, the way we live, why we use our lands as we do, and what we think we need to improve in our practices to achieve our needs* […]" (Kaxinawá, Interview 23).

The phases that comprised the assessment are presented below.

i) Knowledge mobilization

As a first step, the policy practitioners used dialogue methods, including circles of culture to facilitate the mobilization of the Kaxinawá knowledge pertaining to the characterization of the KNOIL social-ecological context of resource management and governance. The dialogues focused on identifying the Kaxinawá land uses and on understanding how management practices had been adapted in response to landscape and territorial changes. Via this data, the policy practitioners became Amazon since ancient times; from colonizers who enslaved the Kaxinawás for "rubber tapping" in the 19th century; and from other IPLC and (non) governmental institutions with whom contact has increased in the last three decades. It also become clear that the Kaxinawá's form of agriculture, although often called 'slash-and-burn' or shifting cultivation, is actually closer to agroforestry; that it focuses on subsistence; and that it has mostly conserved ecosystems. Moreover, the Kaxinawás highlighted the

central role of their worldviews for their resource management and governance. These worldviews stressed the importance of community and democracy, and included animist values that show a spiritual connection with nature's biophysical entities (cf. Matuk et al., 2020). For instance, nature is valued as providing food and medicine, but also as a source of knowledge and spirituality. Such values have guided a stewardship with nature that is based on reciprocity, via which the Kaxinawás aim to supply the needs of both Kaxinawás and nature's (non)living entities.

The characterization of the KNOIL context was followed by a joint identification of priority needs of the Kaxinawás to be aligned with the SISA goals. The policy practitioners identified that the Kaxinawás sought mainly to enhance food security and livelihood sovereignty while also enhancing the sustainability of resource management in alignment with their k-p-w. These needs were aligned with the SISA goal to enhance ecosystem services and maintain the rain forest cover at 88 % of the territory of Acre by enhancing bio-cultural diversity. One policy practitioner explains:

> "*We aligned Kaxinawá and SISA needs by considering that Kaxinawás, as other IPLC, have conserved forests with their culture and knowledge. So, by helping them to strengthen sustainable access for their livelihoods, we enable them to keep contributing to biodiversity* […] (Policy practitioner, Interview 17).

After familiarizing themselves with the Kaxinawá context, the policy practitioners used participatory mapping to allow the Kaxinawás to mobilize their knowledge and identify specific landscape and soil classifications that are relevant to plan resource management in KNOIL. The Kaxinawás shared their tacit, explicit, oral, and heterogeneous knowledge which ended up in a shared classification. This classification consisted of five landscape units (Table 12, Figure 7) which the Kaxinawás distinguished according to topography; vegetation; and humidity. Subsequently, Kaxinawás indicated nine criteria that they use to distinguish the ten soil classes that receive different land uses in KNOIL. These criteria included: landscape topography; vegetation; humidity; clay type; color; presence of "clay cracks" (expansible clay); presence of plant roots; stoniness; and "massapê" – clayey soils with a compromised drainage and with gleyic, plinthic or vertic properties (IUSS Working Group WRB, 2015). The Kaxinawás referred to soils using different names that include these criteria. These names reflect different levels of importance of these criteria for different Kaxinawás. To synthesize these criteria, the policy practitioners asked Kaxinawás to rank them in order of importance. Out of the nine criteria, the Kaxinawás selected the four most important ones that they considered sufficient to identify soils. Landscape classes were included together with other soil classification criteria Kaxinawás use to distinguish soils (Table 12).

Subsequently, the policy practitioners mobilized their own knowledge, by classifying the soils and landscapes of KNOIL. Using the system of Tricart and Kiewitdejonge (1992), the policy practitioners identified 5 landscape units which were subsequently integrated, or, as Tengö et al. (2017) put it, weaved together, with the five landscape units that the Kaxinawás had identified (Figure 7). These units were represented together with soils, as they occur in association with 5 (major) reference soil classes, each of which can comprise several other specific soil classes according to Brazilian and international classifications (EMBRAPA, 2013; IUSS Working Group WRB, 2015). In the case of KNOIL, the policy practitioners found that these 5 major classes included 47 specific soil classes (Figure 8). To classify these soils, the policy practitioners collected, described, analyzed, and classified soils using more than 100 criteria derived from these Brazilian and international classification systems.

Kaxinawás contributed to this process by indicating what variations in soil properties are relevant to manage resources in KNOIL.

Table 12. Kaxinawá categories and criteria of soil classification.

Criteria	**Name**	**Categories**	**Name**
Massapê	Massapê (*Kaya*)	Present	*Mae kuxipa tesh*
		Absent	*Mae kuxipa te make*
Texture	Clay type (*Mae husi husipa*)	Clay	*Mae tesh*
		Clay mixed with sand	*Mae maxi husia*
		Sand	*Mae txasha kapa*
Color	Color (*Ushna*)	Reddish	*Huxi*
		White	*Hushupa*
		Purple	*Aku*
		Red	*Taxipa*
		Black	*Mexupa*
		Yellow	*Paxinipa*
		Grey	*Akunepa*
Landscape unit	Land shape (*Mae betsa pabu*)	Riverside lands	*Matxi kaya pashku kesha*
		Low lands	*Mae papa*
		Middle lands	*Mae txeima*
		Firm lands of valleys and of tops	*Mae matxi manâ*
		Watershed divide	*Matxi pashku kesha txeima*

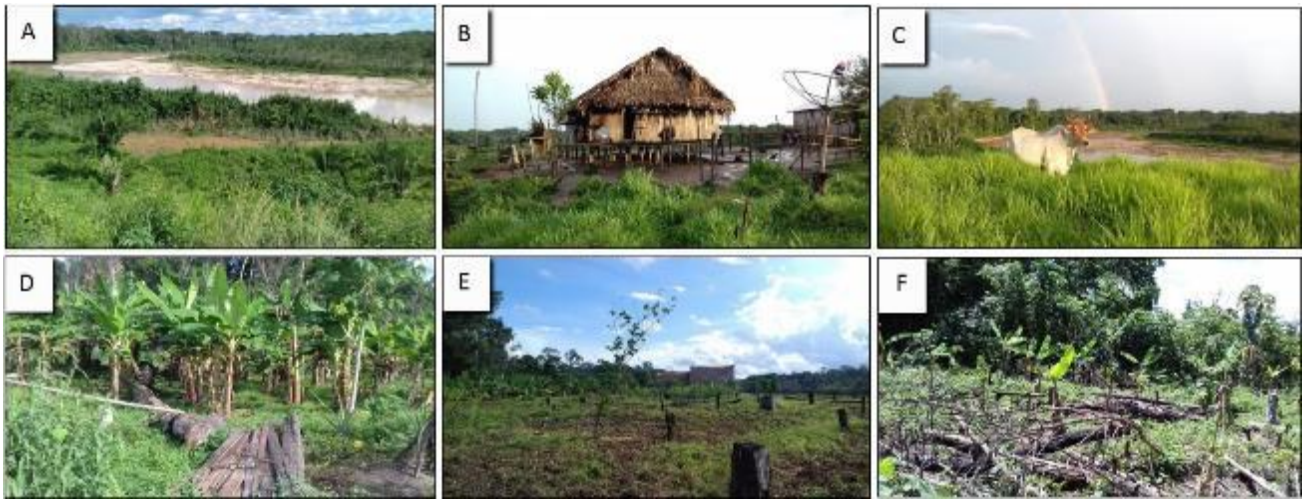

Figure 7. Landscape units and land uses of KNOIL. A) Conservation area in riverside floodplain; B) Dwelling in slope; C) Cattle in firm land of valley; D) Wetland of depressions with shifting cultivation; E) Cleared area in firm land of tops; F) Riverbed flat tops with shifting cultivation.

Although the Kaxinawás and the policy practitioners each mobilized knowledge in distinct processes, these processes also involved co-production:

> "*We exchanged knowledge with Kaxinawás during all activities we did to identify their land uses, soils, and landscapes. We were not there to teach, but to share and learn*" (Policy practitioner, Interview 7).

> "*When we accompanied policy practitioners to identify soils, we were like teachers and students. We told them knowledge we naturally have about the lands, and we also learned aspects of soils that they consider important*" (Kaxinawá, Interview 1).

In the end, the knowledge that was mobilized consisted of policy practitioners' and Kaxinawás' distinct classifications (Table 12, Figure 7) which formed the basis for the process of integration.

ii) Knowledge integration and co-production

When it came to knowledge integration, the policy practitioners and Kaxinawás relied on processes of synthetization and translation. The policy practitioners asked the Kaxinawás to indicate names of landscape and soil categories that they identified previously. All Kaxinawás referred to landscape units using the same names, so these were maintained. However, this was not possible in the case of soils. As we mentioned before, the Kaxinawás used different names to refer to the 10 soil classes that they identified in KNOIL. This posed a challenge to integrate the Kaxinawá knowledge diversity because the policy practitioners wanted the Kaxinawás to settle on a single name for each class, to establish fixed soil names that would allow for a clear communication during the planning process. In response to this challenge, the policy practitioners invited the Kaxinawás to come up with names they could agree on, as this policy practitioner reflects:

> "*After we assessed how the Kaxinawás distinguish soils, we asked them to search for a name that could express each class* […] *It took time for them to define and agree on names because they use different names to call soils*" (Policy practitioner, Interview 34).

Subsequently, the policy practitioners integrated the scientific and Kaxinawá knowledge by bridging and weaving correspondences and complementarities between the 47 specific classes they had identified to the 10 soil classes that the Kaxinawás had identified. Since those 47 classes accounted for slight variations in soil properties that are irrelevant to plan land use in KNOIL, the policy practitioners grouped them in 10 classes – that have similar physical, chemical, and morphological properties – and weaved them together with the 10 soil classes Kaxinawás use for planning land use. This process resulted in an identification key that includes both scientific and Kaxinawá names and criteria for soil classification and associated land uses (Table 13). While Kaxinawás contributed indirectly to this weaving of knowledge, the policy practitioners did not include Kaxinawás directly. The policy practitioners' reasoning for this was that it is not SISA's intention to teach IPLC about scientific classifications but to create a common basis of knowledge that builds on ILK. Yet, this exclusion meant that the Kaxinawás did not validate this identification key.

Table 13. Integrated Kaxinawá and scientific soil classifications and related land use types.

Soil names	**Classification criteria**				**Land use types**
	Landscape classes	*Massapê*	*Texture*	*Color*	
Mai taxipa maxi sesea husia **(**Red clayey earth) - Plinthic Acrisol	*Mae txeima* (Middle lands)/ Slope	Present	Sand mixed with clay/ Medium	Red and white, red dots/ Dark reddish grey, red mottling (plithite)	Cattle grazing
Mai taxipa maxi husia (Red sandy and clayey earth - Haplic Acrisol	*Mae Txeima* (Middle lands)/ Slope	Absent	Sand mixed with clay/ Medium	Reddish/ Brown to strong brown	Shifting cultivation/agroforestry gathering, hunting
Mai bena kuru kaya kesha (Riverside new sandy earth) - Fluvic Regosol	*Mae papa* (Lowlands)/ Wetlands of depressions	Absent	Sandy/ Sandy	White/ Light grey	Annual crops (peanut, watermelon, cassava, beans jerimun)
Mai taxipa (Red earth) - Haplic Luvisol	*Mae txeima* (Middle lands)/ Slope	Absent	Sand mixed with clay/ Medium	Red/ Dark reddish brown	Shifting cultivation/agroforestry, gathering, hunting
Mai kuin sesea (Painted massapê) - Eutric Plinthosol	*Mae papa* (Lowlands)/ Wetlands of depressions	Present	Sand mixed with clay/ Medium	White/ Light grey, red mottling	Shifting cultivation (cassava, maize, banana, yam, taioba), agroforestry (i.e. coffee, fruits), conservation
Mai bena papa maxiá (New grey earth with massapê) - Eutric Gleysol	*Matxi kaya pashku kesha* (Lowlands)/ Riverside floodplain (including igarapés[1])	Present	Clayey/ Clayey	Grey/ Greyish	Soil extraction for ceramics, conservation
Mai kuin tesh kaya (True massapê) - Haplic Vertisol	*Matxi pashku kesha* txeima (Watershed divide)/ Riverbed flat tops	Present	Clayey/ Clayey	Purple/ Very dark grey to brown	Shifting cultivation and conservation, gathering, hunting
Mai kuin bena kaya (True new earth) - Sandy Cambisol	*Mae matxi manâ* (Firm lands)/ Firm lands of valleys or of tops	Present or absent	Sand mixed with clay/ Medium	Red/ Reddish brown to brown	Cattle grazing
Mai bena sesea taxipa (New painted earth) - Plinthic Cambisol	*Mae matxi manâ* (Firm lands)/ Firm lands of valleys or of tops	Present	Clayey/ Clayey	Grey painted with red dots/ Light grey, red mottling (plinthite)	Shifting cultivation/agroforestry, banana
Mai bena maxia (New sandy earth) - Haplic Cambisol	*Mae matxi manâ* (Firm lands)/ Firm lands of valleys or of tops	Absent	Sandy/ Sandy	Grey/ Light grey	Shifting cultivation/agroforestry, gathering, hunting

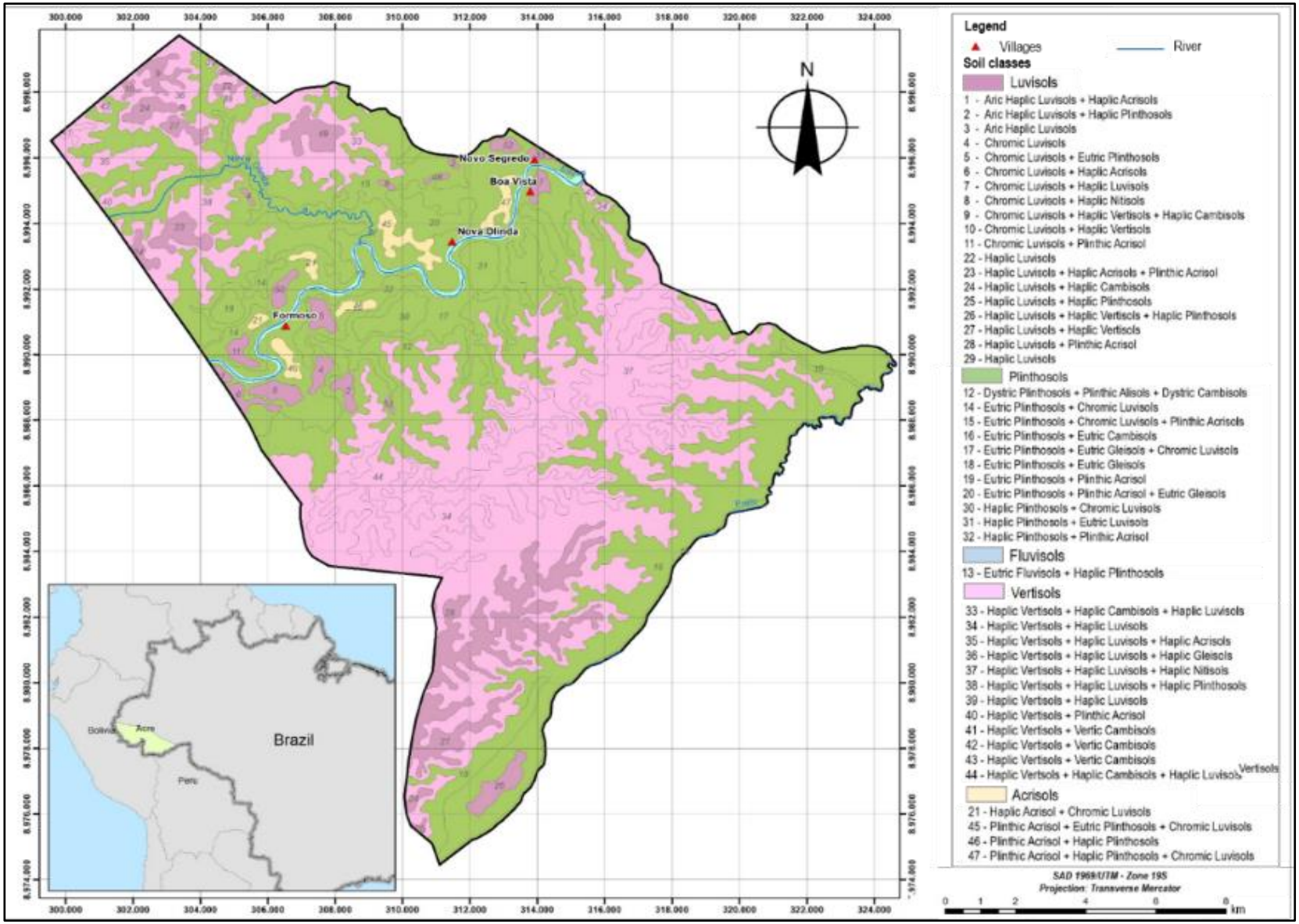

Figure 8. SISA policy practitioners' scientific classification of the soils in KNOIL - Acre, Brazil.

Another challenge emerged when the policy practitioners needed to accommodate the 10 combined scientific and Kaxinawá soil classes to represent them on a map with the scale of 1:100,000 which the resolution of available georeferenced data allowed. To do so, the soil classes with the scientific names Gleysols and Cambisols, which occur in narrow bands in KNOIL, had to be grouped with soil classes they occur close to. This is why these soil classes are presented in the map (Figure 9) in association with and not separate from the other soil classes. The 10 soil-specific categories presented in Table 13 are aggregated in 5 groups of categories in this map. The map thus represents two corresponding sets with 5 soil categories each. The association of soil classes is common in pedology (EMBRAPA, 2013) and it was not a problem for the Kaxinawás, once they were aware that the policy practitioners would consider the differences of these soils to plan ACM.

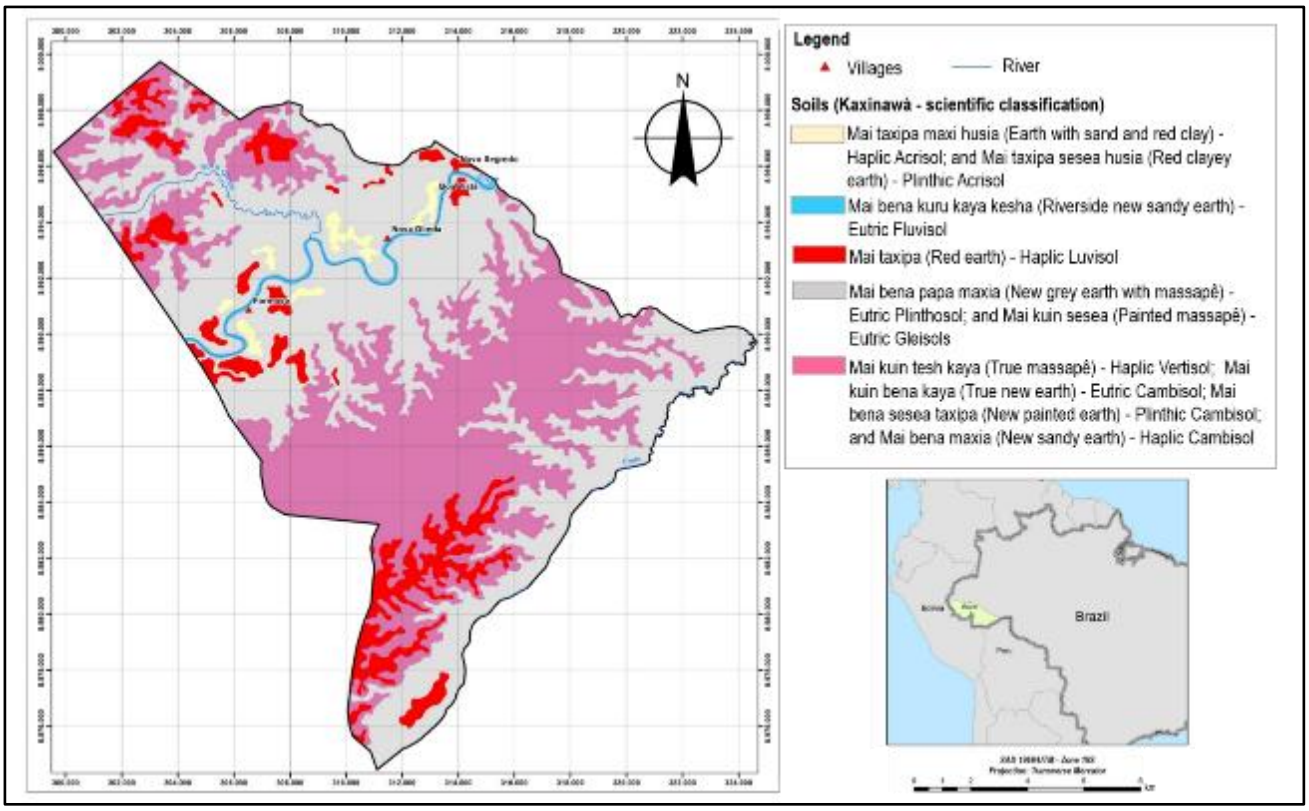

Figure 9. Integrated Kaxinawá and scientific classifications of the soils of KNOIL (Acre – Brazil).

The knowledge integration processes resulted in two main outcomes: the identification key and the map. When discussing the legitimacy of these outcomes, one issue came to the fore. While the policy practitioners explained that the Kaxinawás chose the soil names that were used in the identification key, the Kaxinawás reported that the chosen names were agreed on the basis of a majority of Kaxinawás. Most Kaxinawás agreed with these names because they understood from the policy practitioners that they had to create a single name for soils. However, not all Kaxinawás recognized these names as legitimate:

> "*After asking us about the names we give to soils, the policy practitioners asked us to create a unique name to call each soil… I understand these names in the table and in the map, but we do not call the soils with these exact names in our tradition* […]" (Kaxinawá, Interview 32).

5.4.2. Planning

When it came to planning ACM, the Kaxinawás and the policy practitioners relied on the four classification criteria and category names that were mobilized by the Kaxinawás to refer to soils (Table 1). The policy practitioners stated that they did not use the assessment outcomes (i.e. map and identification key) because these were produced mainly for the scientific community. Nevertheless, the knowledge that was mobilized was considered useful for the policy practitioners to identify knowledge correspondences and complementarities and to develop planning strategies with the Kaxinawás. The Kaxinawás said that they could rely on oral communication and on their own mental maps to plan ACM; however, they wished they could have used the outcomes of the assessment to disseminate knowledge that they built with the policy practitioners to those KNOIL members who did not participate in the SISA processes.

The phases that comprised the planning are presented below.

i) Knowledge mobilization, integration, and co-production

While the planning of ACM built on knowledge produced in the assessment step, the use of this knowledge to address concrete land use practices and needs in KNOIL required new knowledge mobilization, integration, and co-production processes. These processes involved the bridging of Kaxinawá and policy practitioners' knowledge on land use and resource management as well as discussion of technical measures on how practices could be improved to enhance environmental conservation, bio-cultural diversity, and livelihoods. The Kaxinawás and the policy practitioners reflected on the interplays between different land uses, including the challenge to ensure food and livelihood security, sovereignty, and how to enhance ecosystem services. The policy practitioners supported the Kaxinawás to reflect on management options and on their possible impacts but they did not guide Kaxinawás' choices.

Two main planning strategies were co-produced to address both local needs and SISA goals in accordance with the Kaxinawá knowledge. First, slash-and-burn agriculture was adapted. Kaxinawás reported that they had realized that the clear-felling of pristine forests had become unsustainable due to the increasing Kaxinawá population density and demand for resources, and due to the fixing of the territorial border in the 1970s. The policy practitioners suggested to increase agricultural productivity and avoid the clearing and burning of pristine forest because this reduces biodiversity and causes intensive nutrient leaching. Instead, the policy practitioners recommended to use shifting cultivation methods in existing fallows that are in a good state of ecological restoration and that are more suitable for crops. These fallows are located in areas that were previously used for agriculture but were left without crops for the regeneration of secondary forest and soil fertility. Additionally, the policy practitioners suggested to increase soil fertility by intensifying the use of fruit trees in agricultural areas and by transforming them into robust agroforestry systems. The Kaxinawás agreed with these changes and added to them the creation of a nursery orchard to work as a bank of seeds for these systems.

The second ACM planning strategy was aimed at increasing food security by reducing crop losses. Because both crops and cattle used to be placed close to the houses of the Kaxinawás cattle were damaging crops. As Kaxinawás had no income to protect crops from cattle with fences, which would be the first recommendation by the policy practitioners for them to manage this problem, the policy practitioners facilitated the Kaxinawás to reflect on other management options. The policy

practitioners proposed to place cattle in soils distant from the houses that are suitable for pastures or to quit cattle grazing. Because cattle grazing is a practice that was inherited from colonizers and the Kaxinawás wanted to strengthen their cultural patrimony, most Kaxinawás preferred to quit it. A few families decided to maintain herds but restrict them to Plinthosols that are distant from houses and crops.

ii) Knowledge application

The Kaxinawás and the policy practitioners applied the ACM planning strategies via experimentation in areas selected for communal use in KNOIL. Once this experimentation worked successfully, the Kaxinawás started applying these strategies by themselves. The application of the knowledge that was co-produced during the processes was performed by both Kaxinawás and policy practitioners. The process enabled the Kaxinawás to review their tacit knowledge and to increase the accuracy of their evaluation of lands' suitability. For instance, traditional approaches used by the Kaxinawás to assess soil humidity and texture, like making holes in the soils with knives or feeling the soil texture between the tongue and teeth, were complemented with approaches that policy practitioners use to examine the subsoil. The adoption of planning in practice has resulted in an optimization of the Kaxinawá land use and management. These practices were incorporated into the Kaxinawá governance (e.g. rules to allocate cattle grazing and shifting cultivation). In addition, some of the Kaxinawá community members who participated intensively in the SISA processes became knowledge (agroforestry) agents and disseminated the knowledge that was built with the SISA policy practitioners to KNOIL community members who did not participate in these processes.

The assessment and planning that we discussed in this section involved challenges as well as positive outcomes. The subsequent section will discuss these in relation to our conceptual framework and the guidelines we presented earlier.

5.5 Discussion

Our findings suggest that the SISA knowledge integration processes in KNOIL partially achieved the objectives of safeguarding knowledge diversity and usability. While the outcomes of the assessment and planning processes were generally considered to be legitimate, relevant, and appropriate to the local context, we also highlighted challenges to maintain knowledge diversity, particularly in the knowledge integration process. This resulted in the Kaxinawás not recognizing the outcomes of this step as legitimate. This happened despite the efforts of the policy practitioners to include categories in the assessment that contained names that the Kaxinawás indicated and to weave together the Kaxinawás' and scientific classifications while attempting to respect diversity. A key moment was the request by the policy practitioners that the Kaxinawás create single names for their soil classifications, which was contrary to how the Kaxinawás signify soils. This demonstrates a dominant role of policy practitioners in setting the terms for knowledge integration. It also illustrates how uneven power relations can pervade integration and co-production processes even though participatory methods were applied to prevent this. It should be noted however, that our analysis shows that knowledge usability was not affected (cf. Cash et al., 2003). We suggest that this can be explained by the fact that the policy practitioners and Kaxinawás used the indicators they identified to decide land use and resource management as a boundary object; as common language that denoted an area of common concern (Carlile, 2002). This enabled them to co-produce knowledge that was usable, despite the shortcomings in conserving knowledge diversity as a whole.

Despite this challenge to knowledge diversity and legitimacy, the knowledge processes in KNOIL reflected many of the guidelines presented earlier. An intercultural approach (Rist and Dahdouh-Guebas, 2006) was visible during most parts of the assessment and planning, when the policy practitioners actively shared power with the Kaxinawás and both sides engaged in the processes. The policy practitioners also expressed humility; they actively stepped back from their authority and expertise to craft the mobilization of their scientific knowledge with the Kaxinawás, to synthesize the Kaxinawá knowledge, and to align Kaxinawá needs and SISA goals. The policy practitioners did so by using dialogue methods to facilitate the Kaxinawás to structure and synthesize their classifications, and to create and identify knowledge correspondences and complementarities. As such, the policy practitioners employed methodological bricolage (Kincheloe, 2009), which allowed them to account for the different socio-ecological influences (across time and space) on Kaxinawá resource management and planning.

While attempting to exercise ethical sensitivity to safeguard knowledge usability and diversity, 'reflexive questioning' (Klenk et al., 2017) was lacking on why the Kaxinawás resisted to agree on a common and fixed nomenclature for soils. Confronted with this response, the policy practitioners could have paused the process to reason together with the Kaxinawás (Jasanoff, 1998) and adapt the process where necessary. Our data suggests that the Kaxinawás did not disagree explicitly with the policy practitioners, but rather that they did not fully understand the implications of the knowledge integration for the usability of its outcomes. Moreover, the policy practitioners reduced their involvement in the development of the identification key and the map. By excluding the Kaxinawás from the finalization of knowledge outcomes, the policy practitioners prevented the Kaxinawás from having a final say about their legitimacy.

Coming back to the central objective of our article, our analysis has demonstrated that during the knowledge co-production process, the specified guidelines provided by the intercultural approach, humility, and methodological bricolage were important in ensuring knowledge usability. At the same time, knowledge diversity was partly sacrificed due to extant uneven power relations and due to shortcomings in exercising ethical sensitivity and reflexive questioning.

5.6 Conclusion

Our case has shown that knowledge differences can be overcome when policy practitioners share power with locals to shape integration and co-production processes and outcomes. We also saw that these processes are rarely perfect. Even with appropriate methods and attitudes in place, challenges will often occur and uneven power relations are difficult to overcome in practice. But, as our analysis has also demonstrated, these challenges do not have to sacrifice the legitimacy of the process as a whole. In our case, challenges to knowledge diversity did not create unsurmountable problems for knowledge usability.

A first lesson that we draw from our analysis relates to the facilitation of knowledge processes. The KNOIL case showed that to share power with IPLC, policy practitioners can include more flexibility and adaptation in these processes; that is, they can improve their use of methodological bricolage. In our case, this could have resulted in the inclusion of diverse contents, nomenclatures, and meanings that would better reflect the heterogeneity of ILK. Moreover, to empower locals to negotiate taken-for-granted assumptions that structure knowledge processes, policy practitioners must be transparent about their assumptions and expectations, and about the implications of knowledge choices.

Continued reflection will help to correct and adapt processes and mitigate misleading and misunderstandings in earlier parts of the process.

A second lesson refers to the policy and planning processes that assessments are meant to inform. Our case resembles other documented examples (e.g. Nadasdy, 2003; Ayana et al., 2015) in which the exclusion of IPLC from the finalization and validation outcomes amounted to an extractive mode of knowledge production and compromised legitimacy and usability. To avoid this, care should be taken to include IPLC in the formulation of the policy frameworks that guide the integration of ILK and in the production of the knowledge outcomes that will be presented to scientific and policy communities. Although we agree with the SISA policy practitioners that it is neither ethical nor the role of policy practitioners to teach science to IPLC, we suggest that policy practitioners can share knowledge outcomes with IPLC throughout the entire process of policy implementation – e.g. by using non-technical and local terms and by familiarizing locals with scientific terms and concepts that are relevant and complement their knowledge (de Albuquerque et al., 2014).

We conclude with a call for attention to the relation between knowledge diversity and power. IPLC's resource management, knowledge, and SES are dynamic and need to adapt in face of global changes and policy goals. While it is difficult to completely avoid uneven power relations, extraction, and reduction of knowledge diversity (Lemos et al., 2018; Turnhout et al., 2020), continuous reflection on whether power is effectively shared is needed for these processes to result in legitimate outcomes. This reflection should account for which meanings may have been lost and created during the process; how these meanings resonate with understandings and needs of IPLC; and whether the consequences of knowledge choices are culturally and ethically justifiable. This requires a redirection of the focus of knowledge integration from the perfection of methods and frameworks towards a practical ethics that is able to addresses and mitigate the political implications and consequences of knowledge integration processes as they arise in practice.

CHAPTER 6

INCLUDING KNOWLEDGE, SOCIOCULTURAL, AND ECOLOGICAL DIVERSITY IN POLICY: DISCUSSION, CONTRIBUTIONS, AND CONCLUSION

Fernanda Ayaviri Matuk van Maurik

6.1 Introduction

This chapter discusses the findings and addresses the research questions and objective of the thesis. As presented in Chapter 1, the need for such an investigation arose from the concrete problems and needs on livelihoods and rights that IPLC face (Toledo et al., 2003; Antunes, 2020). Literature suggests that environmental policies need to include IPLC and their ILK to maintain and enhance the key contribution that these communities make in their territories to global biodiversity, nature conservation, and human well-being (Díaz et al., 2018). The predominant failure of these policies to address these needs has underscored the importance of advancing the legitimacy and effectiveness of integration and co-production processes to include scientific, Indigenous, and local knowledge systems. As was discussed in Chapter 1, achieving this will require ensuring knowledge diversity, bridging worldviews, and managing uneven power relations between participants of these integration and co-production processes. This thesis therefore articulated the following objective: "*to understand how to advance the legitimacy and effectiveness of processes and outcomes of environmental policies that aim to include IPLC and ILK*".

In this chapter, I first answer the three research questions by synthesizing the findings of Chapter 3 on the Brazilian MGMC case study and the findings of Chapters 4 and 5 on the KNOIL and SISA policy case. Thereafter, I discuss my findings and link them to relevant academic debates. I first discuss how to further the inclusion of ILK to achieve legitimate and effective knowledge integration and co-production processes and outcomes (Section 6.3). Second, I discuss how science-policy interfaces can support the enactment of multiple and diverse knowledge systems, worldviews, and human-nature relations (Section 6.4). Third, I reflect on the ethnoecological approach of the thesis (Section 6.5). I conclude the chapter by proposing recommendations for actors who work on the science-policy interface to include IPLC and ILK in environmental policies in a legitimate and effective manner (Section 6.6).

6.2 Revisiting the research questions

RQ 1. *What scientific, Indigenous, and local knowledge needs to be included in policy related frameworks and outcomes to ensure that policies align with the needs and contexts of IPLC?*

The contents and meanings of both scientific and ILK systems that need to be included in policy frameworks and outcomes broadly relate to classification systems (i.e. categories, criteria, and concepts), worldviews (i.e. assumptions, values, aspirations, and beliefs), and practices of knowledge co-production and use. Chapter 3 has presented a TSEN framework that follows the ethno-ecological approach discussed in Chapter 2. The framework is based on the central premise that all knowledge systems are formed by k-p-w assemblages, which are connected to specific social-ecological contexts and historical pathways. The MGMC case (Chapter 3) and the KNOIL case (Chapters 4 and 5) highlight these k-p-w assemblages and demonstrate the interconnections between knowledge and the worldviews and practices that inform scientific knowledge, local knowledge in the MGMC case and Indigenous knowledge in the KNOIL case. These three chapters revealed that while ILK is mostly related to landscape and territorial specifics of local SES, it is also shaped in interconnection with the knowledge and k-p-w of actors of diverse spatial scales. Scientists and practitioners take part in this shaping by influencing or facilitating IPLC's decisions on what knowledge is included in participatory assessments to inform planning that will address local practices in the context of these communities.

Ensuring the inclusion of scientific, Indigenous, and local knowledge systems in assessment and planning was found to involve maintaining the meanings that constitute the integrity of each knowledge system while integrating or co-producing new knowledge (cf. Tengö et al, 2017). Overall, the diversity of ILK systems comprises a shared cultural and epistemological basis that is linked to the (partial) communal use of lands by IPLC (cf. Surrallés and Hiero, 2005). While ILK is predominantly oral, this cultural and epistemological basis is also registered and transmitted through drawings, practices, and cultural identity, among others (cf. Hill et al., 2020). IPLC validate ILK based on the tacit knowledge that has been learned from their ancestors (i.e. values and beliefs) and based on social learning – that is, learning-by-doing from nature's feedback to land-use experiments and from the exchange and creation knowledge with other IPLC and social actors (cf. Berkes, 2012). Furthermore, most ILK systems commonly have an animist foundation and a focus on subsistence that makes Indigenous knowledge share similarities with local knowledge systems (Diegues, 2000). Despite this common basis, ILK systems also exhibit heterogeneity. This heterogeneity derives from the specificity of the various practices and expertise that IPLC develop in relation to the characteristics of the lands that families use as well as from personal trajectories, age, and gender (cf. dAlves, 2005). For instance, IPLC that dwell in wetlands tend to specialize in crops that adapt to these lands. Furthermore, the knowledge of women differs from the knowledge of men, which relates to the different practices they engage in, for example, household tasks and support in harvesting are mostly done by women while other agriculture activities as well as hunting, and territorial protection are mainly done by men. Similarly, there are also differences between the knowledge of elders and children. This heterogeneity is relevant for the resource management and governance of IPLC.

Following from the above, policy-related assessment and planning must recognize not only the diversity between scientific and ILK systems but also the diversity within ILK (cf. Barrera-Bassols and Zinck, 2003). Equally, science is also not a homogenous knowledge system. Chapters 3, 4, and 5 have shown that the disciplinary background and experience of scholars and policy practitioners mattered in what knowledge was included, what knowledge was produced, and how the knowledge was produced. For instance, the previous work of the SISA practitioners who have backgrounds in social and natural sciences in other policies of Acre that address IPLC led these practitioners to obtain rich capacities to support knowledge integration and co-production. These experiences and capacities proved to be instrumental in ensuring that these processes were based on a hon-hierarchical and non-dichotomized conception of knowledge systems and disciplines. These practitioners were able to reflect on what elements of their scientific knowledge systems could be included in an assessment to fit with ILK and local contexts. They also reflected on what elements of ILK were important to include in an assessment to ensure their relevance and usability to inform planning. Thus, the policy practitioners were mindful of the potential implications of excluding ILK diversity during knowledge integration and co-production for the usability of the outcomes of policy to serve local needs and the sustainable use of livelihoods by the community. These findings show that when it comes to the question of what knowledge is important to include, diversity between and within knowledge systems and relation to context are both of key importance. The effectiveness and legitimacy of assessments and policies derive from the way in which planners manage to ensure the inclusion of sufficient diversity in a meaningful relation to locals, to ILK, and to their context.

RQ2. *How are worldviews bridged to enable the inclusion of relational understanding of humans and nature in assessment and planning?*

Science, policy, and IPLC actors bridge worldviews through processes of dialogue, reflection, and negotiation on values about people and nature, aspirations (i.e. needs, interests, finalities, and goals), and meanings (i.e. classification categories, among others). Chapters 3 and 4 revealed that worldviews are elicited and bridged when these actors explain to each other, in an intercultural way, the reasons behind their categorizations and concepts – for example, land suitability is categorized in view of specific practices and finalities. Chapter 4, which presented an assessment and planning process, showed that when values, beliefs, and aspirations can be embraced in their plurality to address both local needs and policy goals, planners can avoid reduction of diversity and de-contextualization. Although the bridging of worldviews can involve transforming them, this is not necessarily a problem as long, as long as local values and agreed changes are jointly respected. When planners and locals see the need for this transformation to achieve common goals or common knowledge (cf. Pretty et al., 2009; Pascual et al., 2017), this can support the legitimacy of these processes. A key example was when the Kaxinawás chose to prioritize crop production over cattle grazing. Their recognition that cattle grazing is not part of their traditional culture resulted in a change in values, meanings and practices related to land use. Planners also made such changes when they saw that the slash-and-burn agricultural management techniques, which they initially thought should be abandoned to avoid emitting carbon to the atmosphere, is the only way to clear dense forest in Indigenous lands such as KNOIL and that they can be adapted to become more sustainable. Both examples indicated an open attitude and a willingness to learn. They also showed that these learning processes involved a renegotiation of values, goals, and knowledge at an ontological level (cf. Wenger, 1998; Kenter, 2018).

Science and policy actors bring out and gain an understanding of the holistic worldviews of IPLC by participating in IPLC's everyday practices and by listening to local environmental histories – that is, histories of changes and configurations related to landscape, territory, management, and governance. The inclusion of these worldviews together with the knowledge they relate in both assessment and planning requires inter- and transdisciplinary collaborations, among planners themselves and between planners and IPLC (cf. Rist and Dahdouh-Guebas, 2006). As shown in Chapter 4, these processes led to the understanding by planners of the pragmatic finalities of (animistic) spiritual beliefs and the diverse values that locals have in relation to sustainable management and livelihoods. The processes thus resulted in the mutual recognition that despite their differences, Western scientific and Southern IPLC worldviews are bridgeable (cf. Pretty et al., 2009). The co-produced holistic and relational understandings that result from these processes enrich assessment and planning. They, moreover, ensure that policy decisions are legitimate and effective and that they prevent risks to local livelihoods, resilience, conservation, biodiversity, and well-being. One example of this comes from Chapter 4 when the SISA planners and the Kaxinawás complemented the ES and NCP frameworks with a relational understanding of humans and nature. In so doing, the focus on the contributions and services that nature provides to people was complemented with the recognition that humans also contribute to nature, which was called PCN. Such an understanding aligns with the concept of k-p-w because it underscores a relational understanding of humans and nature, which highlights how humans and nature co-produce biodiversity and livelihoods. Thus, the bridging of worldviews can result in co-produced relational understandings, and this relationality is important for the legitimacy and effectiveness of assessment and planning.

RQ 3. *How and to what extent do planners and IPLC acknowledge and overcome challenges of uneven power relations during policy participatory processes in practice?*

Chapters 4 and 5 showed that even though planners and IPLC enter into integration and co-production processes with the intention of establishing symmetrical relations, uneven power relations between them may still emerge in practice (cf. Turnhout, 2018; Turnhout et al., 2020). Failing to address uneven power can compromise these processes. As discussed in Chapter 5, this happened in the KNOIL case when the planners imposed a strategy to integrate knowledge that involved a translation of local classifications that was not agreed on by the locals. This resulted in a reduction of knowledge diversity in the outcomes of these processes. IPLC did not oppose the imposition of power or question the authority of the planners. This lack of opposition reflects a long history of hierarchical relations between science and policy actors with IPLC, which in Acre was dominant until the 1990s (Sills, et al., 2014).

When power relations are not actively resisted by IPLC, it is important that planners attempt to level them from the start. As seen in Chapter 5, planners can use technologies of humility (Jasanoff, 2003) and engage in an intercultural approach (de Albuquerque et al., 2014) to actively reduce the presumed authority of science, to recognize the relevance of other forms of knowledge, and to create trust with the community. They must also be sensitive to the emergence of uneven power relations when a knowledge integration process is already ongoing, and they must address these relations explicitly and appropriately. An example of this occurs in Chapter 5 in which the integration process could have been improved on this point when local people hesitated to agree with the planners' strategy of integration. Planners could have engaged in reflexive questioning in response to this hesitation (Klenk et al., 2017) by pausing and asking open questions to the community to assess the situation. They also could have used methodological bricolage (Kincheloe, 2008) to respond to these emerging power relations and to adapt the process accordingly. This could have supported the co-production of legitimate knowledge in ways that fit the Indigenous knowledge and IPLC's own frameworks.

The planning process that followed the assessment as described in Chapter 5 did show a more symmetrical approach in which community and planners jointly deliberated and co-produced management and land use strategies. The process showed that although the assessment process entailed uneven power relations, it did not entirely sacrifice the legitimacy and effectiveness of the outcomes. These outcomes (e.g. maps containing both Indigenous and scientific knowledge) were still seen as usable by both planners and the local community and were adopted in the planning of land use, resource management, and governance by locals (cf. Dilling and Lemos, 2011; Kirshhoff et al., 2013). However, if the meanings of the Indigenous knowledge had been maintained in these outcomes in a way that locals could recognize them, the community would have been able to use these outcomes without external support.

6.3 Including Indigenous peoples and the local communities and their knowledge in policy

In this section, I discuss the main findings of the cases studied that relate to the inclusion of IPLC and ILK in environmental policies and link these findings to the theories that I used in the thesis. As Chapter 1 showed, literature on knowledge co-production and integration processes pays attention to the importance of practitioners accounting for the diversity of knowledge systems, disciplines, worldviews, and values when conducting these processes (Pascual et al., 2017; Díaz et al., 2018; Kenter, 2018). Accordingly, the basic suggestion made by scholars – especially those who advocate for inclusive environmental assessment frameworks like IPBES – is that the outcomes of knowledge integration and co-production should not only be credible but also legitimate and effective for both

practitioners and IPLC. This has resulted in a focus by scholars on improving processes, approaches, and methods on how to achieve this legitimacy and effectiveness While scholars have concentrated efforts in providing "better" frameworks for practitioners to achieve legitimate and effective policy processes and outcomes, the findings of this thesis confirmed that practitioners are failing to deliver this achievement mainly because they are not addressing uneven power relations that emerge during these processes (Nadasdy, 2003, 2007; Turnhout et al., 2020). Some literature explicitly recognizes the political and power dimension of these processes (Nadasdy, 2003; Turnhout et al., 2012, 2020; Turnhout, 2018). This literature criticizes established and often taken for granted assumptions about the superiority of scientific knowledge over ILK and advances a symmetrical and decolonized conception of knowledge systems. It stresses the need of engagement, trust, transparency, and joint decision-making so that practitioners and IPLC can establish symmetrical relations in practice (cf. Tengö et al., 2017).

My research has taken the above-mentioned literature as a starting point and uses a symmetrical concept of knowledge, which considers all knowledge systems to be connected to worldviews and practices. This conceptualization of knowledge systems bridges the ethnoecological conception of ILK as formed by k-p-w assemblages that are re-constructed over time in entwinement with different contexts (Toledo and Barrera-Bassols, 2009) and the STS conception of knowledge as situated (Haraway, 1988; Raffles, 2002). In line with this conceptualization, my findings have stressed how participatory knowledge processes unfold in practice and how they are shaped by unpredictable and context-based dynamics (Turnhout et al., 2012, 2020). The importance of practice and contingency for the unfolding of these processes means that the focus on intentions, approaches, and methods that is present in much of the literature on co-production is not sufficient (Kenter, 2018; Turnhout et al., 2012, 2020).

My analysis highlights two main contributions that confirm importance of practice and contingency for understanding and managing uneven power relations. First, I have shown the value of practitioners responding to power dynamics as they unfold during policy participatory process and adapting processes accordingly to prevent the extraction of ILK, the reduction of diversity, and the exclusion of IPLC needs. To attain these goals, specific attention needs to be paid to power relations in the negotiations and adoption of classification related categories and meanings that reflect different ontologies and worldviews (Nadasdy, 2003; Turnhout et al., 2020; see section 6.4).

Second, my analysis stresses the importance of the inclusive validation of outcomes by practitioners and IPLC. The main criteria that scientists tend to use for validation are blinded peer-reviewed journals and evidence-based data (Agrawala, 1998; Kowalczewska, 2019). Yet, we have seen that knowledge is considered legitimate when it is considered fair and credible, which means that it fits with the diverse knowledge systems, worldviews, values, needs, and contexts of different actors involved (cf. Cash et al., 2003). To achieve this, traditional scientific criteria do not suffice and different criteria, including those of IPLC, must be used to co-validate knowledge (cf. Hill et al., 2020). My analysis also indicates that only co-produced knowledge that legitimately integrates different epistemologies and ontologies can be valid for different knowledge holders. This co-validation is important not only for knowledge legitimacy but also for its effectiveness. The case studies showed that policy outcomes are adopted and implemented when practitioners and IPLC re-value the relevance of their knowledge contents and meanings and align them with criteria that are relevant for local

resource management planning and governance (cf. Moreno et al., 2014; Von Haaren and Galler, 2016). This revaluation is important for ensuring outcomes that are considered usable by IPLC (cf. Dilling and Lemos, 2011).

While effectiveness of co-production is commonly assessed in terms of policy uptake, relevance or uptake alone do not guarantee the actual use of planned policy outcomes in practice (Kirshhoff et al., 2013). Our analysis shows that relevance and usability must be determined in practice by assessing the extent to which outcomes fit with local needs and social-ecological specifics and are adopted in practice. As IPLC adjust planning strategies to the dynamics of everyday life and SES, our data showed that collaborative processes involve long-term commitments where practitioners and IPLC continue to work together after processes of policy assessment and planning are concluded.

Overall, what our findings highlight is the importance of ethics and care in guiding knowledge integration and co-production processes so that planners can be responsive and adaptive to the unfolding dynamics and implications of these processes (cf. de la Bellacasa, 2011; Klenk et al., 2017). This topic will be further discussed in Section 6.6.

6.4 Towards a cosmopolitics that includes diversity

In this section, I build further on the understanding that the previous discussion highlighted: that including ILK in policy to attend IPLC needs while also realizing policy goals related to nature conservation, biodiversity, and well-being in a legitimate and effective manner requires that science-policy interface actors move beyond epistemology and account for practice and sociocultural and ecological contingencies. This means to think of the knowledge processes that are part of the assessment and planning of environmental policies as entailing more than classifications and measurements (cf. Von Haaren and Galler, 2016; Kenter, 2018). Accordingly, the literature emphasizes that including IPLC and ILK in policy processes and outcomes requires that policy and these community actors also bridge the different ontologies, worldviews, values, and needs that underlie their knowledge choices and understandings of human-nature relations (Rist and Dahdouh-Guebas, 2006; Woolgar and Lezaun, 2013). This literature also stresses that these actors need to overcome the differences between their Western and Southern worldviews to include the holistic worldviews of IPLC in pre-given frameworks, in framings of environmental problems, and in goals that policy practitioners target while making knowledge decisions for assessment and planning (Berkes, 2009; Moreno et al., 2014; Pascual et al., 2017; Díaz et al., 2018).

My analysis suggests that the legitimate and effective inclusion of ILK in policy is achieved when uneven power relations among planners, IPLC, and other participants in policy are explicitly addressed. This means that dialogues and participatory processes need to be conceived of as entailing political standpoints and positions. Ensuring that these political positions are made visible rather than hidden requires a form of politicization of the process (cf. Turnhout et al., 2020). Moreover, the influence of actors who are not included in participatory processes should also be recognized as exercising power and thus being political, including scholars who propose frameworks and strategies for practitioners to integrate and co-produce knowledge, as well as social actors at other spatial scales whose practices affect IPLC's livelihoods, for example, through the trade of commodities, such as soy or beef. This analysis thus points out that any genuine adoption of ethics in practice by science-policy interface actors that leads to this inclusion requires a broader politicization of the influence of power

in both knowledge production and policy, which in turn implies decolonizing both science and policy (Shahjahan, 2011; Latulippe and Klenk, 2019).

This politicization of science and policy entails the explicit recognition that the exclusion of IPLC and ILK from scientific knowledge production and policy is rooted in the colonialism of the global South by the global "West" or North of the past and continues as "neocolonialism" until today (Mignolo, 2009). This neocolonialism is reinventing an exploitation of Southern human and natural resources that leads to inequalities between the North and South and that is strongly supported by the diffusion of Western science and policy knowledge and their related ontologies (Escobar, 2012). The fact that this knowledge is often transmitted to and adopted in the South without being necessarily adapted to fit Southern epistemologies, ontologies, and contexts is considered to create a 'coloniality' within science and policy (Lander, 1993, p.1). This coloniality is expressed in taxonomic divides that entail hierarchical relations and false ideas of full divides, for example, Western/North and South, and neutral and objective (Said, 1990). Our analysis showed these full divides cannot be sustained: while Southern and Western knowledge and worldviews have differences, they may also converge and be bridged. Still, while the actions of colonialism that have been mostly attributed to Eurocentric and North American epistemes and practices (Santos, 2005; Escobar, 2012), they have been also reproduced by Southern actors. Chapter 3 showed the Brazilian government's influence in constraining maroon land rights in favor of agribusiness. As long as a strong divide between South and North remains enacted by such actors, the effects of colonialism and the exclusion of Southern knowledge will continue to negatively affect biodiversity and well-being globally (cf. Agrawala, 1998; Haraway, 2016).

With the call for decolonization of both science and policy arises the need for transparency on 'what for', 'for whom', and 'by whom' knowledge of science and policy is produced (Escobar, 2008; Jamarillo, 2013). Therefore, I emphasize that a non-hierarchical and post-colonial (symmetrical) approach to knowledge and power requires i) moving beyond the Western epistemic borders and ways of ordering space to include marginalized Southern episteme to inform decolonization and to set goals and objectives for land use (Smith, 1999); ii) discussing that science and policy are mostly funded by Northern companies whose profits remain mostly in the North and resultant inequalities and environmental degradation center in the South (Wallerstein, 2011; Toledo, 2006); and iii) mitigating colonial relations that are reproduced in the South in collaboration with the North towards leveraging needs and problems of local communities together with problems and challenges of global scale to address them synergistically (Mehaan et al. 2018).

In addition to transparency of the objectives, supporters, and beneficiaries of environmental science and policy, the articulation of epistemological and ontological differences is needed for the co-production of shared and relational understandings on people and nature to be included in both environmental assessment and planning (cf. Pascual et al. 2017). I argue that the call for decolonizing science and policy translates into the need to better inform planning with assessments that support the envisioning of policy options by planners and IPLC that are feasible and lead to outcomes that are usable in IPLC's social-ecological context (cf. Berkes, 2009; Von Haaren et al., 2014). Particularly, an intercultural dialogue in which these actors clarify to each other the values and assumptions that underlie their classification systems and approaches to resource management and governance have been found to help bridge worldviews while making legitimate and effective knowledge decisions (cf.

de Albuquerque et al., 2014). Accordingly, science-policy interfaces need to pay more attention to the human-nature relations that are informed by ILK and to the cosmovisions that are found to foster sustainability in IPLC contexts. Doing so not only serves a post-colonial agenda but may also promote human well-being, biodiversity, and environmental conservation more broadly.

Another point for politicization is the co-production of shared relational understandings on people and nature by policy and IPLC actors. It is not only important to include ILK and holistic worldviews in policy but also to simultaneously address people and nature in both assessment and planning (cf. Pretty et al., 2009). Scholars stress the intricate human-nature relations that have created the environmental problems that policies want to mitigate (i.e. social inequalities, biodiversity loss, and climate change) and the need for policies to address conservation and well-being together (Sachs, 2012; Díaz et al., 2018). They also emphasize the need of a broader adoption in science and policy of the understanding that knowledge is entwined with nature; that people and nature co-produce each other (Díaz et al., 2018); and that humans and the non-human nature form a unity (Latour, 1997; Escobar, 2012). Chapter 3 illustrates this co-production. When maroons adopted monoculture, a concomitant loss of 'ILK', 'cultural', and 'ecological' diversity happened, whereas when they replaced this monist form of relating to nature by their plural land uses, these linked domains of diversity were restored. Other examples of this co-production are found in studies that show how forests hold legacies of their interplays with humans (Levis, 2018).

My analysis showed that practitioners can understand this co-production by assessing the state and use of natural resources with IPLC to frame strategies to address SES in ways that add to their pre-defined frameworks and ontological assumptions (cf. Irvire et al., 2016; Kenter, 2018). To do so, scholars with a background in social and natural sciences must strengthen their interdisciplinarity to engage with the holism of IPLC and so address both people and nature (cf. Merçom et al., 2019).

ILK and social-ecological context of IPLC are not limited to the local and current temporal scales in which policies and management take place but are shaped in relation to other spatial scales, SES, and path-dependencies (cf. Folke, 2006) and, hence, in relation to broader political contexts as well. This analysis confirmed that ILK is performed together (Haraway, 2016) and co-evolves in synchrony with the sociocultural and ecological diversity of IPLC's territorial contexts as well as the planet (cf. Holling, 2001; Toledo and Barrera-Bassols, 2009). For instance, the cases of MGMC and KNOIL showed how IPLC create ways to co-evolve with their environment. This analysis also showed that these relations need to be thought to include global to local scales, especially in the current Anthropocene[18] period. However, while the concept of the Anthropocene mostly emphasizes the negative impacts of humans on nature, IPLC, their ILK, and k-p-w show alternatives to sustainable global futures (Wyborn et al., 2020). Our case studies elucidated how human-nature relations may be turned towards environmental solutions if ILK and IPLC are included in policy as equals. This insight may be taken both to other localities and to higher spatial scales.

[18] The concept of an Anthropocene refers to a geological period that has been recognized since 2019. This period succeeds the Holocene epoch, which had been in effect since the last glacial age (around 11,650 years ago). The Anthropocene is conceived to have started with the intense emission of greenhouse gases to the atmosphere, which is largely associated with the widespread industrial use of fossil fuels since 1945. It is marked by the transformation of the Earth's resilience state and the recognition that the provision of natural resources is limited by planetary boundaries, which need to be addressed by policies that target people and nature in their interplay (Trischler, 2016; Subramanian, 2019).

The importance of understanding nature and people as entwined and the insight that global processes are being shaped by the IPLC and ILK now and in the future suggest the need for policies to embrace the "cosmopolitics" of IPLC (cf. La Cadena, 2005). As Viveiros de Castro (2004) explains, the entwinement between ontologies, knowledge, and nature means that different worldviews perform different worlds, natures, or universes (cf. Woolgar and Lezaun, 2013). In their pluriverses – plural worlds and cultural forms of conceiving nature – IPLC carry out a cosmopolitics to make holistic political decisions that affect the needs of human and natural entities as well as to be solidary cosmopolitans who care for the needs of other actors and cultures (Stengers, 2005; La Cadena, 2005). Embracing this cosmopolitics implicates that science and policy actors move away from a universalist and colonial form of thinking and 'world-making' to make place for a politics that respects knowledge, sociocultural, and ecological diversity and that makes its singularities flourish (La Cadena, 2005; cf. Haraway, 2016). As such, the priorities of humans and non-humans and the abuses against any of them should be accounted for in policy processes. It also implicates that these actors should address IPLC contexts as being more than a scale of policy and management but as a place that has its own governance and management systems that can be learned from (cf. Ostrom, 2010).

The holism, inter-, and transdisciplinarity that are implied in cosmopolitics may be seen with a bias as being naïve[19] or impractical (FAO, 2005; Latour, 2010). However, they have become necessary in view of the boundaries that the planet has to continue providing resources for a growing population that has perpetuated unsustainable patterns of relating to nature (Steffen and Smith, 2013). The urgency to promote diversity is thus clear if we acknowledge that, even though humans have only lived for about 200,000 years on Earth, they are triggering the sixth massive biological extinction of this planet, which is about 4.5 billion years old (Trischler, 2016). While ideas of a single universe and legitimate knowledge have led to competition and individualism and to the extinction of ecological and cultural diversity, the theories that defend the legitimacy of pluriverses and a broader distribution of power across humans and nature have turned to integration, co-production, cooperation, and systemic interdependency as the motor of our co-evolution (Dempster, 1998; Favivi, 2020). The anthropocentrism and Western dominance found in science-, policy-, and world-making cannot be used as a flag of political neutrality. Through this lens, there is no in and out; the knowledge, people, and non-human natural entities that are politically "excluded" continue to relate to each other and shape our Earth system as well as affect both elite and non-elite actors (cf. Haraway; 2016). If we change this exclusionary thinking to an inclusive and relational thinking, this is for the better of diverse and just futures for the life of both humans and the non-human nature. Humility of humankind towards both people and nature jointly, and not towards each separately seems to be the key to make diversity and co-existence flourish.

6.5 The pros and cons of using an ethnoecological umbrella research approach

In this section, I discuss the benefits and challenges found while using the research approach that was adopted in the thesis. Overall, the use of Ethnoecology as an umbrella research approach was useful to enable the inter- and transdisciplinary assessment and co-production of data with the participants in the research (IPLC and practitioners) in the two in-depth case studies. The challenges

[19] While I propose that science and policy actors give credibility to IPLC and ILK to foster conservation, I am aware of the debates that these communities are not 'noble savages' (Diegues, 2008) but I draw on the evidence found by FAO (2017) and IPBES (2019) that the territories managed by these communities hold a large part of the planet's biodiversity.

were mostly related to the broadness of subjects and to the holism that the research pursued. These points are detailed below.

As explained in Chapter 2, by adopting PAR, I assumed that the knowledge generated in the research would involve premises and values, co-production of knowledge with the participants in the research, and the goal to contribute to both science and society (cf. Tromp et al., 2009). My previous research with IPLC (e.g. Matuk, 2012; Matuk et al., 2017) sensitized me to see the need to further understand how to address ILK and k-p-w in association with the conservation of sociocultural and ecological diversity. The goal of providing this understanding guided my co-production of data with the IPLC and practitioners who participated in my research. IPLC played a role in this co-production through their inputs, during interviews, participant observation, workshop activities, and data co-validation. Doing this co-production, while also drawing on the different science fields of the research supervisors and co-authors (i.e. Soil science, Ethnoecology, biology, STS, philosophy, political sciences, and Geography), as well as on different theories and grounded data, required several redefinitions of the research theme and reinterpretations of the data. This made the research challenging but the ethnoecological umbrella framework proved to be flexible and adaptable, as different levels of understanding on the relations among the challenges, theories, and categories addressed were (re)pieced together. I also achieved my goals of providing direct contributions to IPLC that were planned in Chapter 2. Finally, the wide variety of ethnoecological methods that I adopted (de Albuquerque et al., 2014) supported me in relying on and cross-checking different sources of data, for example, the data obtained with individual interviews and group activities, which enhanced the data's reliability.

An important contribution of the research approach to the research project was that it enabled me to put into practice the ethnoecological and PAR principle that power must be shared with research participants. I established a symmetrical relation with the participants in the research through bonds of trust that were mediated by transparent dialogue and agreements on intended activities, on expectations, and on how I envisioned to co-create the research with them. Particularly in relation to IPLC, eating together, listening to them with interest, interacting informally while staying in the community, and expressing that I care for their causes helped me to establish a symmetrical relation with them (cf. de Albuquerque et al., 2014). My introduction to the communities by (non)-governmental entities with which they had already previously established trust was key to gain their trust quickly. Here I would like to remark on the aspect of co-authorship with IPLC that was raised by a reviewer of a journal with which we worked and is linked to the power relations that are particularly involved in the publication of the data collected. While IPLC collaborated as co-authors in practice, they were not added as such to the papers of the thesis. We did this to follow current standards of publication, but the question of IPLC and their role as co-authors in publications should be considered by journals in the future.

The reciprocal trust established with the participants in the research made them feel appreciated and open. It prompted the IPLC to help me adjust my planned research scope and fieldwork activities, for example, to broadly include resource management and governance, to fit their work schedule, and to include extra guided-tours in their lands to make their ILK more understandable. Drawings were also made by them on their own initiative to express meanings of nature. Due to this trust building, they became willing to actively participate in different activities and to discuss their management and

governance challenges. In KNOIL, the Kaxinawás spoke openly of the ups and downs they saw in the policy processes. Moments of sensitization and reflection by IPLC on their history of battles for territory and livelihoods came up fluidly and richly during interviews and group activities. Such moments also made IPLC regain strength to fight for their needs and rights. They expressed gratefulness for participating in the research during the celebrations at the end of the fieldwork in both study areas. This engagement also led IPLC members who were said to have never wanted to participate in a research or policy to participate and contribute intensively in my activities. Likewise, a symmetrical relation with practitioners made them also willing to give their time for my interviews and to talk openly about both the SISA policy and the ups and downs they perceived in the implementation of this policy with the Kaxinawás.

The symmetrical relations established also enabled me to speed up my data collection, while taking care not to take too much time of the IPLC (Coelho, 2014). Fast data collection was important because of the area's remoteness and the financial constraints to return to it, in the case of KNOIL – see Chapter 2. The fast data collection for the thesis, including the ethnographical participant observation, was feasible on a tight schedule because I adopted a qualitative data analysis – which does not include experiments that may demand more time and successive returns to the field. In the case of KNOIL, data collection went particularly fast because I did not need to collect all the soil samples used in my study; I relied on the soil data from the SISA planners (do Amaral et al., 2013; 2015). Moreover, I relied on my personal experience with conducting and teaching participatory research[20].

The conceptual challenge of using the research approach that I followed had primarily to do with the difficulty to integrate the variety of subjects that needed to be bundled to enable the analysis of the challenges and strategies that influence the legitimate and effective inclusion in policy of ILK, as conceived in Ethnoecology, namely as part of k-p-w assemblages (Toledo and Barrera-Bassols, 2009). These subjects included theories that consider knowledge systems in a symmetrical way (Haraway, 1998), that depict social and natural disciplines as possible to be integrated (Latour, 1997), and that conceive territory and landscape as social-ecological constructions (Raffestin, 2014; Holling, 2001). They also included analyzing frameworks that are commonly used for environmental assessment and planning (Berkes, 2009; Díaz et al., 2019; MA, 2005; Reed et al., 2015) and theories that address science and policy practices and the power relations they encompass (Nadasdy, 2003; Turnhout et al., 2012, 2020). To address these subjects together I had to link different concepts and analytical approaches of schools of thought that address these subjects – including STS (Hajer and Versteeg, 2010; Law, 2009; Turnhout, 2018); Geography (Raffestin, 2014); complex SES's theory (Folke, 2006), and post-humanism, which added complexity to my data analysis.

Despite the challenge pointed out, the use of Ethnoecology as an umbrella approach allowed me to create a bridge between the "Southern" Ethnoecology, ILK, and post-colonial theories I adopted and the predominantly (Western) "Northern"-based critical schools of thinking and scientific frameworks (i.e. ES and NCP) I also adopted. This was possible because of the large flexibility found in Ethnoecology, and because the methodological bricolage that I used (Kincheloe, 2008) gave place

[20] I started researching ILK in 2007 (e.g. Matuk, 2008, 2009) and teaching PAR methods and its extension approach in 2010 – as a substitute professor in the Federal University of Viçosa (Minas Gerais – Brazil), while supervising students from the Bachelor in Geography – and from 2015 on, as a permanent adjunct professor of Agronomy and Biology and as part of the board of research groups, in the Federal Institute of Minas Gerais.

for different understandings and methods to be allied on specific aspects. The strong points in this regard were, first, that I could present results obtained through an ethnoecological study to scholars who might not be acquainted with this discipline. Second, I contributed to Ethnoecology by linking principles and methods of PAR that most ethnoecologists adopt in practice but the theoretical underpinnings and implications of which had not yet been reflected on much (Barrera-Bassols and Zinck, 2003; de Albuquerque et al., 2014). This theorization also contributed to my study by enabling me to give a clear explanation about why conventional scientific approaches that do not include the research informants as active participants tend to have a limited capacity to depict their "object" of study reliably and legitimately (cf. Tromp et al., 2009). In contrast, the rich data and symmetrical relations that were created strongly fostered such reliability in my research.

I could articulate and present similarities and complementarities among the different schools of thought adopted, which pointed to promising possibilities for other scholars and practitioners to use them together to address IPLC and ILK. This similarity was found in the concepts of knowledge in Ethnoecology – as part of k-p-w assemblages (Toledo and Barrera-Bassols, 2009) – and in STS, as situated in context (Haraway, 1988), which enabled me to propose a way for scholars and practitioners to co-produce criteria to judge the legitimacy and effectiveness of policy-related knowledge outcomes in accordance with different knowledge systems in a non-hierarchical way – as discussed in Section 6.3 of this chapter. I also observed that various schools of thought, including Ethnoecology, post-humanism, STS (Latour, 1997; Haraway, 2016), SES (Holling, 2001; Folke, 2006), and post-colonial theory (La Cadena, 2005; Escobar, 2016) all conceive knowledge, people, and nature, as co-evolving – as demonstrated in Section 6.4. Accordingly, the complementarities among this literature enabled me to provide a framework to understand the space, territory, and landscape as a social-ecological construction (see Chapter 3) that shows how social and ecological inputs happen, resembling SES. Furthermore, the post-humanist view adopted in this framework also adds to geography, as most geographers conceive of territories and landscapes as being mainly social constructs (e.g. Haesbaert, 2004; Massey, 2005; Santos, 2005).

While the focus of the thesis on the inclusion of ILK in policy processes and outcomes informed the choice for a predominant role of social sciences in the research, I opted to use soils and Ethnopedology/Ethnoecology in collecting and analyzing data related to IPLC and scientific classification systems related to soils. It was hard to find an interdisciplinary approach that could give equal space to the different social and natural science disciplines used in the research. Yet, the different jargon and subjects of study of these sciences made interdisciplinarity difficult to frame in the research plan with the supervisors in the time allotted to finish the thesis. Nonetheless, I was still able to merge subjects that are usually separately addressed but do need to be addressed together to support the inclusion of ILK in policy (cf. Haraway, 2016). As such, the data related to (ethno)pedology was still efficiently related to the study of classification systems and policy legitimacy of social sciences in the thesis (see Chapter 5). Moreover, it proved relevant to the understanding of people-nature relations, IPLC management and governance, and policy assessment and planning.

I conclude that, despite the cons I presented in this section, the pros I stressed made the use of a participatory ethnoecological umbrella approach, together with PAR and methodological bricolage, efficient to create bridges among different knowledge systems, disciplines, and ontologies in my research. It also importantly provided insights to advance the non-hierarchical and post-colonial

inclusion of IPLC and ILK in policy process and outcomes with legitimacy and effectiveness. The following section introduces lessons and contributions that the research mediated towards this advance. I would like to add that personally, the research with IPLC using this approach has hugely enriched my view of the world, IPLC, and research.

6.6 Furthering the inclusion of Indigenous and local communities and their knowledge in policy with legitimacy and effectiveness

This section departs from premises discussed in this chapter thus far and seeks to translate these into recommendations for policy and practice. My thesis argues that the intention alone of including ILK and IPLC needs in knowledge integration and co-production processes does not ensure the achievement of legitimate and effective outcomes (cf. Klenk et al., 2017). Rather, as these processes involve various forms of knowledge, worldviews, power, nature, and contexts, achieving legitimate and effective outcomes relies on negotiations that are made on epistemological, ontological, and political levels. Accordingly, a cosmopolitics that accounts for the roles and needs of social actors and nature and that brings together the global South and North in (non-colonial) symmetrical ways, is needed for practitioners to include IPLC's holistic worldviews and to address their entwined knowledge, sociocultural, and ecological diversity. The adoption of critical-emancipatory approaches in research, such as Ethnoecology and PAR, are moreover needed for knowledge to be co-produced and for science to contribute to both scientific debates and social needs. I argue that what is needed for science and policy actors who work with IPLC to perform knowledge processes in ways that are attentive, cautious, and efficient is an *ethical practice* that is based on *reflexive questioning* (Klenk et al., 2017), on *technologies of humility* (Jasanoff, 1994, 2003), and on *methodological bricolage* (Kincheloe, 2008). In the text below, I explain how to make these three approaches operational and I identify remaining challenges.

I propose an *ethical practice* for science and policy actors to carefully but openly reconcile and include a diversity of knowledge systems, disciplines, ontologies, worldviews, and needs when using different frameworks and methods with IPLC. This practice departs from these actors adopting a de-universalized conception of science, in which different forms of knowledge are addressed as hybrid, processual, heterogeneous, and negotiated ensembles of contents, meanings, and validation criteria. It also comprises an emphasis on the role that social actors have to concretize conservation, biodiversity, and well-being (Berkes, 2004; Pretty et al., 2009; Turnhout et al., 2013), which calls for a broader recognition of science-policy interfaces as *science-policy-society interfaces* (Ramírez-Monsalve et al., 2016). The recommendations I propose for science-policy-society interface actors to operationalize the ethical practice proposed include the following:

i) Practicing *technologies of humility*

- *Establishing and cultivating trust*. Connecting with IPLC leaderships through (non)-governmental entities that have worked with these communities in synergetic ways before starting the initial contact with them helps to build and create trust (cf. de Albuquerque et al., 2014). During the initial contact with IPLC, the bigger picture of policy goals and frameworks as well as their contextualization in a global, national, and regional scenario needs to be introduced. This introduction justifies the presence of the science and policy actors who intend to work with IPLC in the community's territory and creates acceptance by locals of this presence. It also elucidates the importance of policy and IPLC for each other and stimulates the

uptake of policies by locals. Clarifying the purposes of policy processes will empower IPLC to understand and to appropriate the methods and frameworks used during these processes. It thus supports IPLC to (fore)see and help these science and policy actors to be aware of the implications of the inclusion and exclusion of bits of ILK and worldviews from policy outcomes. The use of a simple language to discuss scientific terms will help to create a symmetrical relation with IPLC. The cultivation of trust throughout participatory processes by requesting input from IPLC and sensitiveness to their acceptance of the terms set for these processes tends to foster a lasting reciprocal relation with them (cf. Ruiz-Mallén, 2012).

- *Relying on informal contact and conviviality with the community*. While being aware of the limits of personal involvement in a community (Tromp et al., 2009), informal contact, for example, in local celebrations and everyday practices, furthers the openness of locals to engage in participatory processes and deepens the understanding and interconnection of science and policy actors with ILK and related k-p-w contents. Such contacts show the interest of scholars and practitioners in the local culture, needs, and environmental histories while also creating space for informal talks that come to enrich data (see Chapters 3 and 5). It thus promotes an informal and equal interaction with IPLC, which transcends the usual formal and hierarchical interaction of policy and scholars with social actors (cf. Cardew, 2020).

- *Settling on a mutually agreed agenda*. Science and policy actors need to express that they perceive the value of ILK and cosmovisions as additions to their scientific knowledge and worldviews. This can be done by inviting IPLC to think about, intervene in, and/or collaborate in shaping the processes proposed to implement policy (Berkes, 2004; Klenk et al., 2017). This invitation incorporates humility in the processes by giving space for IPLC to help these actors correct misinterpretations that might emerge during policy processes that go against the ILK and needs and might harm their SES. Such care may also prevent that uneven power relations remain hidden or become silenced. This should increase the reliability that the decisions made during these processes and their outcomes reflect the integrity of ILK and the worldviews of IPLC (cf. Tengö et al., 2017).

- *Including actors of diverse spatial scales*. As previously discussed, the legitimacy and effectiveness of policy calls for a politicization of its knowledge processes and outcomes. This politicization, through a cosmopolitics, will require that practitioners include more broadly in the participatory processes that are carried out with IPLC the social actors whose practices affect these communities' needs, rights, and livelihoods, and/or the realization of conservation, biodiversity and well-being in their contexts, including policymakers, donors, and agribusiness actors. These actors often do not participate in policy processes with IPLC but need to become more included (cf. Cleaver and Koning, 2015; Turnhout et al., 2020). A way suggested to collaborate symmetrically with these actors and IPLC while planning resource management and governance is to bring to the table their worldviews, practices, and knowledge to safeguard policy outcomes (cf. Berkes, 2009). This dialogue should focus on what are the externalities of the practices of these actors that may compromise IPLC from fulfilling their needs and policy goals can be adapted towards the common good.

ii) Practicing *methodological bricolage*

- *'Making clear agreements to adapt methods in coordination with IPLC'.* Participation in assessment and planning processes starts with the prior informed consent of IPLC (UN, 2010, 2013) but needs to be extended to adapting methods and targeted goals that are acceptable and understandable to IPLC. This adaptation requires that scholar, planners, and IPLC to agree on, and/or redefine methods, concepts, and classification typologies of science and policy frameworks. It thus includes making agreements with locals, such as asking if they accept the methods proposed to integrate and co-produce knowledge and to bridge worldviews and include them both in assessment and planning. The creation of new agreements on methods and outcomes during different participatory processes performed with IPLC tends to lead to joint decisions, according to the findings and the unfolding of these processes (cf. de Albuquerque et al., 2014).

- *Integrating and co-producing knowledge together with relational worldviews*. Science and policy actors must establish an intercultural relation with IPLC to integrate and co-produce knowledge by interweaving knowledge- and worldviews-related contents while using bricolage (cf. Caillon et al., 2017; Hill et al., 2020; see Chapters 3 and 5). This intercultural relation can, then, be used as a foundation to support these actors to creatively and flexibly adapt pre-defined frameworks in order to accommodate different classification typologies, categories, criteria, and so on. By adopting such an approach, science, policy, and IPLC actors can find knowledge correspondences and complementarities and understand the reasons for knowledge differences between their knowledge systems, to co-produce the best fit to interweave scientific- and ILK-related categories (de Albuquerque et al., 2014; see Chapters 3, 4, and 5). This approach should lead to knowledge outcomes in which these systems are inter-weaved side-by-side, with respect for their related meanings, values, aspirations, and beliefs (Pascual et al., 2018; Chan et al., 2016). Interdisciplinarity will be key to enable negotiation and creation of transdisciplinary outcomes that include a third form of knowledge, which not only integrates ILK and scientific knowledge systems but also new knowledge formed in the process to address targeted goals (cf. Toledo and Barrera-Bassols, 2009). It will also support the creation of relational and accurate understandings of the functioning, dynamics, flows, involved in the interplays of SES – for example, between the state and availability of ecosystems, human practices and well-being (FAO, 2005; see Chapter 4).

- *Co-validating knowledge.* Scholars, practitioners and IPLC should jointly validate the knowledge contents and meanings that are chosen to be included in outcomes of policy processes related to environmental assessment and planning on the basis of criteria they consider as credible and relevant. This form of co-validation of knowledge outcomes is more effective when it addresses both intermediate and final products of these processes. The lack of empirical evidence by IPLC on criteria or indicators they use to validate knowledge, for instance, to prioritize NCP and PCN assessed and to plan resource management and governance, should not be a limiting factor for practitioners to consider ILK valid (cf. Nadasdy, 2003). On one hand, these criteria can be empirically identified in the field. On the other hand, scholars and planners can have criteria in mind that cannot be measured precisely but that indicates clearly what must be done towards nature conservation – for example, it is not always possible to measure how much biodiversity will be lost by exponential deforestation whereas it its loss is surely undesired. As such, when empirical proof that an activity is desired or harmful

for ecosystems and biodiversity is not available, different land use and management strategies can be experimented to mediate the production of such proof. Finally, by considering the validation criteria that scholars, practitioners, and IPLC consider credible and relevant in the context of policy implementation, these actors may ensure that final outcomes of their choices are recognizable, legitimate, and usable by IPLC (see Chapter 3; cf. de Albuquerque et al., 2014).

iii) Practicing *reflexive questioning*

- *Demonstrating ethical sensitivity.* Science and policy actors can express a reflexive sensitivity by reporting to IPLC that they care and wish to act towards attending local needs and avoiding harm to the legacy and SES of IPLC. Accessing and reflecting with IPLC on the history of territorial and landscape changes that led to the settings and dynamics that configure their SES at the moment of policy assessment and planning is a way to do this. These assessment and reflection enable a holistic and joint understanding of local practices and natural resources. As such, it supports the reflexive questioning by planners and IPLC on what can and cannot be changed in view of local needs related to livelihoods; social-ecological potentialities and vulnerabilities; previous resilience shifts that were witnessed in the local context; external institutions and practices of other actors that limit local sustainable practices, and so on. This questioning allows these actors to make sense of what bits of scientific knowledge fit or can be reframed to align with the specifics of ILK, practices, and SES. It may thus lead to decisions that are legitimate and effective to deliver what is planned with IPLC to be realized in practice.

- *Reflecting on trade-offs and addressing common goals*. As shortcomings and disagreements on knowledge categories, values, beliefs, needs, and so on tend to surface during participatory processes, science, policy, and IPLC actors need to rely on dialogue to problematize preferences and to make visible the synergies and trade-offs involved in policy decisions (see Chapter 3). This will elucidate who or what (human and non-human, biological and geo-physical entities and/or assets) are being (dis)favored and in what ways (see Chapter 4). The acceptance and joint negotiation of such shortcomings can be addressed as proposed by Haraway (2016, p.1) by "*staying with the trouble*". This idea is based on the recognition that troubles and trade-offs will remain and must not impede these actors from thinking and acting together. Instead of waiting for a future moment or for the emergence of a perfect method to create inclusive solutions, these actors must thus deal together with the shortcomings to include knowledge, sociocultural, and ecological diversity through participatory processes. Therefore, different participants need to make conscious resignations or choices while considering the common good. This will involve minimizing divergences away from outcomes that promote long-term well-being (see Chapter 5).

The guidance proposed here helps to address the three challenges identified in this thesis and ensure legitimate and effective assessment and planning. However, a few issues that might remain deserve some final attention. First, changing the way in which science- and policy-making are done involves transforming traditions of thinking and it is challenging for science and policy actors to step outside their usual frames and practices (cf. Mol, 1999, 2002; Collins, 2001; Turnhout, 2019). Second, SES, knowledge, and policies are dynamic, and this requires the creation of ways of monitoring the

effectiveness and legitimacy of policy outcomes (cf. Chaffin et al., 2014). Third, even when social actors who indirectly affect the capacity of IPLC to deliver policy outcomes become more included in participatory processes and environmental policies, their interests may clash with IPLC needs and with policy goals on conservation. Efforts to overcome the uneven power relations between these actors and IPLC are likely to bump into structures of power that have historically been hard to change (Fletcher, 2012; Turnhout et al., 2020). However, if these actors acknowledge what has been stressed by bodies, such as IPBES and CBD, that addressing climate change, biodiversity, and well-being requires changing social inequalities and practices of society as a whole, agreements between IPLC, science and policy actors, and other social actors may become reality after all to support the diversity of pluriverses in unison.

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APPENDIX

This appendix includes the guiding questions for the semi-structured interviews. The interviews are presented subsequently with: 1) the maroons of MGM; 2) with the Indigenous peoples of KNOIL; and 3) with the practitioners of the SISA (REDD+) policy. The number of questions which is large was adapted according to the flow of the interviews and with the intention to take about 1 hour. As such, these questions give a broad view of the basis used to think of questions and guide the conversation during the interviews with these interviewees and sometimes they aim to check an information by asking it in different ways. The information between parenthesis was used in two ways: i) to give examples that helped the interviewee thinking of possible information that the question was related to, when the interviewee showed silence and seemed to do not have a clear understanding on what I was inquiring on; and ii) linking the question to technical terms that are included in the questions but are translated in the question to a simple language that is accessible by the interviewee without this needing to get insight on scientific terms.. In addition, the questions are separated by topic (in italic) and are sometimes grouped within the same question, when the data on these questions were expected to come together in the answer of the interviewee. The interviews also use a simple language on terms that are scientific and are built to create a flow of a talk.

1) Guiding questions for the semi-structured interviews with the maroons of MGMC

Personal data and cultural identity

1) What is your name and age?

2) Do you have many relatives in the community? Children? How many? How many people live in your house?

3) Are the children living in MGMC? Do they study, work, and/or support the family work with the land in MGMC?

4) How do you feel about living in this land and how do you see your relationship with other members/ families of the community? Would you like to live elsewhere? Why? (values, aspirations, beliefs)

5) What is the main reason for you to live here?

6) How do you identify yourself (e.g. as a maroon – "quilombola" – and/or in another way) and why?

7) When did you move to Malhada Grande? Was your coming beneficial/hard? Why so?

This and the following topic of interview comprise an assessment on the context and of ILK and k-p-w assemblages

Local knowledge and worldviews on soils, landscape, and on land use and resource management and governance (related) practices

8) What land types (soils) and of forests found in the territory of your community?

9) How do you differentiate them and distribute the types of land use and resource management on them?

10) How do you characterize each environment (landscape type) that you distinguish within MGMC as having different types of lands and forests?

11) What are the (main) types of land use and resource management practiced in the territory of your community?

12) What is the focus of these practices? (e.g. subsistence and/or trade)

13) What sources of income do you have to buy the things you need? (e.g. the products of these practices and/or others). Is there processing of some raw materials in MGMC?

14) Do you practice crop rotation or another practice which aims to conserve the soil and the forests to remain productive? What management techniques or land use practices do you perceive as negative for the conservation of the soil, water, and forest to remain attending the needs of the community now as well as of its future generations? (sustainability and degrading practices)

15) What are the positive and negative characteristics that each of these types of lands offer for these uses? What are the best and the worst lands to produce in MGMC? Why?

16) How do you choose how each of these environments will it be used? How do you monitor changes in your lands, availability of water, forests, fauna, and flora over time? What lands do you choose to plant pasture or crops and why? What other criteria do you use to choose land use? (e.g distance from water, lack of better soil, need to sell on the market; i.e. technical indicators, values, beliefs, aspirations) – see Barrios et al., 2012 on indicators

17) What other criteria do you use to choose land use? (e.g. distance from water resources, lack of more suitable soils, need to sell goods on the market)

18) How are the family's household tasks and farm work divided among family members and organized over the year?

19) Do you practice communal use of resources and collective production? (e.g. of agriculture in common areas)? What are the groups that practice it and how is this use organized?

20) How are decisions on land use and management made and by whom?

Changes in the landscape, territory, and land use and relations with actors of other spatial scales

21) Do you notice changes between how life was like in MGMC in the past and today? Which changes are these?

22) What events do you remember as milestones that triggered these life changes?

23) Do you notice any changes in the characteristics of the environments, lands, forests, and land uses as part of these past changes? And in the recent years (e.g. climate change, soil degradation).

24) What are the causes for these changes? When did they occur? How was it?

25) What impacts did you notice in the environment (soil, water, vegetation, people) as part of these changes that led to the adoption of new practices and to the abandonment and/or retrieving of old practices?

26) Who were/are the actors involved in these changes and how have they affected the community? (e.g. farmers, (non)governmental entities, university, IPLC, among others). Do/did they help the community? How?

27) Have you engaged in grassroots movements to fight for identity and territorial rights? How was or has it been and what have been the struggles found or gains obtained?

28) How is the relationship between people within families and among families in the community today? Is it different than before? And the relation of the community with the types of land (soils), the forests, water, and types of land use?

29) Was there more communal use of lands and land resources and collective work in the past than today? Why so?

Local demands

30) What do you consider to be the greatest difficulties that the community faces to produce agriculture, to obtain subsistence, and to continue living in your territory?

31) What are the main demands of the community nowadays?

32) What does the community aspire to the future?

33) How has been the work with the NGO Centre for Alternative Agriculture (CAA-NM, acronym in Portuguese) to support the maroons to restore the local knowledge, the local cultural and the land resources? Does anyone already use their agroecological techniques? How?

2) Guiding questions for the semi-structured interviews with the Kaxinawás of KNOIL

Personal data and cultural identity

The questions 1 to 5 repeat the same questions made in MGMC (see these questions above) and are added by the question below.

6) How would you define the Kaxinawá people of KNOIL? Do you live in a similar way than other Kaxinawás? And how do you differ from other IPLC of the region?

Likewise, in MGMC, two topics of interview comprised an assessment on the context and of the ILK and k-p-w assemblages:

- *Indigenous knowledge and worldviews on soils, landscape, and on land use and resource management and governance (related) practices*
- *Changes in the landscape and territory and relations with actors of other spatial scales*

The questions 8 to 28 are accordingly the same questions made in MGMC, however with a focus on KNOIL (see these questions above).

As in KNOIL, the assessment included a focus on ES and NCP and on the implementation of the SISA policy, these are added as part of my interviews in this case and their content thus differs from the one that was covered in the interviews made in MGMC.

Assessment included a focus on ES and NCP

The question 11, which relates more specifically to land use and to resource management and governance, was added by questions that relate to ES (MA, 2005; de Groot et al., 2010) or NCP categories. In addition, as I knew beforehand that Indigenous peoples have a holistic relation to nature (Posey, 1999; CBD, 2010), I made questions that also gave place for the interviewees to show their role in these ES and NCP, as showed below – see Fagerholm et al. (2012) about the mapping of ES.

1.1) What are the land uses and types of goods from nature that you see as importantly obtained in KNOIL? (e.g. ES or NCP of provision such as hunting, fishing, medicinal plants cultivation, fuel, collection of raw materials, legumes, fruits, pastures, crops, beekeeping)

11.2) What are the practices of management and of regulation (governance) of the use of the lands and of the soils, water, and forests of KNOIL made by the Kaxinawás to maintain these goods possible to remain being obtained? (e.g. ES and NCP of regulation and/or support such as of regulation of climate, soil quality, water availability; waste treatment; pollination; pest and disease control; maintenance of genetic diversity related to gene pool habitats and to cycles of animal reproduction; and deforestation).

11.3) What is the cultural importance of these goods and practices? What are the contributions of the Kaxinawás for these goods to exist and remain been provided in KNOIL? What are the benefits of nature for community development? Is there a desire to conserve some areas just because of their own value? (e.g. cultural and/or non-material ES and NCP that nature provides for locals and that locals provide to nature by consciously intending to support the provision and regulation of these goods, which include diverse values, spiritual and other beliefs, aspirations, knowledge legacy, management, among others).

Local demands

The questions 29 to 31 repeat the same questions made in MGMC (see above).

Participatory processes and outcomes made as part of the environmental assessment and planning with the practitioners of the SISA (REDD+) policy

32) How do you perceive the relationship that was established community with the technicians (planners) of SISA who have worked with your community during their study of your knowledge and of the soils, forests, and land uses in KNOIL? (i.e. the environmental assessment made by planners of the Indigenous knowledge and of the local context)

33) Did this relation include trust and space for you, Kaxinawás, to speak your ideas and to have your needs, your knowledge, and your cultural priorities included by the policy in the understanding of your knowledge and contexts?

34) How and whether did these technicians make this inclusion made during this study (assessment)? What activities do planners do with you? Did they really include you as participants in the decisions on the knowledge and needs to be addressed as part of their processes carried out with you in KNOIL?

35) How did their procedures and this inclusion unfold during the planning of the land use strategies that were made with the technicians of SISA? Do you consider that the elements that need to be prioritized in land use planning in KNOIL were attained by these technicians? Why and how? Is there anything that you don't agree in their way of conducting these processes and decisions or that you noticed that other Kaxinawás disliked? How and whether was it dealt with by both sides, of Kaxinawás?

36) What do you understand that the SISA policy aimed to do in KNOIL? What it indeed did, in your view?

37) What were the outcomes of the study and planning that the technicians carried out with you in KNOIL? Did/do you get to make use of these outcomes yourself? How? Do you also see practical changes as part of these outcomes, how have these turned out to happen and how have they changed the land use, management, regulation of land use types and management of soils, water, and lands in KNOIL? (i.e. enhancing or not conservation, biodiversity, and well-being).

38) How/whether has these outcomes benefited the KNOIL as a community? Has it benefited the community members in general, or mainly specific members? How?

39) Is there something that could have been done by the technicians to build a better form of relating to the community participants in their processes to better incorporate your aspirations, knowledge and visions / ideas?

Guide for informal talk at the end of the interview, while visiting the garden of the interviewees

1) What activities do you do in the garden of your house and what are their functions for the family?

2) What is planted in the yard? How do you prepare the land for planting and in what time of the year? How do you manage the lands in the garden?

3) What else do you do in the garden? Does the use and management of the lands of your garden differ from the one done in general by the community? Why?

4) What labor is employed on the garden?

5) Do you practice animal breeding, od which type and with which finality?

3) Guiding questions for the semi-structured interviews with the SISA practitioners

Personal data and role on SISA and KNOIL

1) What is your name, age, occupation, and educational background?

2) How long have you been working with IPLC in Acre and via which type of policies and approaches?

3) What was/is your role and the role of the entity with which you work in SISA? For what purpose?

4) Did you work directly with the Kaxinawás? What theoretical, methodological, and/or training reference did you have to work with them groups? (e.g. on ES frameworks, indicators, ILK, and participatory research).

5) How has the SISA framework been designed? How/whether have been IPLC included in this designing?

6) Who are the donors of REDD+ that have funded SISA and how does it work the obtaining of funding and the investment of this funding in Indigenous lands such as KNOIL? And what are IPLC expected to do in return for this investment?

Participatory process in KNOIL (for those who worked directly with the Kaxinawás)

7) How was the policy introduced to the Kaxinawás? How was and has been the relation between the SISA planners and them? How does the carbon emission issue that is targeted to be mitigated by the RED+ policy was treated with the Kaxinawás?

8) What methods and frameworks did you use to conduct the environmental assessment of the Indigenous knowledge and context of in KNOIL? How did it work particularly to assess, map and elicit ES and NCP? And what methods, frameworks and/or approaches were used for the environmental planning?

9) How were these methods defined? And how/whether were the problems and local demands defined to be addressed there?

10) How did you incorporate the Kaxinawá knowledge to these methods and frameworks? Did you consider the consequences of the policy for the Kaxinawás when decisions were made to include priority classification categories and criteria during the assessment of their context and knowledge? And how were such decisions made during the process of planning land use and resource management with them?

11) How and whether was the local governance of these resources addressed during these processes?

12) Did you and the other planners who worked in KNOIL also take into account local worldviews, animist philosophy and related aspirations, beliefs and values of the Kaxinawás during these decisions? How did you do to include them?

13) Did you find challenges to integrate the Kaxinawá and the scientific knowledge (i.e. classification systems and concepts)? What challenges were econutered? Why do you think this happened? How did you approach this? Regarding the worldviews of the Kaxinawás, including also their beliefs, aspirations, and values), was there some challenge to relate to these and to incorporate them to the assessment and planning? Was some reflection made by your team of planners in/or the worldviews that are embedded in the SISA related knowledge?

14) Did you notice some issue that involved uneven power relations among planners and the community as playing a role in these challenges? How was this approached? Were such relations also observed among community members? Did they also contribute to these challenges?

15) Regarding the situations that unfolded in the moment of the participatory processes, how did you deal with them when these extrapolated the unfolding expected for the participatory processes?

16) Did you find conflicts of interest between the SISA policy priorities and the need and aspirations of the Kaxinawás? How and whether were local needs and policy goals aligned?

17) What were the outcomes of the assessment and planning that were implemented with the Kaxinawás? Do you consider that these outcomes reflect their knowledge in a legitimate way? (e.g. that they can understand and make use of these outcomes) Why? Do you also find these outcomes effective to address the goals that were target during the policy implementation?

18) Do you think that something could have been done differently during the processes to improve the legitimacy and effectiveness of these outcomes? What would that be?

19) What were the gains obtained with the experience of the implementation of SISA as a pilot project in KNOIL and how could these be used as lesson for other experiences of participatory implementation of SISA in Acre with other Indigenous peoples and with local communities as well?

Worldviews of planners on the Kaxinawás and on their k-p-w and context

20) What do you think Kaxinawás want to achieve with their land use?

21) How does it work in practice the community autonomy to use resources in Indigenous lands (i.e. limitations imposed by State laws and the tutelage of lands by the national governor)? How does it affect their possibilities of using lands and managing resources?

22) How do you see the local land use and management practices that the Kaxinawás carry out in KNOIL? Are they beneficial or harmful to the soil quality and to the conservation of nature and biodiversity? What can/could be changed to enhance sustainable use of resources in KNOIL?

SUMMARY

The struggle that Southern Indigenous peoples and local communities (IPLC) face to get recognition for their Indigenous and local knowledge (ILK) and sociocultural diversity, and to ensure their needs, livelihoods, and rights is an issue still awaiting to be properly addressed by policies. Environmental policies have aimed to include ILK together with scientific knowledge in natural resource assessments and in the planning of resource management and governance through knowledge processes in which IPLC participate. These processes seek to realize the integration or bridging of knowledge systems. They involve the integration of classification categories and criteria of scientific knowledge and ILK, such as those related to soils, and support the co-production of shared and/or new knowledge by the scientis and planners who implement these policies and IPLC. While these policies aim to enhance the key contributions of ILK to global nature conservation, biodiversity, and human well-being, they have faced challenges to include the diversity of contents and meanings that constitute the knowledge of different IPLC. These challenges threaten the needs IPLC and prevent policies from delivering their intended goals to enhance conservation and well-being. For this reason, a current core concern of the science and policy actors who collaborate across science-policy interfaces is to advance the legitimacy of policy processes and outcomes involving environmental assessments and planning so that these are recognized as valid, credible, relevant, and as aligned with the knowledge diversity of different participants in policy (i.e. planners and communities) so that they address local needs and policy goals with effectiveness in different contexts.

In **Chapter 1** of this thesis, I introduce three challenges highlighted in the literature that policy practitioners, including policymakers and planners have faced to legitimately and effectively include IPLC and ILK in environmental assessment and planning. First, the tendency of the scholars who provide scientific frameworks and the practitioners who use these frameworks when implementing policy with IPLC to treat science and (non-scientific) ILK in a dichotomized and hierarchical way has often led to the extraction and reduction of ILK. As such, ILK is stripped from the meanings it has in IPLC contexts in order to fit scientific classification categories, concepts, and validation criteria that are prioritized to be included in the outcomes of knowledge processes. Second, policy practitioners have failed to bridge their Western worldviews and philosophical ontologies with the holistic worldviews and ontologies of IPLC. As a result, practitioners fail to include the worldviews and related values, beliefs, and aspirations that underlie IPLC's decisions during knowledge processes. They have also failed to interconnect with the holism of ILK to foster relational understandings of people and nature that are important to address conservation and well-being together in local contexts. Third, uneven power relations among planners, IPLC, and other participants in policy processes have constrained the effective participation of IPLC to shape these processes and include their ILK in their outcomes. Nonetheless, the role of power and the (not entirely controllable) performativity of the social practices that shape these processes have been underemphasized, as scholars rather focus on perfecting methods and frameworks to advance policy legitimacy and effectiveness than give attention to power relations in their studies.

The abovementioned challenges related to 'knowledge', 'worldviews', and 'power', tend to persist. Accordingly, the objective of this thesis is to understand: how to advance the legitimacy and effectiveness of processes and outcomes of environmental policies that aim to include IPLC and ILK. This objective is investigated through the following research questions:

1. What scientific, Indigenous, and local knowledge needs to be included in policy related frameworks and outcomes to ensure that policies align with the needs and contexts of IPLC?
2. How are worldviews bridged to enable the inclusion of relational understanding of humans and nature in assessment and planning?
3. How and to what extent do planners and IPLC acknowledge and overcome challenges of uneven power relations during policy participatory processes in practice?

In **Chapter 2**, I explain the ethnoecological umbrella research approach I adopt to answer the research questions. I draw on the ethnoecological understanding of ILK as part of 'knowledge-practice-worldviews' (k-p-w) assemblages that are constituted in entwinement with social-ecological specificities of both local and other spatial scales over time. I also link methodological principles of Ethnoecology and of participatory action research (PAR) that symmetrically address different knowledge systems and their holders. I draw on PAR, which is usually adopted in Ethnoecology, to establish a critical-emancipatory research approach. This approach relies on a 'methodological bricolage', an open and creative approach I use to overarch and bridge conceptual and methodological elements of different schools of thought I draw on to be able to investigate the inclusion of IPLC and ILK in policy. Specifically, I included elements of Science and Technology Studies (STS) that relate to interpretive analysis of discourses and performativity; post-humanism; the geographical analysis of 'territory' and 'landscape'; social-ecological systems' (SES) and 'complex thinking' (Folke, 2006; Berkes, 2009), and post-colonial theory on ILK and diversity (Escobar, 2012). The way in which elements of these schools of thought inform my analysis is detailed in Chapters 3, 4, and 5, which are published as individual journal articles.

In addition to introducing the research approach, Chapter 2 presents the two in-depth case studies I analyse in the thesis, both of which are located in Brazil. The study areas are: i) the 'Malhada Grande Maroon Community' (MGMC), in the semi-arid region of Minas Gerais state; and ii) the 'Kaxinawá Nova Olinda Indigenous Land' (KNOIL), which is part of the Amazon region of the Acre state. The data collection in both areas included interviews, participant observations, and workshops with several ethnoecological methods. However, while both the MGMC and KNOIL cases focused on the participatory assessment of environmental ILK, the latter was also part of the study on the implementation of an environmental assessment and an adaptive collaborative management (ACM) planning. These assessment and planning processes were facilitated by the planners of the 'System of Incentive for Ecosystem Services' (SISA, acronym in Portuguese) policy in the Acre state, which is part of the 'Reducing Emissions from Deforestation and Forest Degradation' (REDD+) policy. In addition, these case studies complement each other as the former addresses local knowledge whereas the latter addresses Indigenous knowledge, which are respectivelly related to local communities and to Indigenous peoples. The qualitative analysis of the data collected in these areas was mainly based on rounds of thematic coding, which covered the science, policy, and IPLC discourses and was focused on references to terms that were related to the central categories of analysis of the thesis: 'knowledge', 'worldviews', and 'power'. The data collection and analysis related to ILK and scientific classification systems focused on soils and was based on Ethnopedology, which is a branch of Ethnoecology that links scientific knowledge and ILK on soils. This enabled me to deepen my analysis of these knowledge systems while also relating to data on soils in connection with forests, landscape and land use, all of which are relevant for environmental assessment and planning.

Chapters, 3, 4, and 5 consist of three individual articles that were published in peer-reviewed journals and that I first authored. In **Chapter 3**, I develop and apply the "Territorial Social-ecological Systems Networks" (TSEN) theoretical-methodological framework. This framework is proposed as a type of landscape approach aimed to support the assessment of what scientific knowledge and ILK related contents are relevant to inform planning with knowledge that is inter- and transdisciplinary and that addresses both IPLC needs and policy goals in different IPLC contexts. TSEN is based on the premise that not only ILK but also the scientific knowledge held by scholars and practitioners is (in)formed by k-p-w assemblages. In addition, it conceives the local context associated with ILK as consisting of a landscape that expresses territorial processes and functions that include social, political, economic, cultural, and ecological components. The application of the TSEN framework in the MGMC case stressed the role of social-ecological interplays and networks of different space-time scales in co-producing the landscapes of this area and in making its territory operate as a SES that links diverse epistemological, ontological, historical, and spatial scales. This application also enabled an analysis of the synergies and trade-offs between global and local needs related to different knowledge priorities and in view of local specificities. The framework is considered to support scholars and practitioners to identify priority knowledge and needs in IPLC contexts. As such, this chapter addresses **the research questions one and two** of the thesis.

Chapter 4 consists of an in-depth case study that was carried out in KNOIL and that involved the SISA (REDD+) policy. This study aims to understand the challenges that planners and IPLC face to realize the legitimate inclusion of diverse knowledge systems, social and natural disciplines, and worldviews. It also investigates how and whether this realization enables planners and IPLC to consider people and nature in a relational way. To do so, I analyze how knowledge processes involved in the participatory implementation of environmental policies are enacted and shaped by the discourses: i) of scholars – which are contained in the global frameworks that draw on the concepts of e'cosystem services' (ES) and of 'nature's contributions to people' (NCP); ii) of practitioners, who draw on these frameworks to carry out environmental assessment and plan ACM with IPLC, and iii) of the Kaxinawás of KNOIL. I also explore the concept of PCN as complementary to ES and NCP. I argue that assessing PCN is crucial for the relational (holistic) understanding of nature and people, and that planners need to consider these contributions together with NCP to address conservation, biodiversity, and well-being together. The chapter, moreover, problematizes the gap that exists between environmental assessment and planning, which are respectively focused on 'knowledge' and 'worldviews' and on 'practices', whereas all of these three elements constitute PCN that affect the state of ecosystems and that should be considered for the achievement of local needs and policy goals. The chapter addresses **all three research questions** by studying the bridging of worldviews for the creation of relational understandings; the inclusion of worldviews together with knowledge in knowledge integration and co-production processes and outcomes; and the role of power relations in these processes. The findings highlight that science-policy interface actors need to explicitly address both these power relations and the role of PCN on ES and NCP to advance the legitimacy and effectiveness of such outcomes.

Chapter 5 relies on both the KNOIL/SISA case study to investigate how participants in policy processes of knowledge integration and co-production for participatory environmental assessment and planning manage challenges related to uneven power relations. I analyze whether and how these challenges are managed by planners and IPLC to safeguard the diversity of knowledge contents and meanings of both scientific knowledge and ILK, as well as how this management affects the usability

of knowledge outcomes. I explore whether processes and outcomes of knowledge integration and co-production are in accordance with local needs and policy goals and in tune with the local social-ecological context. The chapter details the way in which integration and co-production complement each other and take place through different processes. These include the mobilization, translation, and interweaving of classification categories, nomenclatures, and knowledge validation criteria. Moreover, challenges that emerge during these processes and strategies of planners that succeeded or failed to address these challenges are presented. The chapter is focused on **research question 3**, as it analyzes how planners and IPLC manage power to address different knowledge systems in a non-hierarchical and non-dichotomized way. The findings stress that, despite the use of participatory methods and approaches, the inclusion knowledge diversity may be compromised if planners are not sufficiently attentive to power asymmetries. Such asymmetries may lead to decisions that are not in line with ILK and that result in outcomes that are neither legitimate nor usable by IPLC. The chapter ends with a call for a 'practical ethics' that, rather than focusing on perfecting methods and framewporks, relies on culturally and ethically sensitive dialogues. A continuous reflection is proposed for planners and IPLC to respond to uneven power dynamics and ensure the legitimacy and usability of knowledge processes and outcomes.

Finally, in **Chapter 6,** I draw on the findings of Chapters 3, 4, and 5, to respond to the three research questions of the thesis. Regarding **question one**, my data analysis showed that the scientific, Indigenous, and local knowledge contents that need to be included in policy frameworks and knowledge outcomes relate to classification categories, criteria, and concepts; to worldviews (i.e. ontologies; values, aspirations, and beliefs); and to practices of knowledge integration/co-production and use. The legitimate inclusion of these knowledge contents in assessment and planning requires maintaining the meanings that constitute the diversity that is internal to each knowledge system while also including a shared and consensus-based knowledge. Both ILK and scientific knowledge have a relatively homogeneous basis that is shared among knowledge holders and a heterogeneity of meanings on top of that. The heterogeneity is related to the expertise and experiential practices that the holders of these knowledge systems develop and to the context where they are inserted. Responding to **question two**, worldviews are bridged during environmental assessment and planning through processes of dialogue, reflection, and negotiation of values about people and nature, of aspirations, and of knowledge meanings. These worldviews can be embraced in their plurality, but they may need to be transformed for the participants in these processes to achieve common goals and knowledge and adapt resource management. Science and policy actors assess and understand the symbolic and pragmatic meaning of IPLC worldviews (i.e. spiritual beliefs) by participating in local practices and by listening to local environmental histories. Once Western and IPLC worldviews become seen as bridgeable, planners and IPLC become able to co-produce relational understandings, which supports both the creation of legitimate knowledge decisions and the achievement of policy outcomes that effectively address people and nature. Finally, regarding **question three**, uneven power relations between planners and IPLC may be evident even when these actors intend to integrate and co-produce knowledge by sharing power to make decisions. Humility, reflexive questioning, and methodological bricolage were proposed and confirmed to be key approaches that enable planners to adapt their methods and their attitudes to level these relations. In addition, the effectiveness of knowledge outcomes depends on an awareness by planners and IPLC on the implications of both the inclusion and exclusion of bits of scientific knowledge and ILK for local contexts and needs and for policy goals. Yet, to be recognizable,

legitimate and usable by IPLC, policy outcomes, such as maps and reports, must be produced to address not only the policy community but also IPLC.

Chapter 6 also includes further discussion on important themes that are brought up in this thesis and that follow from the answers of the research questions. First, I discuss the inclusion of IPLC and ILK in environmental policies towards a co-production of legitimate and effective knowledge that tackles uneven power relations between policy actors and IPLC. I highlight that the performative contingency and situatedness of knowledge processes and the diverse criteria that holders of scientific and ILK use to validate knowledge as credible and relevant should be accounted for in these processes. In this way power may be practically managed for a joint crafting of knowledge outcomes. I also stress that policy effectiveness depends not only on decisions that are reliable to foster conservation and well-being but also on the long-term monitoring of the uptake of policy planning by IPLC as well as on planners' accounting for practices of actors at diverse spatial scales that might affect the SES of these communities. Second, I unveil the understanding of knowledge diversity as entwined with sociocultural and ecological diversity of different contexts and discuss the need for moving from a colonial, hierarchical way to a cosmological, symmetrical way of addressing IPLC and ILK. Doing so, requires decolonizing science and policy by politicizing the power and implications involved in policy participatory processes. It also reruires adopting a 'cosmopolitics' that promotes the flourishing of IPLC's pluriverses of thinking, being, and governing resources and the needs of both humans and nature. Third, I reflect on the merits and drawbacks of using Ethnoecology as an umbrella approach to link different schools of thought while conducting PAR. I highlight how data is enriched in both reliability and content by including informants as participants of the research and by cross-fertilizing ILK and knowledge from social and natural disciplines with a methodological bricolage. I also emphasize that using this approach was challenging as applying this bricolage requires adjusting the understanding of theory and grounded data throughout the data collection and analysis, which creates complexity. I end the chapter with practical recommendations that are drawn from the lessons in the cases studied for science and policy actors to adopt an ethical practice towards furthering the legitimacy and effectiveness of policies that include IPLC and ILK. This practice is proposed for these actors to adopt technologies of humility, reflexive questioning, and methodological bricolage to negotiate knowledge with these communities on epistemological, ontological, and political levels. It is my hope that these scientific contributions support sustainable futures in which diversity is promoted.

RESUMO

A luta que os Povos indígenas e as comunidades locais (PICL) do hemisfério Sul enfrentam para obter reconhecimento dos seus Conhecimentos indígenas e locais (CIL) e da sua diversidade sociocultural, bem como para garantir as suas necessidades e os seus meios de subsistência e direitos, é uma questão que ainda aguarda ser devidamente tratada politicamente. As políticas ambientais têm objetivado incluir o CIL junto ao conhecimento científico, em levantamentos de recursos naturais e no planejamento do manejo e da governança desses recursos, por meio de processos envolvendo conhecimento dos quais os PICL participam. Esses processos buscam integrar ou criar pontes entre esses sistemas de conhecimento, por meio da integração de categorias e critérios de classificação que são empregados no conhecimento científico e no CIL – tais como aqueles relacionados aos solos. Assim, esses processos apoiam a coprodução de conhecimentos compartilhados e/ou de novos conhecimentos pelos técnicos ambientais que implementam políticas ambientais e os PICL. Embora essas políticas objetivem, desse modo, ampliar as contribuições-chave do CIL para a conservação global da natureza, a biodiversidade e o bem-estar humano, elas têm enfrentado desafios para incluir a diversidade de conteúdos e significados que constituem o conhecimento de diferentes PICL. Esses desafios acabam por ameaçar as necessidades dos PICL e por impedir que as políticas ambientais cumpram os seus objetivos pretendidos, de melhorar a conservação ambiental e o bem-estar humano. Por esse motivo, a preocupação atual central dos cientistas e atores políticos que colaboram entre as interfaces da ciência-política ambiental é avançar a *legitimidade* dos processos e resultados envolvendo conhecimento realizados no âmbito de levantamentos e planejamentos ambientais, para que eles sejam reconhecidos como válidos, dignos de credibilidade, relevantes e alinhados com a diversidade das diversas formas de conhecimento dos diferentes participantes desses processos (ou seja, técnicos, cientistas e PICL). Objetiva-se, ainda, avançar a *efetividade* desses processos resultados, para atender a ambas as necessidades locais e as metas políticas envolvidas em diferentes contextos.

No **Capítulo 1** desta tese, eu apresento três desafios destacados na literatura que os atores envolvidos na implementação de políticas ambientais (incluindo gestores formuladores dessas políticas e técnicos ambientais) têm enfrentado para incluir PICL e CIL de forma legítima e efetiva em levantamentos e planejamentos ambientais. Em primeiro lugar, destaca-se a tendência que ambos os estudiosos que provêm abordagens ou modelos científicos e os profissionais que as usam para implementar políticas com PICL têm, de tratar o conhecimento científico e o CIL (não científico) de forma dicotômica e hierárquica. Essa tendência tem, muitas vezes, levado à extração e redução do CIL. Como tal, o CIL é despojado dos significados que ele possui nos contextos de PICL onde ele é utilizado, para se ajustar às categorias de classificação científica e aos conceitos e critérios de validação de conhecimento que são priorizados para serem incluídos nos resultados dos processos envolvendo conhecimento empregados nessa implementação. Em segundo lugar, nota-se que esses atores têm falhado para estabelecer uma ponte entre as suas visões de mundo e ontologias filosóficas Ocidentais com as visões de mundo e ontologias holísticas dos PICL. Como resultado, estes profissionais têm deixado de incluir as visões de mundo – bem como os valores, as crenças e aspirações relacionadas a elas – que fundamentam as decisões dos PICL durante esses processos envolvendo conhecimento. Assim, eles têm falhado para se interconectar com o holismo contido no CIL, de modo a criar entendimentos relacionais sobre as pessoas e a natureza; entendimentos estes que são importantes para tratar da conservação ambiental e do bem-estar humano de forma conjunta em contextos locais. Em terceiro lugar, as relações de poder desiguais – entre técnicos ambientais, PICL e outros participantes nos processos de políticas ambientais, têm restringido a participação efetiva dos PICL, necessária para

moldar esses processos e incluir o seu CIL nos resultados dos mesmos. No entanto, o papel do poder e da 'performatividade' – ou seja, do caráter não inteiramente controlável das práticas sociais que moldam esses processos – têm sido subestimados. Afinal, os cientistas que têm se debruçado sobre o estudo desses processos têm se concentrado em aperfeiçoar métodos e abordagens para avançar a legitimidade e efetividade dos mesmos, ao invés de dar atenção às relações de poder que guiam esses processos.

Os desafios mencionados acima, relacionados a "conhecimentos", "visões de mundo" e "poder", tendem a persistir. Sendo assim, o objetivo desta tese é compreender: como promover a legitimidade e efetividade de processos e resultados envolvendo sistemas de conhecimento, realizados no âmbito da implementação de políticas ambientais que visam incluir PICL e CIL. Este objetivo é investigado por meio das seguintes perguntas de pesquisa:

1. Qual conhecimento, científico, indígena e local, precisa ser incluído nas abordagens e nos modelos adotados por políticas ambientais para garantir que essas políticas se alinhem às necessidades e aos contextos de PICL?

2. Como diferentes visões de mundo são interconectadas para permitir a inclusão de entendimentos relacionais sobre o ser humano e da natureza em levantamentos e planejamentos ambientais?

3. Como, e em que medida, técnicos ambientais e PICL reconhecem e superam relações de poder desiguais entre si, durante processos participativos envolvidos com a implementação de políticas ambientais, na prática?

No **Capítulo 2**, eu explico a abordagem de pesquisa 'guarda-chuva', baseada na Etnoecologia, que eu adoto para responder as perguntas de pesquisa da tese. Eu me baseio na compreensão etnoecológica do CIL, segundo a qual esse conhecimento integra tríades de 'conhecimento-práticas-visões' de mundo (c-p-v). Estas tríades são constituídas em entrelaçamento com as especificidades socioecológicas de escalas espaciais locais, dentre outras, ao longo do tempo. Eu também vinculo princípios metodológicos da Etnoecologia e da Pesquisa-ação participativa (PAP) que tratam simetricamente (de modo não-hierárquico) diferentes sistemas de conhecimento e seus detentores. Eu recorro à PAP, a qual é frequentemente adotada na Etnoecologia, para estabelecer uma abordagem de pesquisa crítico-emancipatória. Essa abordagem se baseia em uma 'bricolagem metodológica', ou seja, em uma estratégia aberta e criativa que eu uso para cobrir e conectar elementos conceituais e metodológicos de diferentes escolas de pensamento que eu adoto para poder investigar a inclusão de PICL e CIL em políticas ambientais. Especificamente, eu adotei elementos das áreas: Estudos da Ciência e Tecnologia (ECT), relacionados à análise interpretativa de discursos e da performatividade das práticas sociais; pós-humanismo; análise geográfica do 'território' e da 'paisagem'; sistemas socioecológicos' (SSE) e pensamento complexo (Folke, 2006; Berkes, 2009); e teoria pós-colonialista sobre CIL e diversidade (Escobar, 2012). A forma adotada para analisar os dados da pesquisa, usando elementos dessas escolas de pensamento, é detalhada nos Capítulos 3, 4 e 5; os quais foram publicados como artigos distintos de periódicos.

Além de apresentar a abordagem de pesquisa utilizada na tese, o Capítulo 2 introduz os dois estudos de caso que eu analiso na tese, ambos localizados no Brasil. As áreas de estudo são: i) a 'Comunidade Quilombola de Malhada Grande' (CQMG), na região semiárida do Estado de Minas Gerais; e ii) a 'Terra Indígena Kaxinawá de Nova Olinda' (TIKNO), que integra a região amazônica

do estado do Acre. A coleta de dados em ambas estas áreas incluiu entrevistas, observação participante e oficinas nas quais foram empregados diversos métodos etnoecológicos. Enquanto ambos os casos de CQMG e TIKNO se concentraram no levantamento participativo do CIL ambiental, o estudo na TIKNO também incluiu o estudo de um processo de implementação de um levantamento e planejamento ambiental envolvendo um Manejo colaborativo adaptativo (MCA). Esses processos de levantamento e planejamento foram facilitados por técnicos ambientais da política de 'Sistema de Incentivo a Serviços Ambientais' – ou ecossistêmicos – (SISA) do Estado do Acre, vinculada ao programa 'Redução de Emissões por Desmatamento e Degradação Florestal' (REDD+). Além disso, esses estudos de caso se complementam, visto que o primeiro trata de um conhecimento local, enquanto o último trata de um conhecimento indígena, os quais estão respectivamente relacionados a comunidades locais e a povos indígenas. A análise qualitativa dos dados coletados nessas áreas se baseou principalmente na codificação temática desses dados. Esta análise abarcou os discursos científico, político e dos PICL e esteve focada em na referência a termos relacionados às categorias centrais de análise da tese: 'conhecimento', 'visões de mundo' e 'poder'. A coleta e análise de dados relativos ao CIL e aos sistemas de classificação científica se centrou nos solos e se baseou na Etnopedologia – ramo da Etnoecologia que associa o conhecimento científico e o CIL sobre os solos. O foco nos solos me permitiu aprofundar a minha análise sobre esses sistemas de conhecimento e, ao mesmo tempo, relacionar dados sobre os solos a dados relativos à vegetação, à paisagem e ao uso da terra; todos estes relevantes para o levantamento e planejamento ambiental.

Os Capítulos 3, 4 e 5 consistem em três artigos distintos da minha autoria que foram publicados em periódicos revisados por pares. No **Capítulo 3**, eu desenvolvo e aplico o modelo teórico-metodológico "Redes de Sistemas Socioecológicos Territoriais" (RSSET). Esse modelo é proposto como uma forma de estudar a paisagem objetivada a auxiliar o levantamento de quais conteúdos, relacionados ao conhecimento científicos e ao CIL, são relevantes para informar o planejamento ambiental com um saber inter e transdisciplinar que atenda necessidades de PICL e metas políticas em diferentes contextos. O modelo RSSET se baseia na premissa de que não só o CIL, mas também o conhecimento científico (de cientistas e profissionais técnicos) é (in)formado por tríades de c-p-v. Além disso, o contexto local associado ao CIL é concebido como uma paisagem que expressa processos e funções territoriais que incluem componentes sociais, políticos, econômicos, culturais e ecológicos. A aplicação do modelo RSSET no caso CQMG destacou o papel que as interações e redes socioecológicas de diferentes escalas espaço-temporais têm sobre a coprodução da paisagem desta área, bem como sobre o funcionamento do território local como um SSE que articula diversas escalas epistemológicas, ontológicas, históricas e espaciais. Essa aplicação possibilitou, ainda, uma análise das sinergias e dos "prós e contras" relacionados às necessidades globais e locais ligadas a diferentes prioridades de conhecimentos e em vista das especificidades locais. Considera-se que esse modelo apoia acadêmicos e profissionais na identificação de conhecimentos e necessidades prioritários em contextos de PICL. Como tal, este capítulo aborda **as perguntas de pesquisa um e dois da tese**.

O **Capítulo 4** consiste em um estudo de caso aprofundado realizado na TIKNO e que envolveu a política do SISA (REDD +). Este estudo visa compreender os desafios que técnicos ambientais e PICL enfrentam para concretizar a inclusão legítima de sistemas de conhecimento, disciplinas sociais e naturais, e visões de mundo diversos; bem como – e "se" – essa concretização permite que técnicos e PICL considerem o ser humano e a natureza de forma interrelacionada. Para tanto, eu analiso como os processos de conhecimento envolvidos no âmbito da implementação participativa de políticas

ambientais são moldados pelos discursos: i) de cientistas – contidos em abordagens e modelos de alcance global que se baseiam nos conceitos de 'serviços ecossistêmicos' (SE) e de 'contribuições da natureza para as pessoas' (CNP); ii) de gestores e técnicos ambientais, que se valem dessas abordagens e desses modelos para realizar levantamentos e planejamentos ambientais com PICL; e iii) dos Kaxinawás da TIKNO. Eu também exploro o conceito de 'contribuições das pessoas para a natureza' (CPN), em complemento aos conceitos de SE e CNP. Eu argumento que é crucial avaliar as CPN para a compreensão relacional (holística) da natureza e das pessoas, e que técnicos ambientais precisam considerar essas contribuições junto com as CNP para tratar da conservação ambiental, da biodiversidade e do bem-estar humano juntos. Além disso, o capítulo problematiza a lacuna existente entre levantamentos e planejamentos ambientais, que se focam respectivamente em conhecimentos e visões de mundo e em práticas; enquanto esses três elementos constituem CPN que afetam o estado dos ecossistemas e que deveriam ser considerados para se cumprir necessidades locais e objetivos políticos. O capítulo aborda **as três perguntas de pesquisa** da tese, pois investiga a criação de pontes entre visões de mundo para a criação de entendimentos relacionais; a inclusão de tais visões junto a conhecimentos em processos e resultados envolvendo a integração e coprodução de saber; e o papel das relações de poder nesses processos. Os resultados destacam que os atores que atuam na interface ciência-política precisam abordar explicitamente essas relações de poder e o papel das CPN sobre SE e CNP para promover a legitimidade e efetividade de tais resultados.

O **Capítulo 5** se baseia no estudo de caso TIKNO/SISA para investigar como os participantes de processos de integração e coprodução de conhecimento, feitos como parte de levantamentos e planejamentos participativos ambientais, gerenciam desafios encontrados, ligados a relações de poder desiguais. Eu analiso como e "se" esses desafios são gerenciados por técnicos e PICL, de modo a salvaguardar a diversidade de conteúdos e significados dos conhecimentos científico e indígena, bem como esse gerenciamento afeta a usabilidade dos resultados desses processos. Eu exploro se os processos e resultados ligados à integração e coprodução de conhecimento estão de acordo com necessidades locais e objetivos políticos, e em sintonia com o contexto socioecológico local. O capítulo detalha a maneira como integração e a coprodução de conhecimento se complementam e ocorrem por meio de diferentes processos. Estes incluem a mobilização, tradução e interligação de categorias e nomenclaturas de classificação e de critérios classificatórios (indicadores) de validação de conhecimento. Além disso, são apresentados desafios que surgem durante esses processos, bem como estratégias usadas pelos técnicos envolvidos que obtiveram êxito ou falharam para lidar com esses desafios. O capítulo se concentra na **pergunta de pesquisa 3**, pois analisa como técnicos e PICL gerenciam relações de poder para tratar diferentes sistemas de conhecimento de forma não-hierárquica e não-dicotômica. Os resultados ressaltam que, apesar do uso de métodos e metodologias participativas, a inclusão da diversidade que compõe cada sistema de conhecimento pode ser comprometida, caso os técnicos envolvidos não se atentem suficientemente às assimetrias de poder encontradas. Essas assimetrias podem levar a decisões que não estão em conformidade com o CIL e que geram resultados que não são legítimos nem utilizáveis pelo PICL envolvidos. O capítulo é concluído com a evocação de uma 'ética prática' que, ao invés de enfocar o aperfeiçoamento de métodos, abordagens e modelos, se baseia em diálogos culturalmente e eticamente sensíveis. Propõe-se uma reflexão contínua por parte de técnicos ambientais e PICL para responder a dinâmicas de poder desiguais e garantir a legitimidade e usabilidade de processos de conhecimento e dos seus resultados.

Finalmente, no **Capítulo 6**, eu utilizo os resultados dos Capítulos 3, 4 e 5, para responder às três questões de pesquisa da tese. Com relação à **pergunta um**, a análise de dados mostrou que os sistemas de conhecimento científico, indígena e local que precisam ser incluídos em abordagens e modelos adotados em políticas ambientais e nos resultados de processes envolvendo diferentes sistemas conhecimento estão relacionados a: categorias de classificação e critérios e conceitos relacionados; visões de mundo, bem como ontologias, valores, aspirações e crenças relacionados; e práticas de integração/coprodução e utilização de conhecimentos. A inclusão legítima desses conteúdos de conhecimento em levantamentos e planejamentos ambientais requer a manutenção dos significados que constituem a diversidade interna a cada sistema de conhecimento, bem como de um conhecimento compartilhado e consensual. Tanto o CIL quanto o conhecimento científico têm uma base relativamente homogênea que é compartilhada entre os seus respectivos detentores, além de uma heterogeneidade de significados que se adiciona a essa base. Essa heterogeneidade está relacionada às competências e práticas vivenciais que os detentores desses sistemas de conhecimento desenvolvem e ao contexto em que eles estão inseridos. Respondendo à **pergunta dois**, as visões de mundo são interligadas, durante processos de levantamento e planejamento ambiental, por meio de processos de diálogo, reflexão e negociação de valores sobre as pessoas e a natureza, bem como de aspirações e de significados cognitivos. Essas visões de mundo podem ser adotadas em sua pluralidade, mas podem precisar ser transformadas para que os participantes nesses processos possam atingir objetivos e conhecimentos compartilhados e adaptar o uso e manejo de recursos naturais. Os atores científicos e políticos avaliam e compreendem o significado simbólico e pragmático das visões de mundo dos PICL (por exemplo, crenças espirituais) ao participarem de práticas locais e ao ouvirem histórias ambientais locais. Uma vez que as visões de mundo Ocidental e de IPLC se tornam vistas como interligáveis, técnicos e PICL se tornam capazes de coproduzir entendimentos relacionais, os quais apoiam a criação de decisões de conhecimento legítimas e a obtenção de resultados da implementação de políticas ambientais que são efetivos para endereçarem as pessoas e a natureza. Finalmente, em relação à **pergunta três**, as relações de poder desiguais entre planejadores e PICL podem ser notadas mesmo quando esses atores almejam compartilhar poder para tomarem decisões durante a integração e coprodução de conhecimento. Humildade, questionamento reflexivo e bricolagem metodológica foram propostas e confirmadas como sendo estratégias-chave que permitem que técnicos ambientais adaptem seus métodos e suas atitudes para nivelar essas relações. Além disso, a efetividade dos resultados de processos envolvendo conhecimento depende da conscientização de técnicos e PICL sobre as implicações da inclusão e exclusão de fragmentos de conhecimento científico e CIL sobre ambos os contextos e necessidades locais e os objetivos políticos envolvidos. Ainda assim, para serem reconhecíveis, legítimos e utilizáveis pelos PILCL, esses resultados das políticas, tais como mapas e relatórios, devem ser produzidos para atender não apenas à comunidade política, mas também aos PICL.

O Capítulo 6 também inclui uma discussão aprofundada sobre temas importantes que são levantados na tese, decorrente das respostas às perguntas de pesquisa. Em primeiro lugar, eu discuto a inclusão de PICL e CIL nas políticas ambientais, rumo a uma coprodução de conhecimento legítimo e efetivo que lida confronta relações de poder desiguais entre atores políticos e esses povos e comunidades. Eu destaco que esses atores devem levar em conta o ‘caráter situacional’ e performativo (ou contingente) dos processos de conhecimento ligados a essa coprodução, bem como os diversos critérios que os detentores de conhecimentos científicos e CIL usam para validar conhecimentos como dignos de credibilidade e relevância durante esses processos. Desta forma, o poder pode ser gerenciado

na prática, visando a elaboração conjunta de resultados. Eu também enfatizo que a efetividade das políticas ambientais depende não apenas de decisões que sejam confiáveis para promover conservação e bem-estar, mas também do monitoramento, em longo-prazo, da adoção de planejamentos ambientais resultantes por PICL e da consideração das práticas de atores de diversas escalas espaciais que podem afetar os SSE desses povos e comunidades. Em segundo lugar, eu desvelo a compreensão da diversidade do conhecimento como estando entrelaçada à diversidade sociocultural e ecológica de diferentes contextos e discuto a necessidade de passarmos de uma forma colonial e hierárquica para uma forma cosmológica e simétrica de tratamento a PICL e CIL. Essa passagem requer a descolonização da ciência e da política, por meio da politização das implicações e das relações de poder envolvidas em processos políticos participativos. Ela também requer a adoção de uma 'cosmopolítica' que promova o florescimento dos 'pluriversos' (ou universos plurais) de pensar, ser e governar recursos naturais e necessidades dos humanos e da natureza. Em terceiro lugar, eu reflito sobre os méritos e as desvantagens encontrados ao se usar a Etnoecologia como uma abordagem "guarda-chuva" para vincular diferentes escolas de pensamento durante a realização de uma PAP. Eu destaco como os dados são enriquecidos, em confiabilidade e conteúdo; uma vez que os informantes da pesquisa são tratados como participantes na mesma, e que o CLI é fertilizado com conhecimentos das disciplinas sociais e naturais via uma bricolagem metodológica. Eu também enfatizo que foi um desafio usar essa abordagem; pois a aplicação dessa bricolagem requer o ajuste do entendimento teórico e dos dados gerados na pesquisa, ao longo da coleta e análise de dados, o que cria complexidade. Eu termino o capítulo com recomendações práticas que foram extraídas das lições obtidas com os casos estudados, para que atores científicos e políticos adotem uma 'prática ética', no sentido de promover a legitimidade e a efetividade das políticas que incluem PICL e CIL. Essa prática é proposta para que esses atores adotem tecnologias de humildade, questionamento reflexivo e bricolagem metodológica para negociar conhecimentos com esses povos e comunidades, nos níveis epistemológico, ontológico e político. Eu espero que essas contribuições científicas apoiem futuros sustentáveis nos quais a diversidade seja promovida.

LIST OF ACRONYMS

COMPLETED TRAINING AND SUPERVISION PLAN

Fernanda Ayaviri Matuk
Wageningen School of Social Sciences (WASS)

Name of the learning activity	Department/ Institute	Year	ECTS
A. Project related competences			
Introduction to Interpretive Research Design course	WASS	2016	3
SENSE Introductory course	SENSE equivalent to WASS	2016	2
Writing Research proposal	WASS	2016	6
Integrated Land Use Systems (Silviculture department) course	Freiburg University (Germany)	2016	5
"*Knowledge, worldviews, and practices of land use related to nature's benefits: contributions to an ethnoecological study on ecosystem services*"	Open international convention EMBRAPA, Acre, Brazil	2017	0,5
"*Advancing the inclusion of Indigenous and local knowledge in the implementation of environmental policies*"	WUR, FOREFRONT PhD discussion group	2016-2019	1
"*Ethnoecological knowledge exchange and participatory land use planning: the case of SISA policy in the Amazon Kaxinawá Nova Olinda Indigenous Land*"	World Soil Conference, WUR, Netherlands	2017	1
"*Incorporating local knowledge, practices and worldviews into integrated land use planning when implementing REDD+ on the ground: the case of Kaxinawá Indigenous Land (Acre –Brazil*)"	FLARE Conference, Sweden	2017	1
"*Detangling knowledge integration to co-produce adaptive co-management: the case of the SISA policy and the Kaxinawá Nova Olinda Indigenous Land*"	WASS PhD day	2018	0.5
Writing retreat of the Governance and FNP cluster	WASS	2018	1
B) General research related competences			
Spatial thinking in the social sciences: on the local, the rural and nature course	WASS	2016	4
Grasping Sustainability	SENSE	2018	2
Scientific Writing	WGS	2017	1.8

Qualitative Data Analysis	WASS	2017	2,5
C) Career related competences/personal development			
"*Advancing the inclusion of Indigenous and local knowledge in environmental science and policy*"	FNP/WASS	2017	0.5
Workshop given at the FLARE conference	Stockholm University	2017	1
Workshop given at the Alumni Day (WUR 100 years event)	WUR	2018	1
Master class workshop offered by FNP in complementation to the SDG Conference (2018)	FNP/WUR	2018	1
Workshop given at the Farmers Internship experience event of the Boerengroep WUR association - WUR (2018); named: "*Participatory research and the Farm Internship Experience*"	WUR	2018	1
Guest lecture together with prof. Verina Ingrand (FNP) on "Participatory *methods for research fieldwork*", SDC 33306	SDC/WASS	2018	0.5
PhD representative of the FNP chair group (1 year)	FNP	2018	1.5
Workshop given at the Event of Vodsel Anders: "Why and how to include agrobiodiversity including Indigenous and Local knowledge"	Boeregroep/Voedsel Anders/WUR	2019	1
T**otal**			**38.8**

*One credit according to ECTS is on average equivalent to 28 hours of study load

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