INCLUSION OF INDIGENOUS KNOWLEDGE

Knowledge Co-Production for Conservation and Sustainable Development in the Amazon

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Dissertação

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DECLARAÇÃO DE AUTORIA

Eu Hanna Katharina Becker, declaro que a presente dissertação de mestrado intitulada "INCLUSION OF INDIGENOUS KNOWLEDGE Knowledge Co-Production for Conservation and Sustainable Development in the Amazon", é o resultado da minha investigação pessoal e independente. O conteúdo é original e todas as fontes consultadas estão devidamente mencionadas na bibliografia ou outras listagens de fontes documentais, tal como todas as citações diretas ou indiretas têm devida indicação ao longo do trabalho segundo as normas académicas.

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Lisboa, 30.10.2025

RESUMO

Esta pesquisa analisa os métodos e desafios da coprodução de conhecimento entre atores externos e povos indígenas e comunidades locais nos esforços de sustentabilidade amazônica, buscando construir pontes éticas e inclusivas entre diferentes sistemas de saber. Embora o papel do conhecimento indígena na conservação e governança seja amplamente reconhecido, ainda há uma lacuna significativa, marcada pela ausência de ferramentas e métodos práticos que favoreçam a integração efetiva do Conhecimento Local Indígena. Para enfrentar essa lacuna, o estudo reúne percepções obtidas por meio de revisão de literatura, revisão de escopo sobre o contexto amazônico, análise qualitativa de 14 estudos de caso e seis entrevistas semiestruturadas com participantes indígenas, locais e externos, vinculados a três iniciativas de cocriação.

As revisões efetuadas destacaram a importância de incorporar o Conhecimento Local Indígena como resposta às ameaças das indústrias extrativas, das mudanças climáticas e do desmatamento. A análise dos casos revelou padrões recorrentes para uma colaboração bem-sucedida, como a valorização das epistemologias indígenas, o uso de metodologias participativas lideradas pelas comunidades, a promoção de governança multiescalar, a influência do conhecimento indígena sobre políticas públicas, a geração de co-benefícios socioecológicos pela bioeconomia e a adoção de abordagens baseadas em direitos e justiça. Observou-se, entretanto, escassez de registros detalhados dos processos, o que limita o avanço metodológico.

As entrevistas mostraram que o intercâmbio de conhecimento depende de relações de longo prazo e compromisso mútuo, sendo mais eficaz quando mediado por práticas vivenciais — como oficinas, caminhadas e narrativas coletivas — em vez de formatos abstratos. Persistem desafios ligados a diferenças epistemológicas, barreiras logísticas e à necessidade de garantir continuidade estrutural. Conclui-se que a coprodução equitativa requer mudança de paradigma, priorização de metodologias adequadas e apoio à autonomia indígena, favorecendo colaborações sustentadas que impulsionam um desenvolvimento justo e duradouro na Amazônia.

Palavras-Chave

Conhecimento Indígena; Coprodução de Conhecimento; Sustentabilidade; Conservação; Floresta Amazónica

ABSTRACT

This research investigates the methods, and inherent challenges in the co-production of knowledge between external actors and Indigenous Peoples and Local Communities (IPLC) in Amazonian sustainability efforts. The investigation aims to contribute to bridge diverse knowledge systems in an ethical and inclusive way. While the literature acknowledges the critical role of IPLCs knowledge in conservation and governance, a significant knowledge gap persists, marked by a deficit of practical tools and methods for Indigenous Local Knowledge (ILK) inclusion. Addressing this gap, this study synthesizes insights from: authors-based literature review, scoping review of amazonian context, qualitative content analysis of 14 case studies, and six semi-structured interviews, including external and indigenous/local participants, from three distinct co-creation initiatives.

The reviews underscored the need of integrating ILK to counter threats from extractive industries, climate change, and deforestation. The case study synthesis identified six key patterns for successful collaboration: (1) prioritizing Indigenous epistemologies, (2) adopting participatory/community-led methodologies, (3) fostering multiscalar governance, (4) using ILK knowledge for policy influence, (5) realizing socio-ecological co-benefits through bioeconomy, (6) and employing rights-based/justice-oriented approaches. A key finding was the predominant lack of detailed process documentation, limiting insights into specific methods and tools. In-depth interviews revealed that successful knowledge exchange is based on relational, long-term engagement and commitment. ILK was most effectively transmitted through practice-based, experiential methods (hands-on workshops, forest walks, collective storytelling), rather than abstract, textual formats. Common challenges across the cases include distinct epistemologies, overcoming logistical hurdles, and ensuring infrastructural continuity for long-term impact.

The study concludes that achieving equitable and effective co-productions necessitates a paradigm shift towards genuinely prioritizing practical, adequate methodological designs. Further, fully supporting Indigenous autonomy and transition from short-term interventions to institutionally embedded, sustained collaborations at the speed of trust. These findings provide critical empirical insights for developing culturally responsive methodologies and ethical frameworks essential for accelerating just and sustainable development in the Amazon and beyond.

Keywords:

Indigenous Knowledge; Knowledge Co-production; Sustainability; Conservation; Amazon rainforest

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The words listed here are used in this thesis in abbreviated form: Indigenous Local Knowledge (ILK); Indigenous Knowledge System (IKS); Indigenous Knowledge (IK); Indigenous People and Local Communities (IPLC); Socio-Ecological Systems (SES); Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES).

1. Introduction

1.1 Contextual Setting

Although anthropic domination has resulted in significant improvements in human welfare it is also identified as the major driver of critical negative global changes in water cycles and water scarcity, climate, biodiversity loss, food security issues and ecosystem deterioration mainly caused by the production and consumption behavior in industrial and postindustrial societies (Merçon et al., 2019; Norström et al., 2020).

Emerging sustainability challenges are interconnected, intractable, complex, and influenced by various cross-scale drivers and feedback mechanisms (Norström et al., 2020). These issues have arisen amid the converging dynamics of colonialism, modernism, and industrial capitalism, which practices and logics are structured by distinct categories: society and nature. This has generated an utilitarian notion of nature, fostered through extractive resource practices (West et al., 2024) and has reached the jeopardization of planetary boundaries which are essential for both societal and environmental wellbeing (Norström et al., 2020; *Planetary Boundaries*, n.d.). Against this background, there are endeavors to safeguard natural environments through conservation measures and the establishment of protected areas (West et al., 2024) alongside growing efforts to tackle global social inequality (Minoia et. al., 2024).

In this context, Knowledge co-production is an increasing area in sustainability science practice and research (Chambers et al., 2021). Its underlying rationale is that to examine and tackle the complexity of current unsustainability problems it is necessary to involve various groups of individuals with distinct needs, and interests, who are plagued by political, social, and administrative uncertainty (Norström et al., 2020). The turn to *diverse* knowledge co-production is seen as a promising approach to progress in multi-layered and complex topics (Norström et al., 2020; Chambers et al., 2021).

Here *diverse* refers to challenging the hegemonic idea of Western scientific knowledge, the current dominant knowledge system, as the prevalent standards-setting for research. The latter exists through practices, agents and institutions that manage it including its production, transfer and use (Lam et al., 2020). For informing decision-making, Western scientific knowledge is often seen as producing the most accurate, rigorous, and useful evidence (Tengö et al., 2021), as it employs the objectivity of measuring instruments to generate data from field work that is then converted into information through computer-based analysis (Tengö et al., 2021).

However, there is a growing rejection that scientific research alone investigates and identifies problems, and delivers findings to society. The shift towards multiple knowledge co-productions is expected to enable science to have a greater societal impact, through more interactive collaborations between non-academic and academic actors (Norström et al., 2020; Chambers et al., 2021). Moreover, scholars highlight that collaborating with other knowledge systems such as Indigenous local knowledge (ILK) and practices contributes significantly to meet and overcome urgent sustainability challenges (locally and globally).

Therefore, there is a growing emphasis and interest to mobilize and incorporate ILK besides western-based science (Tengö et al., 2014, 2021; Kadykalo et al., 2021). Several reasons support this claim. For one, ILK embodies holistic, integrated, social and ecological knowledge, beliefs and practices pertaining to the relationship of living beings, including humans, with their environments and with one another (Hill et al., 2020a). ILK systems are developed through adaptation, observations and experimentation over centuries. These long-time co-evolutions can provide useful, valid knowledge, as well as theories, methods and practices (Tengö et al., 2014, 2021; Malapane et al., 2024), because it continuously evolves through innovations, interaction, experiences and multiple knowledge types (written, oral, visual, tacit, gendered, practical and scientific) (Hill et al., 2020a).

Furthermore, Indigenous People and Local Communities (IPLC) make up just 5% of the world's population, but their homelands make for 22% of the

planet's land area. These areas are located in regions with abundant biodiversity. In fact, they manage 80% of the global biodiversity (Fernández-Llamazares & Cabeza, 2018; SDGs, 2019). The UN states that Indigenous peoples, including their knowledge, are repeatedly underserved, under-represented in the climate change discourse (Quinones, 2025; *Indigenous Knowledges and Climate Change*, n.d.; SDGs, 2019). There is thus a significant ethical imperative to engage with various actors, such as IPLC, in the process of decolonizing knowledge (Lam et al., 2020) whilst fighting a growing decline in cultural diversity (Hanspach et al., 2020; Elands et al., 2019)

In short, because of how ILK is and how it can contribute; because of indigenous communities' high stake in the biodiverse natural environments that they live in, and the impact of changing environmental conditions affecting IPLCs lives and knowledge, these communities should be more and better included in projects/research related to these ecosystems. Namely ILK inclusion in knowledge co-production for sustainability transitions should seek a plural understanding of such transitions, moving past the epistemic supremacy of western scientific knowledge (Lam et al., 2020). It should, recognize and incorporate ILK in the design and implementation of operative environmental governance solutions, policy, research, and ecosystem stewardship (e.g. in biodiversity assessments, conservation, environmental research management) (Tengö et al., 2021; Kadykalo et al., 2021; Lam et al., 2020).

The issue of how to have a meaningful, true inclusion of ILK in such collaborations remains nevertheless a critical gap in the literature. There is a lack of appropriate methods and tools for ILK inclusion in projects and science. Experiences of which practices and activities work, or not, have been rarely mentioned, despite the urgent need to inform on how to bridge and mobilize ILK (Tengö et. al., 2021; Lam et. al. 2020; Malmer et al., 2020; Hill et al., 2020a). **This knowledge gap of appropriate methods and tools in collaborations with ILK is the core research problem I address in this thesis.**

As a research context I focus on tropical rainforest. In particular, the Amazon rainforest which is the biggest remaining tropical forest in the world (Butler, 2024). Its values and global ecosystem services are vital and diverse

(Foley et al., 2007), such as its crucial contribution to the global climate balance (Londres et al., 2023). Moreover, this region has been identified as one of the most culturally and biologically diverse areas worldwide (Loh & Harmon, 2005). In addition, complex, conflictive, and diverse socio-ecological systems in the Amazon rainforest include critical sustainability issues such as resource exploitation, deforestation and forest degradation, which threaten the ecosystem (Londres et al., 2023) and its inhabitants, such as IPLC (Trujillo, 2023; Juhasz, 2023).

Through generations of living within specific ecosystems, IPLCs have developed deep, context-specific ecological knowledge essential for effective forest conservation and restoration. Their territories make a substantial contribution to global biodiversity preservation and represent a critical component of climate change mitigation efforts (Londres et al., 2023; Garcia et al., 2024). Diverse Amazonian initiatives integrate ILK with sustainable rainforest management—ranging from state-led to community-based efforts—and have fostered local innovation and resilience. Though vital for regional sustainability, these initiatives remain largely overlooked in academic research (Brondizio et al., 2021a). Furthermore, their potential is frequently insufficiently recognized as transformative pathways. Numerous social and environmental projects in the Amazon use forest based land-use techniques and practices to support local livelihoods and encourage rural sustainable development (Londres et al., 2023). Recent discourse increasingly emphasizes the importance of recognizing and integrating IPLCs knowledge into scientific and policy frameworks for conservation. Advancing this integration requires innovative, collaborative mechanisms that facilitate equitable partnerships and support sustainable, long-term environmental governance (Malmer et al., 2020). Due to these numerous characteristics of this geographical region, and its particular relevance and potential, this thesis focuses on the Amazon region. **The topic of inclusive methods and tools is examined with regard to the Amazonian context.**

1.2 Key Definitions

The following section introduces the key concepts used in this thesis, its similarities and differences. Of particular interest are the definitions regarding indigenous people, indigenous knowledge forms and the diverse knowledge collaboration forms in the context of sustainability transitions.

Purcell (1998) states that “The word *indigenous* has been used to refer to specific groups of people defined by the criteria of ancestral territory, collective cultural configuration, and historical location in relation to the expansion of Europe. Since the 1980s, however, the term has evolved beyond its specific empirical reference. Combined with the term *knowledge*, it has come to signify a social science perspective as well as a philosophical and ideological position (…)” (Purcell, 1998, p.1).

To this effect, when talking about *Indigenous and local knowledge* and *indigenous peoples and local communities*, Hill and colleagues (2020a) highlight that these terms have different meanings in different contexts and geographical areas (Hill et al., 2020a). In sync, “Philosophers of science, activists, and practitioners of indigenous knowledge have debated the status of indigenous knowledge with respect to science. *Indigenous knowledge* is often used synonymously with *local knowledge* or *ethnoscience*, indicating a body of knowledge specific to a certain culture. Science and Technology Studies scholars, however, suggest that all knowledge, including scientific knowledge, is specific to its context” (Philip, 2015, p.1). Furthering this argument, Lam et al. (2020) defined *Indigenous local knowledge* or traditional *ecological knowledge* 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” (Berkes, 2018, p.8).

In sustainability transitions research, according to the literature review of Lam and colleagues (2020), the term ILK is used as an umbrella term of indigenous, traditional, or local knowledge systems. Some authors use just one description, but most papers (n = 60, 74%) used synonymously different terms (Lam et al., 2020).

Further Tengö and colleagues (2021) state that some projects working with citizen science, aiming to engage ILK-holders, use the term Indigenous science. In fact, indigenous people and local communities are in some cases a crucial group of citizen scientists, but the term *science* may or may not be acceptable or adequate to all ILK holders due to the historical legacies of colonialism (Tengö et al., 2021).

In this thesis, in sync with Lam and colleagues (2020), the collective term *indigenous local knowledge* (ILK) is applied to refer indistinguishably to the knowledge types of traditional *ecological knowledge*, *indigenous science*, and *indigenous knowledge*. This is done to find a common term amongst the literature cited.

1.3 Research Design

1.3.1 Problem(s) Definition

This thesis builds on a critical and current problem: the lack of methods and tools to enable the inclusion of ILK in knowledge co-production practices. This problem (Figure 1) will be investigated in the context of the Amazon rainforest, and its specific socio-ecological problems as well as its conservation, sustainable development, management and use.

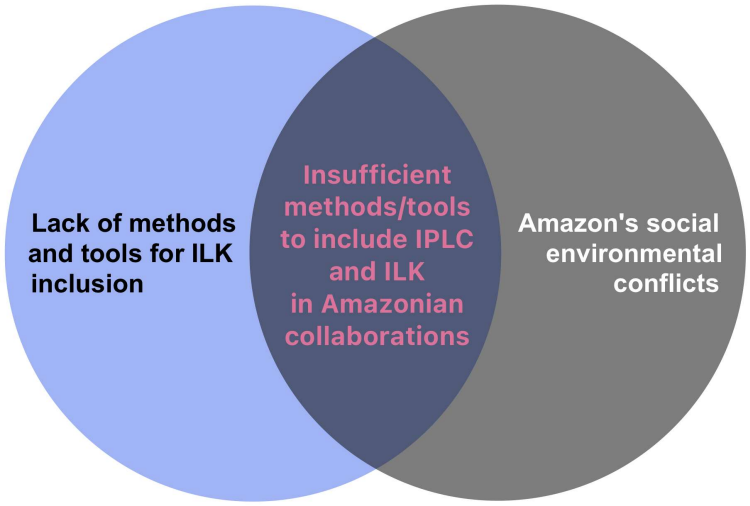

Figure 1: Problem Definition, by Author (2025)

1.3.2 Hypothesis and Key Research Question

Three hypotheses originated from my initial research exploration on ILK inclusion in sustainability research and practice:

1. ILK is a critical element of just and ethical decision-making in the Amazon rainforest.
2. ILK enriches and holds key answers to sustainability problems in the Amazon.
3. There are insufficient methods and practices to enable the inclusion of IPLC and ILK in sustainable transition/development research and practice.

Out of these hypothesis springs my key research question:

How to better include ILK in Sustainability research and practice in the Amazon?

1.4 Aim and Objectives

The primary research aim is to identify knowledge co-production methods and tools to facilitate the inclusion of ILK in sustainability endeavors such as local initiatives, NGOs and policy frameworks. The results of this thesis can contribute to inform future sustainability projects/studies of adequate ILK inclusion methods. By pursuing these following four objectives, this research aims to contribute to a more ethical, just, inclusive and plural collaboration between diverse actors and knowledges, specifically in projects related to environmental management, sustainable development and conservation projects in the Amazon.

To achieve this aim, the following objectives will be pursued:

1. To provide an overview of Maria Tengö's work including current knowledge co-production research, approaches and frameworks, additionally identifying strengths and weaknesses.
2. To outline the current situation of Amazon conflicts related to unsustainable land-use practices and conservation efforts, further the impact on IPLC.

3. To investigate amazonian-based projects which included ILK, to identify the methods and tools used in their collaborative processes and evaluate their usefulness according to participants' perceptions.
4. To propose a typology of ILK inclusion methods based on the evaluation of findings.

1.5 Methodology

The structure of this thesis builds on the Design Council Double Diamond Framework (Design Council, n.d.), which consist of the four work phases: discover, define, develop, deliver.

This thesis follows a mixed-method approach, including an author-based literature review, multiple case study analysis, semi-structured interviews and thematic analysis of interview transcripts. The combination of these research methods allows a comprehensive exploration of the research topic at hand.

1.5.1 Literature Reviews

(1. Exploratory Review) Initially to approach the topic *ILK Inclusion* an exploratory literature review using the keywords; *Indigenous Local Knowledge; Inclusion*; and *Sustainability*, was conducted on the platforms Web of Science[1] and Scopus[2]. These two platforms were chosen because both are multidisciplinary databases, the information provided indicate the active journals that cover current and relevant research; and they play a prominent role in shaping potential research fields (Chadegani et al., 2013). This bibliographical exploration was applied to approach the research topic, get an general overview of the current research landscape, introduce and frame the topic, as well as identify knowledge gaps.

Three applications were used to discover and categorize the related topics and visualize the literature and authors' interconnections:

[1] URL: https://www.webofscience.com/wos/woscc/basic-search
[2] URL: https://www.scopus.com/search/form.uri#basic

(1.1) The application's VOS viewer[3], was used to show a word network visualisation of related other topics (including current trends and potential areas for further research) related to publication data that includes the keywords *Indigenous Local Knowledge*; *Inclusion*; and *Sustainability*. The findings revealed, the topics e.g. climate change, biodiversity, conservation, management are closely related to these keywords, which already provides an understanding in which fields ILK has been incorporated.

(1.2) Open Knowledge Maps[4] was used to identify the most relevant publications related to the same three keywords (*Indigenous Local Knowledge; Inclusion; Sustainability*). The recommended research papers are clustered into main topics, the cluster “Indigenous and local knowledge, Biodiversity and ecosystem services” and “Indigenous knowledge systems, Forest education, Knowledge diversity” best fit the topic of this thesis’ endeavor. Therefore the publications of these groups were included.

(1.3) Litmaps[5] was mainly used to visualise the most important authors of the research area of Indigenous Local Knowledge Inclusion in Sustainability science and practice. With this tool Maria Tengö stood out as one of the authors most cited in this research field.

(2. Author-based Review) In order to structure the literature review, an approach was adopted, focusing first on the work of Maria Tengö, who is recognized as a leading figure in the field of Human-Nature Relationships. The decision to center the review on this particular author was guided by several methodological considerations.

First, Tengö and colleagues have made foundational and sustained contributions to the development of the field. Their seminal work, beginning with the Multiple Evidence Base approach (Tengö et al., 2014), has shaped both the theoretical and practical methodological directions of contemporary research on knowledge co-productions with ILK. This is evidenced by the high frequency of

[3] URL: https://www.vosviewer.com/
[4] URL: https://openknowledgemaps.org/
[5] URL: https://www.litmaps.com/

citations, the adoption and application of this conceptual framework in subsequent studies and practice.

Second, the breadth and depth of Tengö's collaborative work provide a comprehensive lens through which different perspectives and debates can be systematically analyzed. Their body of work encompasses both theoretical models and empirical applications, making it suitable as a central axis for mapping out key themes and methodological innovations in the area, as well as weaknesses such as knowledge gaps.

Third, this selection enhances analytical clarity and consistency in the review process. By anchoring the literature review in one authoritative body of work, it becomes possible to trace thematic developments more systematically, while also critically examining points of divergence with other scholars. For these reasons Tengös's work serves as an anchor for organizing and synthesizing the broader body of research, ensuring both depth and analytical coherence.

Tengö's identified 84 publications (with her as an author or co-author) were examined based on a title and abstract review to identify those most relevant to the topic: inclusive approach, frameworks, methods/tools and practices of diverse knowledge co-production (Figure 2). Articles that were directly relevant to these topics were included. 13 publications were selected to conduct a full-text review, to synthesize the literature content.

Additionally a search for complimentary literature was conducted on the search engine Web of Science using the keywords: *Indigenous Local Knowledge*, *Sustainability*, *Knowledge Co-Production*, *Inclusion.* Out of 101 publications, 55 were available with open access, of which 15 were selected according to the title and abstract information, because these publications inform about knowledge co-production approaches and methods. The literature search was also conducted on Scopus, with the same strategic approach and keywords as just described. The result showed two published papers, which overlapped with the publications on Web of Science. This extension of literature from other authors was included to find approaches, contradiction and

differences within the research field, expanding the literature. The following figure visualizes the selection process of the literature review.

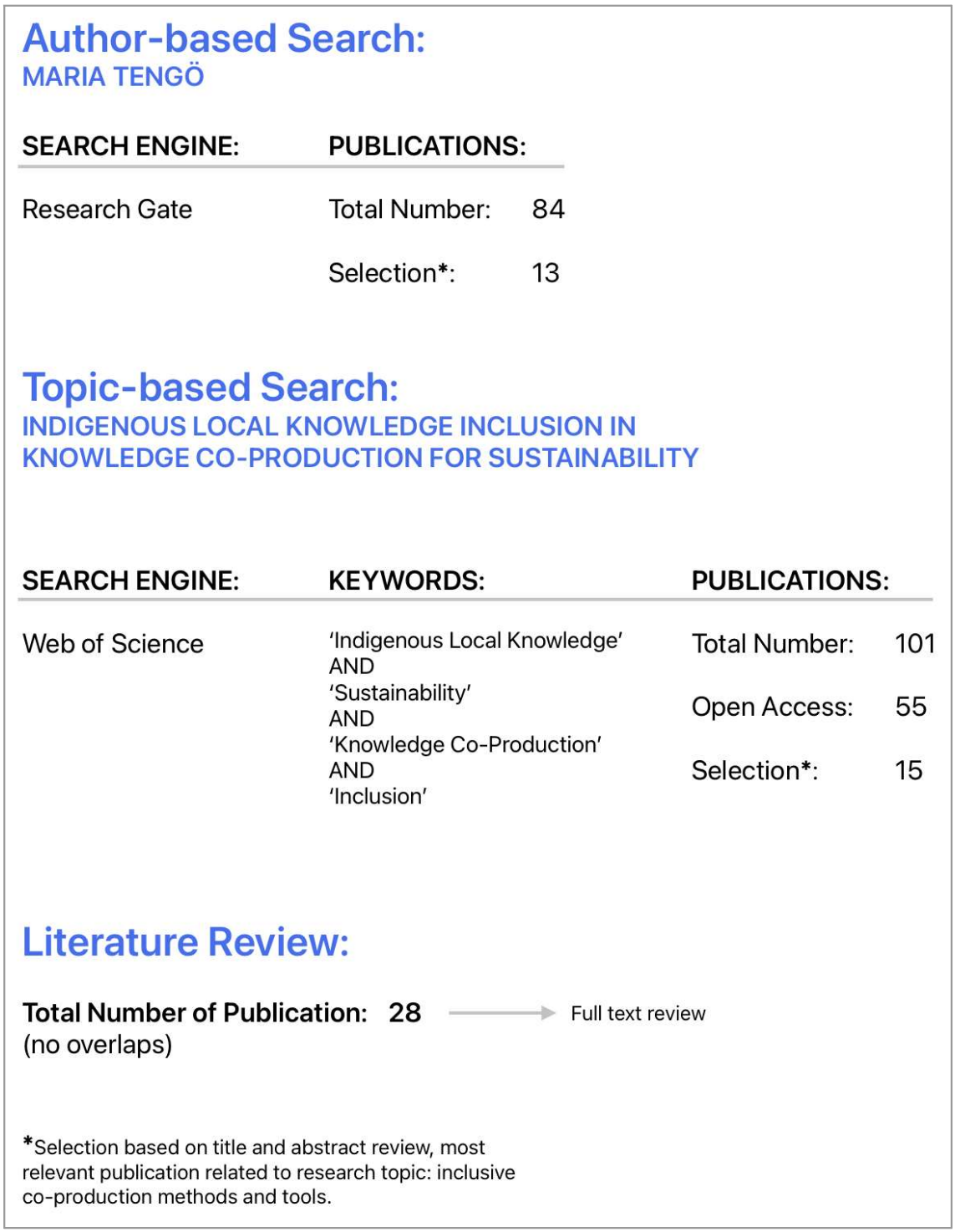

Figure 2: Literature Selection Process, Source by Author 2025

(3. Scoping Review) A second literature review (including scientific papers and grey literature, e.g. websites and news reports) regarding IPLC and ILK in the Amazon was conducted to portray the sustainability problems in the Amazon, which affect IPLC, their territory and knowledge. This was accomplished to provide an overview of the current regional situation. The use of the keywords: *Indigenous local Knowledge*, *Indigenous People Local Communities*, *Amazon*, was applied. Additionally, the tracing of citation chains was conducted. Grey literature is included in the review because socio-ecological issues in the Amazon—such as deforestation, illegal mining, land grabbing, climate-driven ecosystem shifts, and their impacts on Indigenous/local communities—develop faster. Grey literature (e.g., NGO reports, governmental assessments, Indigenous organizations' statements, environmental agency briefings) often documents these dynamics first. Including grey literature allows researchers to access more current and locally grounded data, improving the timeliness and completeness of the review (Reyes-García et al., 2019; Paez, 2017).

1.5.2 Case Studies

Case studies in general can be defined as an empirical approach that thoroughly examines a current phenomena through a systematic, in-depth investigation in an actual setting, within its real-world context (Rule, 2024). Despite being frequently linked to qualitative research, case study research is becoming more widely accepted as being compatible with mixed methods research (Rule, 2024) such as in this thesis. The majority of multiple case studies are likely more robust and compelling than single-case study research, because multiple viewpoints of various participants shed light on the study's subject (Yin, 2018). Opportunities for investigating the relationships between and across disciplines/fields of case study research are presented by the more recent interdisciplinary confluences in fields like environmental studies and cultural studies, amongst others (Rule, 2024). To gain a deeper understanding of complex social-ecological systems, in-depth structured case study comparisons are often used to leverage theories and gain general insights from

specific phenomena with common features (Pahl-Wostl et al., 2022). Case studies of knowledge co-production and action addresses diverse sustainability issues at local to global scales (Chambers et al., 2022).

This study adopts a multiple case study design (Yin, 2018) situated within a regional and cross-national context. This geographical limitation was selected to investigate place-based issues in the Amazon region, connected to and influencing IPLC and their knowledge in this particular region. It examines how Indigenous and Local Knowledge (ILK) is integrated into knowledge co-production processes to tackle and investigate such issues. The investigation aims to identify and analyze methods that enable ILK inclusion, thereby providing a basis for cross-case comparison to reveal both generalizable patterns and context-specific variations in practice.

Case selection is guided by three core criteria: (1) initiatives must involve knowledge collaborations incorporating ILK; (2) address sustainable development, land/forest use, environmental management, or cultural and environmental conservation; (3) and be based in the Amazon region. Cases are intentionally drawn from multiple Amazonian countries to capture geographical and governance diversity while recognizing shared socio-ecological challenges (see Chapter 3). It incorporates cases operating at regional, national, and global scales, offering a comprehensive view of diverse approaches to sustainability and ILK integration across the Amazon. The final selection of 14 case studies is presented in the following table (comprehensive details in Appendix 1).

1. Floating Fab Lab	8. Indigenous Approach on Biological Diversity
2. Cuia Colab	9. Indigenous Storytelling for Conservation
3. Kayapo Project	10. Future Proofing Conservation
4. CoFruta	11. Community-based Monitoring
5. Collaborative Fire Management	12. Kawsak Sacha - Living Forest
6. Win-Win Conservation	13. Earth Innovation Institute
7. Alliances for National Park	14. Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services

Table 1: Selection of 14 Case studies, by Author 2025

To enhance complex social-ecological understandings, in-depth structured case study comparisons with a comparative qualitative content analysis was applied to gain general insights from specific phenomena with common features (Pahl-Wostl et al., 2022) in this research, knowledge co-production processes which incorporate ILK. More comprehensively, this analysis was conducted to reveal multiple reported viewpoints and shed light on the research's subject (Yin, 2018) of choices regarding participation activities, in particular the methods, tools, approaches and practices to work with IPLC and include ILK. The decision to investigate these case studies was done, to provide additionally to the theoretical research also empirical examples of knowledge collaborations, as real-world evidence. As a result, firstly this analysis reveals which methods/tools have been applied in each case study. Secondly synthesized patterns are presented, which emerge in these case studies collaborations when viewed collectively.

1.5.3 Interviews

Semi-structured interviews represent a central qualitative method in social science research, designed to ensure comprehensive coverage of relevant topics (Karatsareas, 2022). This approach was identified as appropriate for examining the integration of Indigenous and Local Knowledge (ILK) in knowledge co-production, given its flexibility and adaptability as a data collection tool. Such interviews promote reciprocity between interviewer and interviewee, offering participants the opportunity to articulate detailed and nuanced perspectives while enabling researchers to probe emerging themes (Kallio et al., 2016; Ian, 2024; Turner & Hagstrom-Schmidt, 2022). Typically structured around open-ended questions, these interviews encourage participants to elaborate on their experiences, while closed yes/no-questions are used sparingly and usually followed by open-ended prompts to elicit deeper insights (Karatsareas, 2022). Despite their strengths, challenges arise in coding and analyzing narrative data, as researchers may struggle to identify consistent patterns and themes across transcripts (Turner & Hagstrom-Schmidt, 2022).

To complement the findings of the case studies, key stakeholders from each case were identified and contacted to enable a more in-depth examination of the collaboration processes. The decision to conduct additional semi-structured interviews aimed to obtain practical insights directly from participants—specifically, one Indigenous and one non-Indigenous individual per case study—who had actively engaged in knowledge co-production.

As highlighted by Norström et al. (2020) conducting participant interviews at the conclusion of the project represents an appropriate method for assessing needs and objectives related to plurality, as well as for evaluating the quality of interactions among actors, interviews provide valuable data on participants' perceptions. By including both Indigenous and non-Indigenous knowledge holders as interviewees, the potential for bias arising from privileging a single perspective was reduced, ensuring a more balanced representation of experiences (Norström et al., 2020).

Participants' assessments of the utility of specific methods and tools may have differed; however, all perspectives were considered equally important for the overall evaluation. Table 2 presents the interviewees and their projects.

1. Project: FabLab Peru	**2. Project: Cuia Colab**	**3. Project: Kayapo**
Interviewees:	Interviewees:	Interviewees:
A1. Benito Juarez	A2. Andrea Bandoni	A3. Matthew Aruch
B1. Zoila Ochoa Garay	B2. Silvane Almeida Maduro	B3. Poyre Mekragnotire

Table 2: Interviewee overview, by Author 2025

The interviews were transcribed following the *Intelligent Verbatim Transcription* standards as recommended by Streefkerk (2023), also called *Simple Transcriptions* (Dresing et al., 2015). This involves the removal of irrelevant words and repeated sentence fragments. These minor edits were implemented to enhance readability and to facilitate more efficient access to the substantive content of the conversations. All omissions concerned elements that did not contribute relevant information to the interview topics or the overall

research objectives and were therefore excluded. Particular care was taken to ensure that no alterations were made to the meaning or nuance of participants' responses. The primary objective of the interviews was to obtain information that enriches the research topic; the application of intelligent verbatim transcription effectively supported this goal. Consequently, the use of fully verbatim transcription was deemed unnecessary (Streefkerk, 2023; Dresing et al., 2015).

Lastly, to analyse interview transcripts a thematic analysis is a suitable method for analyzing qualitative data across a data set (Kiger & Varpio, 2020). The interview answers of the transcripts were included in a thematic analysis to find similarities and contradictions amongst the different (indigenous and non-indigenous) participants' answers from each of the three projects. Whereby viewpoints were compared whether the two interviewee types had similar or distinct experiences in their projects, especially regarding the applied methods. This was designed to avoid bias and should prevent one side from being favored over the other, i.e. to give a voice to both indigenous and non-indigenous participants to share their experiences of the collaboration process.

Turner & Hagstrom-Schmidt (2022) describe, for interpretation of the data, summarize it in codes or themes of information, which are consistent expressions/ideas that were common among interviewees. This qualitative analysis focuses on the two main categories: *During the conduction process*, and *After Finalisation*. These two categories include the core themes: *representatives, constraints, knowledge treatment, power and decision making, common understandings, joined problem definition, mutual trust, scale, outcome, impact, output*, which have been identified by the literature as crucial topics in knowledge co-production processes. The questions in the interview guide were already based on these themes, which facilitated the analysis of the interview answers, as they were already structured. Then the findings were generalized, evaluated and compared with the findings of the literature review, contradictions were discussed (see Chapter 6). Comprehensive details of the findings are presented in the table in Appendix 3.

1.6 Thesis Structure

The structure of this thesis builds on the Design Council Double Diamond Framework (Design Council, n.d.), which consists of the four work phases: discover, define, develop, deliver. Each phase (Figure 3) is complemented with its main tasks and goals.

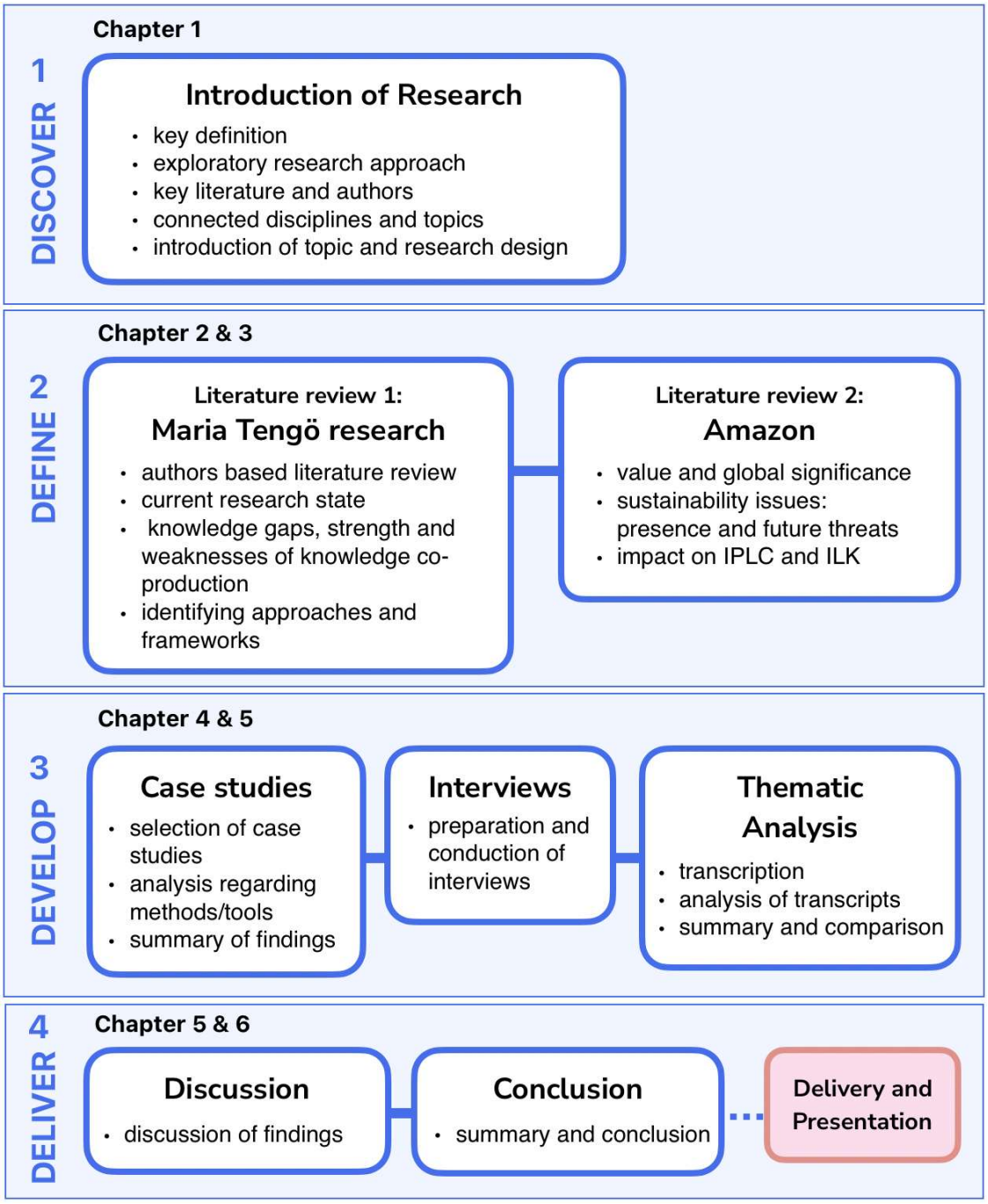

Figure 3: Thesis Structure Mapping, Source: Author, 2025

The thesis is structured as follows:

Chapter 1. introduces the context of the research. Key definitions are presented alongside its Methodology, Hypothesis, Problem setting, Key Research Question and structure.

Chapter 2. presents an author-based literature review, to present and examine possible approaches, knowledge gaps and risks regarding ILK inclusion.

Chapter 3. contextualizes the research geographical area–the Amazon rainforest.

Chapter 4. explores ILP/IK inclusion in knowledge co-production in Amazon-conservation and thus brings the two topics of the literature review together.

Chapter 5. reports the findings of the interviews

Chapter 6. discusses research findings, conclusions as well as recommendations for further research.

Last but not least, Chapter 7. presents a short overview of the conducted research key messages.

1.7 Chronogram

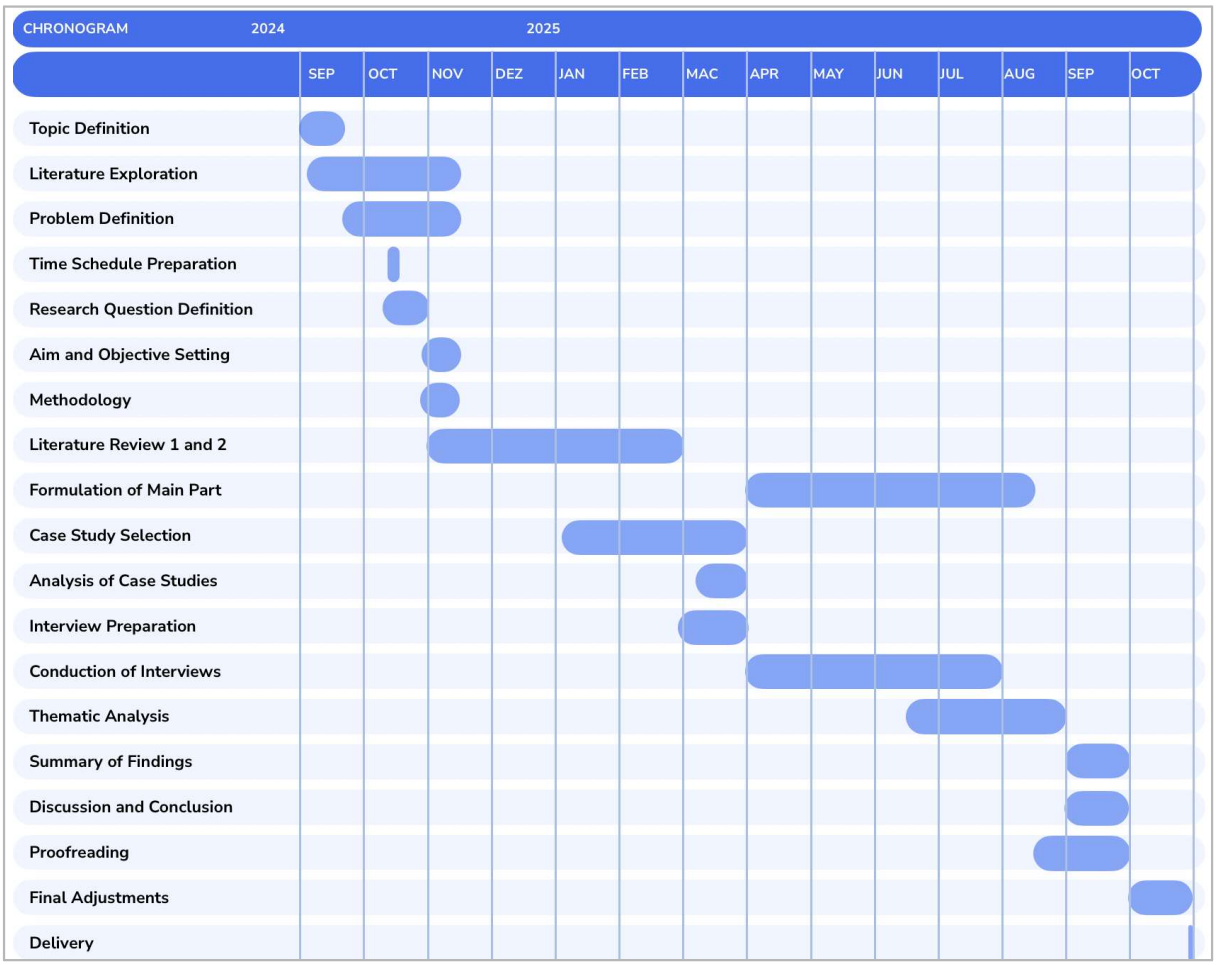

Figure 4: Chronogram, Source: Author, 2024

2. Literature Review

2.1 A Brief Genealogy of Knowledge Co-Production

Knowledge co-production, over the past 40 years, has become increasingly prominent. It forms part of a loosely linked and evolving cluster of development approaches. New forms of producing knowledge started to emerge as a response to the emerging, complex social, economic and environmental challenges (Norström et al., 2020). These approaches are problem focused, context-driven and require multidisciplinary engagement whilst increasingly involving non-academic actors in knowledge-creation and research. For example, participatory research originated from Kurt Lewin's work, then it developed across multiple academic disciplines in the 1970s, focusing on adaptive environmental management assessment and studies of suppressed communities in developing countries.

The introduction of the idea of participation happened through an extension of a peer-community to deal with societal problems with high uncertainties-and-decision stakes. Further developments that stressed its mission-oriented problem-solving nature were named ‘mode 2’ knowledge production. As such, in the 1970s, the term ‘co-production’ was coined by Elinor and Vincent Ostrom. It was used to describe how public services were not only provided by government agencies in a one-way from state-to-society, but as a collaborative product of the whole society. The idea of citizens as ‘co-producers of public services’ was introduced to demonstrate that the provision of basic public services like, for example, policing relied on both police and citizens. Within the field of public administration co-production spread quickly, and currently includes both state-initiated (top-down) and social-movement-initiated (bottom-up) processes.

In the context of sustainability research, knowledge co-production is defined as the: “Iterative and collaborative processes involving diverse types of expertise, knowledge and actors to produce context-specific knowledge and pathways towards a [more] sustainable future” (Norström et al., 2020). As it evolved, two broad approaches emerged, one ‘normative’ and pragmatic that

views co-production as a conscious collaboration to achieve common goals between different actors. The other ‘descriptive’, which examines how society and science constantly influence each other in expected as well as unexpected ways, as all knowledge is continually co-produced and shaped by the latest social order. Despite tensions among these approaches they often merge in different ways (Norström et al., 2020). This historical introduction does not claim to be exhaustive but rather attempts to give a brief introduction of Knowledge co-production history.

2.2 How to include ILK?

Qualitative and open research on Indigenous and Local Knowledge (ILK) offers significant potential due to its accessibility, reliability, and cost efficiency (Lam et al., 2020). Such approaches provide a valuable complement to the predominantly quantitative orientation of Western science by capturing holistic and context-dependent dimensions of ILK that are not easily addressed through reductionist methods (Lam et al., 2020). Empirical analysis shows that ILK research in the context of sustainability transformations relies primarily on qualitative methodologies. Approximately 68% of reviewed studies employed exclusively qualitative methods, particularly focus-group discussions and semi-structured interviews, while 32% combined qualitative and quantitative approaches. This methodological preference reflects the inherent complexity of ILK systems and the need for in-depth, context-sensitive inquiry (Lam et al., 2020).

However, existing research tends to emphasize Indigenous Peoples and Local Communities’ (IPLC) adaptive practices without systematically examining the environmental strategies they use to steer ecosystems toward specific outcomes (Lam et al., 2020). Moreover, while qualitative approaches dominate, the range of applied tools and techniques beyond the commonly used focus-group discussions and semistructured interviews remains insufficiently explored.

2.2.1 Principles for Knowledge Co-Production

Norström and colleagues (2020) outline four general principles (Figure 5) which aim to secure a high quality of knowledge co-production for sustainability research and practice, which are: (1) context-based; (2) pluralistic; (3) goal-oriented; and (4) interactive (Norström et al., 2020).

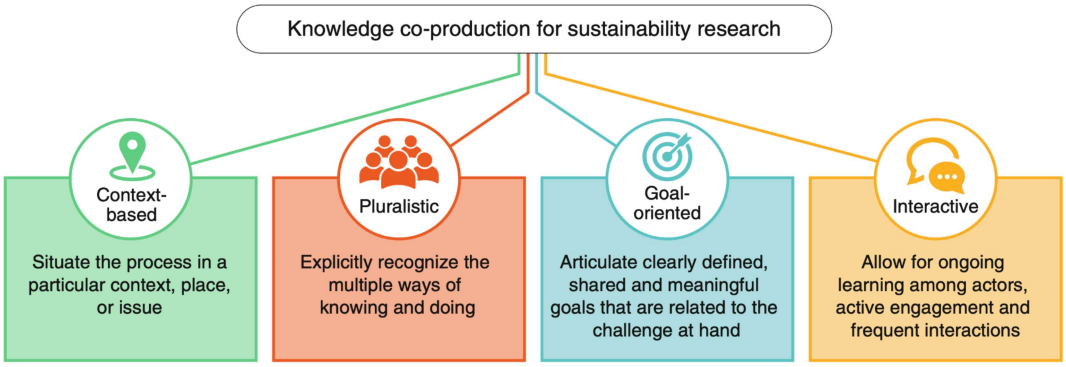

Figure 5: Four Principles for knowledge co-production in sustainability research, Norström et al., 2020, p.3

(1) Knowledge co-production operates most effectively when it is **context-based**, pluralistic, goal-oriented, and interactive. It must be embedded within clearly defined social, economic, and ecological settings, which may be local, regional, national, or global, and should account for the specific problems, taking into account needs, and interests of different social actors (Norström et al., 2020).

(2) A **pluralistic** approach ensures the inclusion of multiple forms of knowledge and perspectives, integrating academic disciplines with non-academic actors. This diversity enriches understanding of sustainability challenges and enhances the quality of outcomes, though it can also generate power asymmetries and higher transaction costs. Systematic reflection is therefore essential to address unequal dynamics and to surface differing values and visions (Norström et al., 2020).

(3) Clear and shared objectives are crucial to **goal-oriented** co-production. Common goals and intermediate milestones guide collaboration, allowing actors to align strategies, resources, and expectations. Tools such as theories of change can support collective understanding, though the

complexity of contexts and delayed outcomes often limit the measurability of impacts and the visibility of marginalized actors' agency (Norström et al., 2020).

(4) Finally, **interactive** processes—based on continuous dialogue, collaboration, and knowledge sharing—strengthen the legitimacy, credibility, and usability of the co-produced knowledge. Such engagement increases the likelihood that research outcomes will be integrated into decision-making and address participants' needs effectively (Norström et al., 2020).

Key insights of the four general principles of knowledge co-production for sustainability highlight that during the processes particular social, economic and ecological contexts should be considered, restricted to a defined set of issues from the viewpoint of distinct social actors. Diversity is guaranteed when multiple perspectives, including multi-discipline academics and participants, on a common issue are shared to enrich the picture of the sustainability problem.

In addition, the development process should include a joint definition of objectives and goals, success metrics, co-production design, as well as problem definition. Frequent, regular interactions and conversations among the actors during the whole project are essential because interactions and timing influence the quality of knowledge co-production processes (Norström et al., 2020).

This study clarifies, the four general principles of knowledge co-production should be considered and incorporated in the collaboration process. Although, the question remains, **how can this be realised?**

2.2.2 Knowledge Co-Working Strategy

Similar key-issues as aforementioned (Norström et al., 2020) also influence the Knowledge Co-working strategy development. Hill and colleagues (2020a), outline specific steps on how to conduct a collaboration which includes IPLC. The strategy functions as a road map from regional to global, across scale assessments. Figure 6 visualizes the ILK Approach, which results from the analysis of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) decision document and IPBES assessment

process. The following sets of practices are identified and grouped into four main categories: (1) respecting rights; (2) supporting care and mutuality; (3) strengthening IPLC and ILK; and (4) supporting knowledge exchange. The aim is to empower, encourage, and inform IPLC in each phase. There are many entry points for IPLC in the process, that provide them roles as authors, nominators, reviewers, fellows, dialogue participants, observers (e.g. at Plenary sessions) or organisers (e.g. communication events, other activities) (Hill et al., 2020a).

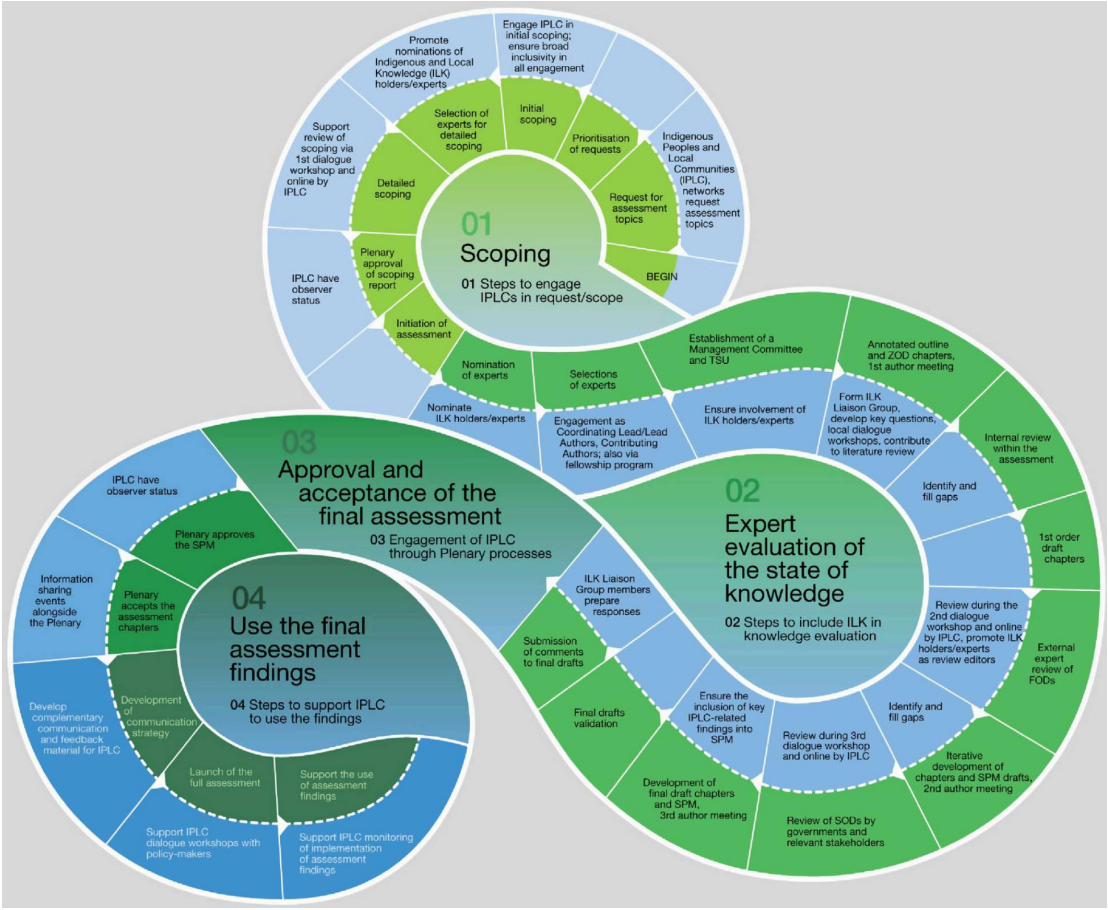

Figure 6: Steps of the IPBES work strategy for ILK inclusion in assessments (Source: Hill et al., 2020a, p.15)

In detail the four categories abovementioned refer to:

(1) **Respecting rights** means ensuring compliance to “Free Prior and Informed Consent” (FPIC). One example of positive initiatives is applying multilateral relevant agreements like the “UN Declaration on the Rights of

Indigenous Peoples". Avoiding any activities that may affect their rights (Hill et al., 2020a). The ILK Approach includes generic questions as a starting point for scoping. IPLC may have their own questions, so it is vital to engage them in the initial scoping stage. For the requirement of details, a dialogue workshop serves to allow for active engagement and participation (Hill et al., 2020a).

(2) **Supporting care and mutuality** implies key capacities such as promoting inclusiveness and cultural plurality; building trust; acknowledging the customary, decision-making, time frames (although relatively slow); respecting diverse ways of engagement (e.g. rituals and ceremonies) (Hill et al., 2020a). The second assessment phase includes also the critical evaluation by experts of the state of knowledge; also ILK-experts and ILK-holders engaging with each other and acting as reviewers and authors; and of IPLC in the conversations more widely (Hill et al., 2020a).

(3) **Strengthening IPLC and ILK** requires the promotion of activities in-situ, in the place where the knowledge is governed, validated and produced. Information storage is ensured in accordance with the relevant standards. Furthermore, ensuring meaningful participation, building capacity; and collaborating with already established IPLC networks and organisations are important aspects (Hill et al., 2020a). This also includes the roles of IPLC as observers at the plenary, accepting and approving the assessment comes to the fore (Hill et al., 2020a).

(4) **Supporting knowledge exchanges** relies on a collaborative process of problem definition. The recognition of knowledge systems working in parallel should be promoted through exchange. Each knowledge system has its own validation methods and histories. Empowerment dialogues are conducted through iterative two-way processes (Hill et al., 2020a). The application of the assessment findings happens. IPLC engagement in workshops, targeting knowledge-policy and the development of capacity-building tools and complementary communication is conducted. Networks of IPLC can aid the implementation monitoring of assessment findings (from local to global levels) (Hill et al., 2020a).

In short, ILK Approach consists of dialogue workshops as a method to conduct multiple knowledge collaborations. In these workshops, IPLC's rights have to be respected, whilst IPLC's engagement in the initial scoping stage is highlighted. Respecting diverse ways of engagement such as rituals and ceremonies, is recommended, as well as ensuring meaningful participation, building capacity and collaborating with IPLC organisations/networks.

2.2.3 Multi-Evidence Base Approach

Framework concepts are proposed to integrate different types of knowledge and theoretical perspectives, contributing to broader and more inclusive understandings of research problems (Tengö et al., 2014). Building on this foundation, Tengö and colleagues (2014, 2017, 2021) introduced the Multi-Evidence Base (MEB) Approach. It first emerged from the "Guna Yala Dialogue" in 2012, which laid the groundwork for a transdisciplinary expert network and emphasized equity and integrity in cross-knowledge collaborations (SwedBio, n.d.). The increasing use of conceptual frameworks aims to overcome disciplinary limitations and strengthen transdisciplinary collaboration (Tengö et al., 2014, 2021).

The MEB Approach seeks to connect scientific and Indigenous-local knowledge systems, recognizing their complementary contributions to understanding regional and global challenges (Tengö et al., 2014, 2021). It positions different knowledge systems as distinct yet equally valid, enriching assessments of issues such as sustainable resource use, environmental governance, and land management (Tengö et al., 2017, 2021). This approach has been further developed and tested in multiple projects, particularly within science–policy–practice interfaces (SwedBio, n.d.).

Its core objective is to facilitate cross-fertilization, integration, and co-production of knowledge, valuing differences between evidence types, including those across scientific disciplines and between qualitative and quantitative methods (Malmer et al., 2020; Tengö et al., 2014, 2017, 2021). Crucially, it allows each knowledge system to be expressed on its own terms, without privileging any as the external validator (Tengö et al., 2014). By actively

engaging actors, institutions, and processes, the MEB Approach weaves knowledge together through mutual respect and collaborative pathways (Tengö et al., 2017, 2021). The MEB Approach is presented and visualized in the next figures 7a,b and c, which show the process of knowledge-weaving.

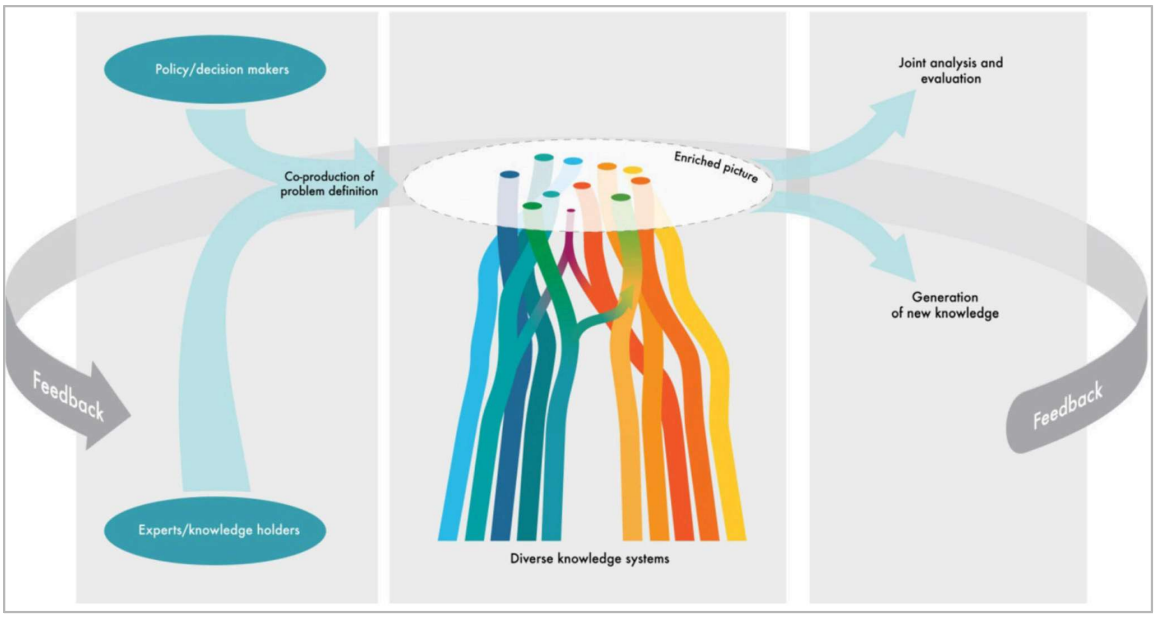

Figure 7a: Working with diverse knowledge systems - whole process (Tengö et al., 2014, p.587).

Figures 7a and b show the interweaving of science with other types of knowledge, to build a more comprehensive knowledge base. This couldn't be achieved by only one knowledge system by itself (Tengö et al., 2014, 2021).

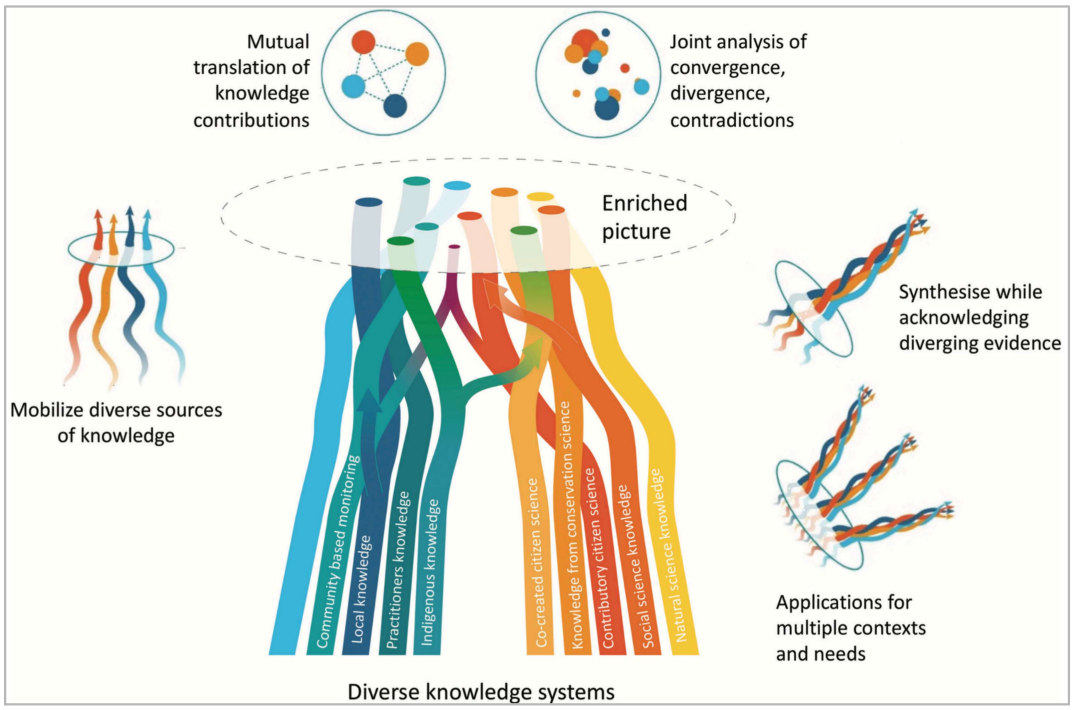

Figure 7b: Creating Synergies (Tengö et al., 2021, p.509)

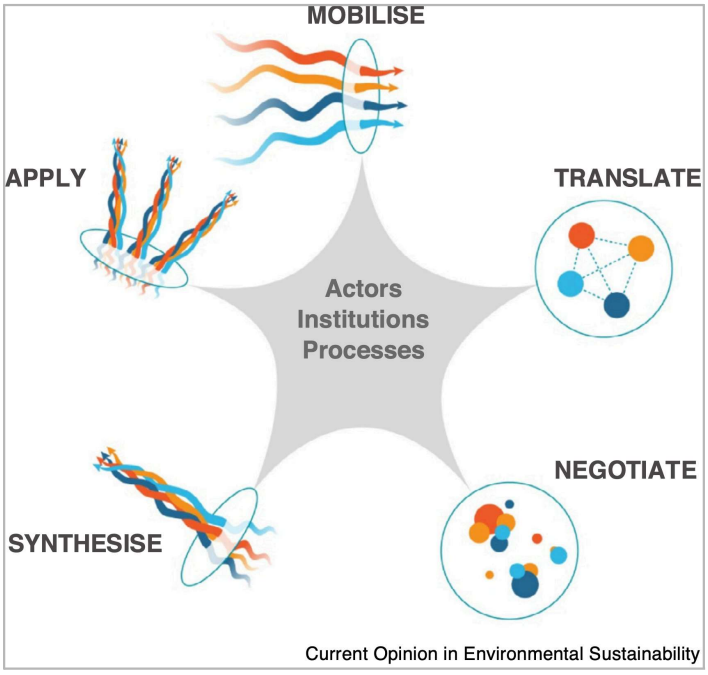

Figure 7c: The Five Tasks of the MEB Approach - environmental sustainability (Tengö et al., 2017, p.18)

The MEB Approach proposes five interconnected tasks to guide respectful collaboration between multiple knowledge systems: mobilizing, translating, analyzing and negotiating, synthesizing, and applying (compare figure 7c) (Tengö et al., 2017).

Mobilizing emphasizes making Indigenous and Local Knowledge (ILK) visible and shareable through culturally appropriate methods, which can also revitalize marginalized knowledge systems. **Translating** ensures mutual comprehensibility between scientific and Indigenous knowledge holders. **Analyzing** and **negotiating** involve acknowledging agreements and disagreements stemming from incommensurable knowledge systems. **Synthesizing** focuses on integrating distinct perspectives into shared understandings, and **applying** emphasizes the practical use of co-produced knowledge for communities, researchers, and decision-makers (Tengö et al., 2017).

A key principle of the MEB Approach is the equitable collaboration through joint goal setting and shared problem formulation, which enhances the effectiveness of knowledge integration (Tengö et al., 2014; Malmer et al., 2020). Its application, for example in Indigenous climate adaptation pathways research in central Australia, demonstrated how combining knowledge systems can support climate resilience (Hill et al., 2020b). Empirical studies show that focus groups, participatory scenario planning, community monitoring, fuzzy cognitive mapping, as well as participatory maps, art or film, support MEB activities such as mobilization, translation, and negotiation (Malmer et al., 2020; Tengö et al., 2014, 2017). Equity is maintained through research agreements, intellectual property protocols, and adherence to the principle of prior, free, and informed consent, which must be secured throughout the project (Hill et al., 2020a; Malmer et al., 2020; SwedBio, n.d.).

Validation remains nevertheless a central epistemological challenge. Knowledge systems employ different criteria and methods, ranging from quantitative experimental designs to qualitative interpretative approaches, which complicates generalization across contexts (Tengö et al., 2014). The concept of validity depends on instruments, data, and interpretations, as well as the

collective judgment of those interpreting phenomena (Tengö et al., 2014). Effective cross-system validation requires intersubjective processes that recognize diverse worldviews and evaluation mechanisms (Tengö et al., 2014, 2021). While peer-to-peer validation and formal consultation mechanisms have been proposed, further work is needed to clarify procedures that respect customary control, ownership, and transmission of ILK (Malmer et al., 2020; Tengö et al., 2021). The difficulty of balancing scientific governance structures with open collaboration remains a key issue for the broader application of the MEB Approach (Malmer et al., 2020).

2.2.4 Collaborative Pathways and Co-Production Agility

This study develops the concept of co-productive agility, understood as the capacity of diverse actors to navigate tensions and power dynamics in order to collaboratively define and implement transformative sustainability actions. Initially, actors may not share common goals, but trust-building, accountability, and reframing of perspectives over time can enable collective purpose and action. According to Chambers and colleagues (2022), empirical analysis identifies four interrelated pathways to transformation: elevating marginalized agendas, questioning dominant agendas, navigating conflicting agendas, and exploring diverse agendas (see Figure 8). Each pathway relies on cultivating “agile spaces” through values such as humility, legitimacy, fairness, and safety, and requires adaptive forms of facilitative leadership—ranging from taking the lead in powerful spaces to stepping back in marginal spaces (Chambers et al., 2022).

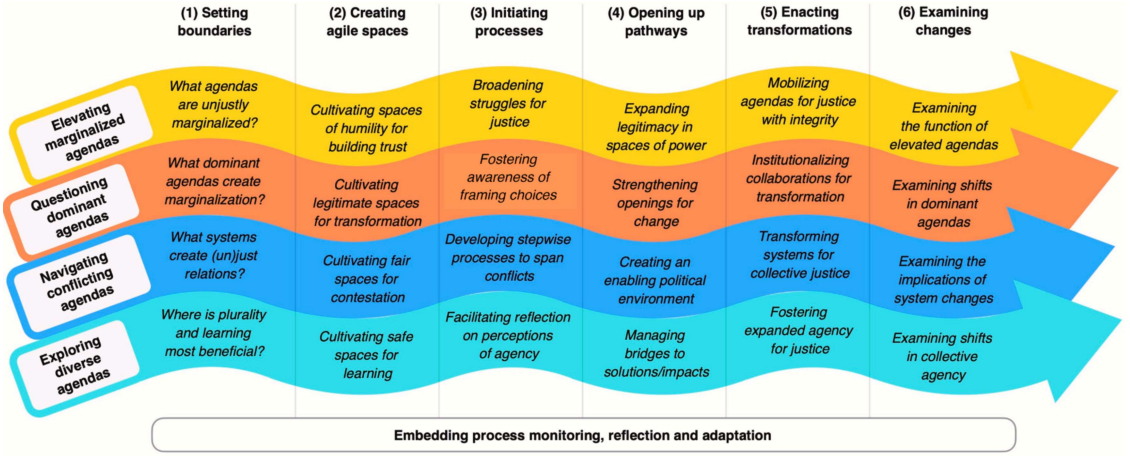

Figure 8: Four pathways - essential steps to promote co-productive agility (Chambers 2022 et al., p.10).

Co-productive agility can reshape actors' willingness and capacity to collaborate and foster new paradigms, but it also faces significant obstacles. A key challenge emerges when co-production processes are co-opted to advance singular agendas, failing to address underlying political tensions. When these tensions—such as between process and impact or exclusion and inclusion—are navigated flexibly, transformative outcomes become possible. However, current practice often prioritizes consensus and measurable short-term outputs over deep engagement with disagreement, leading to superficial inclusion. Pressures to demonstrate immediate results encourage the creation of large multi-stakeholder platforms that can dilute power-sensitive engagement, whereas more agile initiatives strategically limit participation to balance power relations and ensure safer spaces for dialogue (Chambers et al., 2022).

Institutional structures rarely support facilitative leadership, which is essential for co-productive agility. Effective facilitation requires abandoning rigid progress metrics in favor of iterative, process-based evaluation approaches that emphasize reflection and adaptive learning. Embedding researchers within practice settings—rather than framing problems as knowledge deficits—enables more flexible and responsive transformations. This, however, demands shifts in governance and funding models to value processes that iteratively negotiate tensions rather than aiming for linear solutions (Chambers et al., 2022).

A core principle of co-productive agility is “staying with the trouble” of difference, proactively transforming power relations rather than suppressing conflict. Elevating marginalized agendas can stimulate questioning of dominant narratives, enable safer exploration of diverse perspectives, and support the navigation of conflicts even in polarized contexts. Learning networks and future visioning processes can operate across multiple pathways, supporting broader transformations across scales (Chambers et al., 2022).

However, interpretations of “marginalized” agendas are subjective and context dependent, highlighting the importance of reflexively broadening struggles for justice (Chambers et al., 2022). Greater attention to questioning dominant agendas, exploring diversity, and navigating conflicts is needed to avoid reproducing hierarchies in co-production processes. Finally, scaling co-productive agility beyond local initiatives requires ensuring that global and national efforts do not override local agency. Overall, this framework advances understanding of how strategically engaging with difference and power dynamics can foster more just and sustainable transformation pathways (Chambers et al., 2022).

2.2.5 Modes of Knowledge and Action Co-Production

The study ‘*Six modes of co-production for sustainability*’ by Chambers and colleagues (2021) examine diverse design and implementation choices that shape co-production processes in sustainability transformations, particularly in collaborative ecosystem management. It identifies six distinct co-production modes, each characterized by different engagements with purpose, power, politics, and transformation pathways, which in turn lead to varying outcomes and risks. While some approaches foster systemic reframing of perspectives and collective agency, others are more effective for influencing policy or advancing specific solutions. Importantly, each mode entails potential drawbacks, including the reinforcement of existing power structures, creation of echo chambers, or co-option by dominant interests. Understanding these connections provides a heuristic framework to guide the design of co-production efforts and to anticipate their trade-offs (Chambers et al., 2021).

The necessity of careful facilitation, long-term and multi-scalar engagement, and the deliberate bridging of diverse values and perspectives to achieve meaningful outcomes are highlighted. Co-production processes can produce a wide range of impacts—from reshaping narratives, institutions, and social relations to generating scientific knowledge and influencing policy—but these outcomes are not easily achieved simultaneously. Notably, efforts prioritizing scientific knowledge production often have limited broader transformative results, whereas approaches emphasizing reflexive dialogue and relational engagement are more successful at reframing agency and perspectives (Chambers et al., 2021). The most transformative institutional changes occur when co-production processes balanced critically reflexive and action-oriented strategies, enabling unforeseen directions for collective action (Chambers et al., 2021).

However, despite promising intermediate outcomes, the long-term sustainability impacts of knowledge-and-action co-production remain uncertain. This is largely due to insufficient monitoring of social and ecological change during the process, making it difficult to attribute observed effects to co-production. Iterative monitoring and adaptive learning were associated with stronger outcomes, emphasizing the need for more flexible evaluation practices. Current funding and policy frameworks that demand predefined problems and linear impact pathways constrain the transformative potential of co-production (Chambers et al., 2021).

By critically examining assumptions about purpose, power, and pathways, the study seeks to help researchers and practitioners navigate trade-offs and risks inherent in different co-production strategies. The aims are to strengthen transparency, foster critical reflection, and support more adaptive, inclusive, and politically aware co-production practices (Chambers et al., 2021).

The specific tasks in each mode are presented: (1) to research solutions more ‘realist’ investigative methods are applied such as ecosystem modelling; (2) empower relatively marginalized actors through supporting initiatives of local and indigenous communities directly; (3) fostering dialogues around synthesized knowledge; (4) using ‘relativist’ methods such as critical social

science methods to reframe technocratic narratives and shift practices/policies that marginalize social concerns, supported by multi-scalar networks; (5) facilitation techniques and boundary objects used to connect actors, to explore conflicts and to reframe perspectives, as well as complementary bottom-up and top-down processes; (6) highly relativist and systems thinking design, creation safe space, through urban/transformation labs, create safe spaces facilitated co-productions (Chambers et al., 2021).

2.2.6 Participatory, Trans- and Interdisciplinary Research Approaches

Despite acknowledged limitations (e.g. Tengö's research) multiple scholars emphasize the importance of more place-based and context-specific approaches (Lam et al., 2020; Tengö et al., 2014). In this regard, transdisciplinary and interdisciplinary research offer valuable methodological pathways, as they begin with specific real-world problems rather than abstract theories or fixed methodologies (Lam et al., 2020). Transdisciplinary research, in particular, enables collaboration between scientific knowledge systems and Indigenous and Local Knowledge (ILK) on an equal footing, fostering genuine co-creation processes. It is characterized by the active involvement of both scientific and societal actors and is increasingly promoted at a global scale through knowledge co-creation initiatives aimed at advancing sustainability transformations (Lam et al., 2020; Tengö et al., 2014). Indigenous partnerships, knowledge systems, and values, are essential for realizing the transformative potential of transdisciplinary research, particularly in addressing complex socio-environmental challenges. Their integration enhances the capacity of such research to generate interventions that address social and ecological complexity (Baker et al., 2023). Transdisciplinary methodologies engage with knowledge co-production, horizontality, and decolonization to varying extents. Horizontal co-production may occur either inter-disciplinarily, where academic disciplines collaborate as equals, or trans-disciplinarily, where both academic and non-academic knowledges—such as Indigenous or local

epistemologies—are valued on their own cultural terms and evaluated within their respective worldviews (Manuel-Navarrete et al., 2021).

Chakraborty and colleagues (2022) exemplify a transdisciplinary framework. The research team undertook a process of knowledge co-production aimed at equitable stakeholder inclusion. The applied sensitive methodology included a systematic literature review of global knowledge co-production efforts, semi-structured interviews with regional actors, and ethnographic participatory observations conducted during group meetings, thematic discussions, and multi-stakeholder workshops. These methods were specifically chosen to assess the co-production process rather than represent the full methodological repertoire (Chakraborty et al., 2022).

A wide range of approaches encompass multiple conceptual frameworks and methodological terms, including collaborative governance, social learning, co-design, transdisciplinarity, research-informed co-management, participatory modeling, global dialogues, learning networks, and participatory action research. Such collaborative spaces bring together actors whose values may either align or stand in tension with one another, reflecting the complexity of knowledge co-production in practice (Chambers et al., 2021; Chambers et al., 2022).

Several participatory methodologies, in particular, have been developed to facilitate integration of Indigenous and Western scientific knowledge, with general acceptance among knowledge holders. While some of these approaches are well-established, others remain in developmental stages. Their applicability is highly context-dependent, and no single method is universally suitable for all instances of knowledge integration (Johnson et al., 2015). These approaches include, but are not limited to: Participatory rural appraisal, Participatory action research; Participatory education; Participatory mapping; Participatory workshops and modeling; Participatory scenario planning; Community-based monitoring; Participatory conservation planning; or Participatory environmental restoration (Johnson et al., 2015).

Systems Theory and Design disciplines are already examining how to conceptualize and evaluate societal transformation processes directed toward

sustainability (Chambers et al., 2022). One practical example is the Transition Design Framework, which aims to integrate transdisciplinary knowledge, practices, and skills to initiate and catalyze systemic change (Irwin, 2015). In parallel, open-ended “transformational spaces” are increasingly recognized as arenas for experimentation and innovation, enabling actors to test ideas, generate agency, and enhance transformative capacities. The Transformation Lab (T-Lab), currently implemented in various regions of the Global South and North, exemplifies such a transformative venue (West et al., 2024).

Decolonial approaches to transformation emphasize the importance of relational engagement with diverse worldviews, particularly in the context of Global North interactions with the pluriverse. West and colleagues (2024) identified a three-step decolonial process inspired by the Zapatista movement: first, “locating the self” through reflexive examination of one’s own assumptions and values; second, “learning to learn” through serious engagement with alternative epistemologies; and third, “walking with” through active socio-political participation that supports the coexistence of multiple worldviews (West et al., 2024).

Research on ILK co-production and knowledge co-management increasingly highlights Indigenous-led initiatives that assert epistemic sovereignty and agency in collaborative processes (Tengö et al., 2021). Merçon and colleagues (2019) further argue that systematic efforts to achieve mutual understanding can be effectively structured through transdisciplinary methodologies, action research, boundary work, and other place-based co-production strategies (Merçon et al., 2019). In addition to these procedural elements, contextual and place-based ethics, caregiving practices, support for Indigenous rights and governance systems, arts-based methodologies, and innovative pedagogies have been underscored as critical in posthumanist-performative approaches to transformative change (West et al., 2024). Arts-based methods—such as storytelling, theatre, and other performative practices—are increasingly recognized as powerful vehicles for integrating knowledge and action (West et al., 2024). This aligns with perspectives highlighting the continued significance of oral traditions. As

Brondizio and colleagues (2021b) note that oral histories, storytelling, and music-making serve as powerful conduits for intergenerational knowledge transmission, reinforcing the role of cultural practices in sustaining and transforming knowledge systems (Brondizio et al., 2021b).

One influencing factor is the scale of knowledge collaborations, NGOs and research institutions are increasingly functioning on a global level. Processes of co-producing knowledge have mostly entailed pluralistic alliances at local and regional levels, involving academics alongside representatives from various sectors, including local and national governments, businesses, NGOs operating at local and regional levels, and managers of natural resources (Norström et al., 2020). Place centrality in Indigenous approaches to sustainability transformations means that deep connections between beings such as plant, animal, physical, and spiritual, can only occur when people are in relationship with the place and resources (West et al., 2024). Initiatives in sustainability education led by Indigenous peoples aimed at reshaping worldviews and cultural practices through the lens of the ‘scaling deep, up, and out’ framework (originating from systems approaches and social innovation). As it mainly concerns transformational approaches to epistemology, ontology, and culture within collectives and individuals that “unsettle” settler colonial relations of place, scaling ‘deep’ has repercussions across the other categories. It is intrinsically connected to Scaling ‘up’ and ‘out’, rooted in the genealogy of place, and recognizes the strong link between uncovering Indigenous perspectives on ecosystems and the health and revitalization of Indigenous societies as a whole (West et al., 2024).

2.3 ILK Gaps and Hazards

Emerging modes of knowledge co-production between scientific and Indigenous/local knowledge (ILK) systems offer substantial opportunities but also entail major risks and challenges (Norström et al., 2020). A central difficulty stems from the interaction of distinct worldviews, practices, ethics, power relations, and rights, since knowledge co-production processes are still largely

shaped by Western political agendas and research methods, despite the socially situated and value-laden nature of all knowledge (Lam et al., 2020).

Historically, scientific actors have dominated such collaborations, often marginalizing the holistic and place-based character of ILK (Malmer et al., 2020), while Indigenous-led initiatives continue to face structural and historical constraints (Tengö et al., 2021). However, effective knowledge co-production requires participants to engage in mutual learning about diverse worldviews, epistemologies, and environmental ontologies (Greenaway et al., 2021). A lack of experts able to bridge epistemic and institutional boundaries remains a major gap (Hill et al., 2020a).

In addition, the meaning and effectiveness of knowledge co-production for sustainability transitions remain contested and unclear. This conceptual ambiguity, coupled with a lack of comprehensive empirical evidence, has resulted in co-production often being framed as a universal remedy, which risks oversimplifying its actual transformative potential (Chambers et al., 2021).

Power imbalances are among the most critical issues in knowledge co-production, shaping decision-making, validation, and representation (Tengö et al., 2021; Chambers et al., 2021, 2022; Hill et al., 2020a). These asymmetries, often linked to centralized authority and dominant actors, lead to distrust and reluctance to share ILK (Tengö et al., 2021; Kadykalo et al., 2021). Practical strategies to address such inequalities remain limited, and in many cases, power structures are reproduced rather than transformed, particularly in global North–South collaborations (Chambers et al., 2022).

Against this background, recognizing the differences between knowledge integration, parallel approaches, and genuine co-production is essential (Tengö et al., 2014). Manuel-Navarrete and colleagues (2021) highlight, while horizontal knowledge co-production requires direct engagement with power relations, such considerations are often peripheral within transdisciplinary discourse. Instead, transdisciplinary approaches typically emphasize the generation of socially robust knowledge aimed at solving complex, systemic ("wicked") problems, often without critically addressing underlying power asymmetries among participating actors (Manuel-Navarrete et al., 2021).

Collaboration with ILK carries risks of undermining local institutions and erasing culturally embedded relations to place through externally imposed metrics and universalist frameworks (Tengö et al., 2021, Table 1). Equally important is the critical reflection on the biases and assumptions embedded within existing methodologies. Such reflexive deliberation is essential for non-Indigenous researchers to build sustained, trust-based relationships and to meaningfully contribute to co-production processes (Greenaway et al., 2021). Trust-building is central, especially given ongoing colonial structures and appropriation of ILK without full consent (Malmer et al., 2020; Kadykalo et al., 2021). Intellectual property protection remains insufficient (Hill et al., 2020a), and validation practices continue to privilege Western science over ILK, leading to persistent epistemic inequities (Tengö et al., 2014; Malmer et al., 2020; Kadykalo et al., 2021). Despite ILK's contribution to understanding global environmental and social change, plural perspectives remain underrepresented in sustainability research (Lam et al., 2020).

True inclusiveness is hindered by procedural and substantive shortcomings in participation processes (Kadykalo et al., 2021; Díaz-Reviriego et al., 2019). ILK is often treated as supplementary to science rather than as an equivalent knowledge system (Lam et al., 2020; Tengö et al., 2014). Building trust requires long-term engagement, which is frequently constrained by limited funding, short project timelines, and expectations of unpaid participation by IPLC (Kadykalo et al., 2021; Chambers et al., 2021; Tengö et al., 2021; Hill et al., 2020a).

Despite extensive calls for knowledge integration, there is a notable lack of methods and tools for mobilizing and bridging ILK and science (Tengö et al., 2014, 2017, 2021; Lam et al., 2020; Malmer et al., 2020; Hill et al., 2020a). Transdisciplinary approaches are hindered by insufficient methodological clarity and the inadequacy of dominant formats for expressing ILK, which often takes oral, ritual, or visual forms (Hill et al., 2020a). Emerging practices, including boundary objects, seasonal calendars, digital storytelling, photovoice, and yarning, offer promising pathways, but remain underdeveloped (Hill et al., 2020a). Greater methodological transparency and place-specific approaches

are needed to enable meaningful ILK engagement and broader transferability (Lam et al., 2020).

Finally, scholarship emphasizes the need to examine the impacts, trade-offs, and multi-scalar dynamics of co-production processes, as they can fail to advance sustainability or may even reinforce inequities when inadequately designed (Chambers et al., 2021). Developing robust tools, long-term partnerships, and equitable governance structures is crucial for moving toward more just and sustainable futures.

2.4 Final Remarks and Key Messages

Approaches, modes, pathways and strategies further the research of how to connect/bridge diverse knowledge systems more successfully (Chambers et. al., 2022; Chambers et al., 2021; Tengö et al., 2021, Malmer et al., 2020; Norström et al., 2020). There are also some indications, which **design choices** could be **applied to conduct co-working initiatives**, such as the predominant use of **qualitative methods** to work with IPLC/ILK (Lam et al., 2020). Light was brought into what contributions lead to a high quality of co-production, how to **navigate conflicting tension** towards transformative potential and what are trade offs between design and outcomes of such efforts (Norström et al., 2020; Chambers et al., 2021; Chambers et. al., 2022).

Still there are risks, **problems and knowledge gaps** that need to be further addressed in future studies, such as the challenge of working together with actors having **different practices, worldviews, ethics** (Lam et al., 2020); or the **dominant role** of scientific planning and implementing of cross-knowledge collaborations; and practical, multifaceted, and holistic character of ILK (Malmer et al., 2020). Furthermore, dominant actors/agendas, and the distributions of **power and decision** making are reported to bring risks (Tengö et al., 2021; Chambers et. al., 2021; Chambers et. al., 2022; Hill et al., 2020a). These issues can bring the **mistrust amongst participants** and **can hinder knowledge holders from sharing knowledge** (Malmer et al., 2020). Relatively **short time frames** of conducting a project/study of knowledge

collaboration limited by **insufficient funding hinders** even more the building of **trusting relationships** (Chambers et al., 2021; Tengö et al., 2021).

How to achieve true inclusiveness remains still one of the **biggest issues**, especially the **lack of appropriate methods and tools** to include ILK is insufficiently mentioned in publications (Tengö et. al., 2014, 2017, 2021; Lam et. al., 2020; Malmer et al., 2020; Hill et al., 2020a). There is the **mismatch between** the relatively inflexible **text-based format of assessments**, **and** the **distinct character of ILK** material that are **transmitted in practical ways**, for instance through oral, songs, dance, art. Most of the approaches to include ILK are either new or still in development (Hill et al., 2020a).

Despite the potential risks and challenges that remain, as the work to promote changes toward equitable, just, and sustainable futures goes on (Lam et al., 2020). Further **development and testing of tools and methods is necessary to enable and improve knowledge co-production** efforts (Malmer et al., 2020).

3. The Amazon as a Research Context

3.1 Introduction

The Amazon rainforest has been chosen, as a geographical research context, due to its high diversity of different ethnic groups and cultures (Loh & Harmon, 2005), and the various conflicts and sustainability problems concerning the extraction of natural resources and forest/land-use activities which affect the ecosystem and IPLC, including their traditions, lifestyle and knowledge (Londres et al., 2023).

This chapter provides the reader a non-exhaustive introduction to this region which crosses eight countries in South America: Brazil, Bolivia, Peru, Ecuador, Colombia, Venezuela, Guyana, Suriname, and the territory of French Guiana, a department of France (DeArmond et al., 2023). The borders of the Amazon are defined as proposed by Eva and colleagues (2005) who coined the widest Amazonian outline. Although some of its limits might have been changed by now due to land-use activities since this proposal was made in 2005, it is an appropriate geographical boundary as this thesis includes the topic of the landscape transformations in the Amazon.

As a starting point, we look at the Amazon as a critical ecosystem. Ecosystem processes contribute to human well-being and economies in a broad variety of ways. Although all humans depend on ecosystems for interacting with and enriching human lives (directly and indirectly), how humans can sustainably manage these ecosystems remains a complex challenge (Tengö et al., 2014). Globally, ecosystems are governed primarily by Indigenous peoples and local communities (IPLC), whose practices and knowledge systems are as varied as the places from which they originate from (Tengö et al., 2021). When talking about this intrinsic biological and cultural diversity the term biocultural diversity is applied.

Global biocultural diversity, affected by sustainability issues, is raising attention in academia to interpret, represent and shape complex socio-ecological systems (Hanspach et al., 2020; Elands et al., 2019). Especially in the Amazon, an area recognized for its high biocultural diversity

(Loh & Harmon, 2005). Because IPLCs have lived in and with specific ecosystems for generations, they have gained extensive knowledge due to their specific constraints and conditions, which can be crucial for context-sensitive forest conservation and restoration (Londres et al., 2023).

It is recognized that Indigenous lands contribute significantly to the conservation of biodiversity and play a crucial role in climate change mitigation (Garcia et al., 2024). The critical need for science and policy to acknowledge and mobilize the knowledge of IPLC for conservation efforts has received more emphasis recently. It is necessary to develop and put into place creative, cooperative procedures that will open doors for collaboration, for conservation and long-term sustainable governance (Malmer et al., 2020). This gap in knowledge of appropriate and inclusive methods, tools and practices of ILK incorporation in such projects and studies is of critical significance, as extensively illustrated in Chapter 2.

3.2 Amazon: Key Features

3.2.1 Amazon in Numbers

The biggest part, approximately 60% of the Amazon rainforest, is found in Brazil, including one-third of the world's primary tropical rainforests (Butler, 2024). Amazonian rainforest accounts for close to 10% of the world’s terrestrial productivity and biomass, and helps by storing organic carbon in biomass and soil, keeping greenhouse gases from the atmosphere, therefore it plays a crucial role in climate change (Foley et al., 2007).

The Amazon is the largest remaining tropical rainforest on earth and it contains one of the greatest collections of biological diversity of plant, animal, and microbial life-forms. The Amazon provides crucial ecosystem goods and services to humanity, of economic and societal value (Foley et al., 2007).The biodiversity is reflected in the number of species which counts 40,000 plant species and 16,000 tree species. Additionally to the flora, the fauna includes: 3,000 fish species, 1,300 birds, 430 or more mammals, 1,000 or more amphibians, 400 or more reptiles (Butler, 2024).

More than 40 million people live in the Amazon, including 2.2 million Indigenous peoples (Flores et al., 2024) from 375 indigenous ethnic groups, who live within ~3344 indigenous territories and ~522 protected natural areas (Walker et al., 2020), as well as local traditional communities and Afrodescendent peoples (Flores et al., 2024).

Loh and Harmon identified the Amazon Basin in a global ranking as one of three areas of highest and richness in biological and cultural diversity (Loh & Harmon, 2005). One element of biocultural diversity in the Amazon is for instance the diversity of human societies that speak at least 300 languages. Most of these languages are endemic, including 75% of them with 1,000 or less speakers. Furthermore, the Amazon region is inhabited by most of the last isolated Indigenous groups on earth, called “Indigenous Peoples living in voluntary isolation” (Cartró-Sabaté, 2018). Such as for instance the Waorani indigenous people from the Ecuadorian Amazon who live in voluntary isolation in and around the Yasuni national park (Trujillo, 2023).

There are multi-scalar dimensions of ILK, for example in relation to migratory species in the Americas. The history of interactions is reflected through this diversity, for example over millennia of trans-continental contacts, migrations and colonization (Hill et al., 2020a). Land for indigenous people is not only a physical asset with some economic and financial value, but an intrinsic dimension and part of their lives and belief systems (Roldán Ortega, 2004).

3.2.2 Amazon’s Conflict(s)

Despite the great diversity in biological and cultural variety and the contribution to the global climate balance, the Amazon rainforest is facing multiple threats because in large areas of its territory there are complex, conflictive, and diverse social ecological systems.

Activities like agro-pastoral frontiers, mining, illegal logging and oil extraction are drivers for deforestation, degradation and resource exploitation (Londres et al., 2023). They can not only threaten environmental concerns like the irreversible loss of the self-regulation of water cycle, the global greenhouse

gas imbalance and biodiversity loss (Londres et al., 2023), but also affect its inhabitants like indigenous people and local communities (Trujillo, 2023; Juhasz, 2023). This is because IPLC of the Amazon have an intrinsic relationship with their environment which connects their lives and beliefs (Roldán Ortega, 2004).

For Indigenous peoples, territory is not only land, but an existential aspect of their lives, with a highly interwoven link between the land, people, and beings that occupy it. Their struggle for land rights is not just about survival, it's about life itself (Josse et al., 2024). Generally, indigenous populations live in constituted territories, which are formally or not (yet) formally recognized as indigenous territories (Codato et al., 2019).

The following summary briefly introduces the key findings of unsustainable practices and conflicting activities, including: Oil and Gas Extraction; Mining, Gold and other Minerals; Deforestation Logging, Ranging, Agriculture; Infrastructure: Roads and Hydroelectric Dams; and Climate Change.

Oil and Gas Extraction

Globally, the Amazon Biome presently plays a crucial role both as a carbon sink and as a fossil fuel reserve. It is endangered by pressures from oil and gas activities. Numerous socio-environmental effects of oil operations are well known, including alterations in indigenous culture and land usage, water body contamination, and biodiversity loss brought on by habitat fragmentation and ecosystem deterioration. As well as alteration of aquatic organisms can lead to an increase in congenital disorders, and other health risks for humans (Codato et al., 2019). Furthermore, Oil-operations lead to deforestation, for the purpose of constructing the oil-drilling sights and roads to access the sights to carry out the oil extraction disclose the previously unthought areas of the Amazon rainforest (WWF, n.d.).

A study from 2008 identified that especially in indigenous territories in the Amazon land use changes are taking place because of activities and decisions related to access to markets (such as oil extraction) (Gray et al., 2007). A more recent study from 2019 identified that still oil and gas activities are one of the

main drivers, besides development of agricultural frontiers, which pose a serious threat to indigenous people and have changed many aspects of their traditional way of life, which includes traditional hunting, fishing, and small-scale farming activities (Codato et al., 2019). Due to the reduction of forests, IPLC are less able to benefit from the natural resources the ecosystems provide, leading to increased poverty, which forces IPLC to move to other regions (WWF, n.d.).

For example extensive damages have been inflicted on the Ecuadorian Amazon and its residents due to oil exploration and production. An investigation by the environmental news group Mongabay found that out of 65 oil concessions, 63 of them overlap with Indigenous territories. The government recognizes a total of 1,202 oil spills that have occurred over the last ten years in these regions (Téllez Chávez, 2023). Furthermore, the land and its IPLC have suffered significant harm as a result of oil exploration and production. As leaders of oil resistance movements experienced persecution, harassment, and sometimes death (Juhasz, 2023).

Mining, Gold and other Minerals

As well as oil extraction, mining for the purpose of extracting metals such as gold causes contamination of soil and rivers. According to the study of Moulatlet and colleagues (2023), mining operations have a major impact on the contamination of water and sediment throughout the Amazon basin, endangering freshwater ecosystems (Moulatlet et al., 2023). The results of conducting geospatial analysis of the entire area of both large-scale mining concessions on Indigenous territory within the Amazon rainforest's biogeographic region revealed that over 20% of Amazonian Indigenous lands are currently covered by both legal and illegal mining, putting hundreds of Indigenous communities and vital ecosystems at jeopardy (Vallejos et al., 2020). Mining is polluting at least 30 Amazonian rivers. Indigenous lands with mining activities had up to three times higher incidences of tree cover loss than territories without mining, although communities have a proven ability to prevent deforestation (Vallejos et al., 2020).

Deforestation Logging, Ranging, Agriculture

Deforestation has happened due to several reasons such as previously mentioned, oil, gas and mining activities. But the main drivers for Amazon deforestation has been due to two primary causes, firstly, large-scale ranching (Laurance, 2005), mainly for cattle ranching, and soybean production (WWF, n.d.). According to estimates, 70–75% of the deforestation in the Brazilian Amazon is caused by large- and medium-sized ranchers. Secondly, Slash-and-burn farming for crops, which was usually carried out by small landowners who clear small areas of forest each year (Laurance, 2005).

A more recent study by Marengo and Souza (2018) states that at a fundamental level, deforestation in the Amazon countries is the result of several forces working in synergies, promote such as economic considerations like low internal costs (for labor, land, fuel, or timber) and rising output prices (particularly for cash crops or timber). As well as formal policies that encourage deforestation, land use regulations, colonial-related economic development initiatives, transportation, and subsidies for land-based enterprises are examples of institutional influences in deforestation. Forest loss is also significantly influenced by failing policies and current land-tenure regimes, such as the corruption or poor management of the forestry industry (Marengo & Souza, 2018).

A study from the Brazilian Amazon revealed that agriculture is causing pesticide pollution in water bodies and sediment close to the frontiers of different indigenous lands. In drainage sediments, surface and ground waters such as streams and wells had been found residues of herbicides and insecticides knowingly used by companies for oil palm plantations in this region. The concentration of these residues (especially glyphosate contamination) are legally permitted by the Brazilian environmental regulatory guidelines, but according to European Union regulatory standards, these values for human consumption are well above the limitation (Damiani et al., 2023).

Infrastructure: Roads and Hydroelectric Dams

Often a great number of indigenous and local communities face challenges and intense disputes, about the topics large-scale development projects and land dispossession, which are key issues of biological and cultural diversity decline in Latin America (Merçon et al., 2019). Large-scale infrastructural development like the construction of hydroelectric dams for example in the Kayapó territory in Brazil, affected the traditional lives of Kayapó people and threatened the displacement of thousands of people, because of a shortage of fish (an essential food for them) due to the the impairment of the natural water flow after the dam was constructed (Watson, 2019).

Another issue is causing roads in tropical climates to be used for both habitation and resource extraction. Furthermore, roads have been the site of a large portion of the Amazon Biome's deforestation. In addition to deforestation, other environmental effects of road construction and operation include damage to soils, aquatic ecosystems, hydrology, wildfires, chemical pollution, and animal mortality (Da Silva et al., 2023). Furthermore, roads for the purpose of distinct activities offer access to previous inaccessible remote forest areas and open up a way for further exploitation (Butler, 2024).

Climate Change

Global and regional warming puts pressure on the Amazon, too. Long-term hydrological and climatic patterns were evaluated in numerous studies that have documented an extension of the dry season and an intensification of the hydrological cycle in the southern Amazon. Changes in droughts and floods, primarily brought on by land use change and natural climate variability are also noticed. In contrast to the southern Amazon, which has seen declines in convection and rainfall over the past decades, the northern Amazon has seen increases in both. Rainfall in the eastern Amazon is expected to decline significantly. Both regional and global impacts will result from climate change in the Amazon (Marengo et al., 2024). In general the Amazon has had less rainfall due to warmer tropical Atlantic temperatures and this is making the rainforest more vulnerable to wildfire and drought (Butler, 2024). Cultural knowledge and practice is undergoing significant erosion due to global change,

likely at a faster pace than the biosphere. In fact, scientists contend that the same dangers are responsible for the loss of biological and cultural variety (Fernández-Llamazares & Cabeza, 2018).

3.2.3 Amazon: Future Changes

In the upcoming decades, it is anticipated that large portions of the Amazon forest may undergo mass mortality events as a result of disturbances connected to land use and climate, which could hasten global warming through carbon emissions and feedbacks with the climate system (Flores et al., 2024). Due to the region's low-productivity and unsustainable agriculture, biodiversity loss and ongoing deforestation will increase the likelihood that the Amazon woods will undergo irreversible change (Marengo & Souza, 2018).

A study projects that 10% to 47% of Amazonian forests would be subject to compounding disturbances by 2050, which might lead to unforeseen ecosystem shifts and it is likely that this will worsen regional climate change impact (this estimate is based on the combination of spatial data on different disturbances). Such impact would mean an irreversible loss of biodiversity, cultural and socioeconomic values (Flores et al., 2024). An increase in maximum surface temperature and a further decrease in total precipitation during the dry season is expected in the future if deforestation persists unchecked. These factors have the potential to drive the Amazon ecosystem into increasingly unstable states. Deforestation in the Amazon is already changing the monsoon patterns in South America, according to new findings, creating drier conditions that could jeopardize the rainforest's long-term resilience.

These results highlight how vital it is to preserve and replenish the Amazon's forest cover as a means of reducing climate change and guaranteeing ecosystem stability (Franco et al., 2025). It will take a mix of international efforts to reduce greenhouse gas emissions and local initiatives to stop deforestation and degradation as well as to increase restoration to keep the Amazon forest robust in the Anthropocene (Flores et al., 2024).

3.3 IPLC in the Amazon

3.3.1 Amazonian Cultural Diversity

ILK is intergenerationally transmitted in an oral way through ceremonies, songs, customs, and lifestyle. Usually its methods and languages preserve distinctive environmental information and customs, relational and interconnectedly with its language and geographical environment. Each ILK is unique and belongs to a specific society, ethnic group, or culture embodying beliefs and cultural practices (Malapane et al., 2024). ILK encompasses the accountancy of governance, social, and economic sphere. It includes family and tenure institutions, naming and classification systems, resource use and practices, and worldviews. Problem-solving is based on experiences accumulated from people-nature interactions, such as the ability to overcome changes and crises of all different kinds (e.g., climate and ecosystem change, livelihood change, availability of resources) (Hill et al., 2020a; Lam et al., 2020).

Moreover, ILK has a high diversity, as it sits at the interface between an enormous variety of cultural practices in distinct ecosystems, (e.g. farmers, fishers, beekeepers, pastoralists, hunter-gatherers, and traditional medical practitioners) (Hill et al., 2020a). Indigenous stories are crucial to reviving biocultural diversity because they are passed down orally through generations and are retained as a communal experience (Fernández-Llamazares & Cabeza, 2018).

Numerous tribes, customs, and cultures have emerged in the Amazon since humans first arrived there between 10,000 and 30,000 years ago. Pre-Columbian Amazon populations probably ranged from 8 to 10 million, if not more. In the Amazon, where subsistence resources were produced through plant and landscape domestication, including earthworks, extremely varied regional systems had emerged (Clement et al., 2015). Native people of the Amazon were (and still are) skilled landscapers. They used agroforestry, fisheries management, a thick network of pathways and canals, controlled burns to draw desirable fauna, and other ingenious environmental management

techniques. For instance the Amazonian dark earths, an artificial soil mixture of charcoal and organic elements.

Experts now estimate that 3–10% of Amazonia is covered with this nutrient-rich black earth (*Peoples of the Amazon - Amazon Aid*, 2021). Highly modified Amazonian dark earths are associated with past large settled populations that may cover greater than 0.1% of the region, creating domesticated landscapes with profound impacts on regional and local ecology (Clement et al., 2015). Many of the most common tree species in the Amazon are domesticated for human benefit (*Peoples of the Amazon - Amazon Aid*, 2021).

Even after centuries of contact with the national society, Indigenous lands have had a strong inhibitory effect on deforestation in the Amazon, according to comparative studies on the performance of inhabited (such as Indigenous lands and extractive reserves) and uninhabited (such as national parks) reserves. Literature about IPLC's role in preventing and reversing deforestation is widely recognized (Garcia et al., 2024). The organisation “Amazon Watch” states that the Amazon's best-preserved rainforests today are the result of indigenous peoples' resistance to colonialism and devastation of their ancestral lands. Upholding Indigenous sovereignty, defending and preserving lives and territories, and promoting and amplifying Indigenous-led approaches to forest conservation, sustainable lifestyles, and regenerative local economies are the best ways to preserve these forests(Amazon Watch, 2023).

3.3.2 IPLCs Risks and Challenges in the Amazon

Such activities bear risks and impacts on IPLC. So state Flores and colleagues (2024) that the loss of forests in the Amazon will negatively affect IPLCs in terms of their livelihoods, lifeways, and knowledge systems that serve as a source of inspiration for cultures around the world (Flores et al., 2024). Because the rapidly changing socio-economic, political, and environmental conditions lead to a cultural loss that can occur within a single generation. Different economic opportunities and a more degraded environment is

becoming increasingly unsuitable for their traditional livelihood activities, and especially the traditional knowledge.

For instance, the ILK about the use of wild plants among the Amazonian indigenous society of Tsimane' Amerindians in Bolivia decreased each year, especially in regions close to market towns. Scholars assume that the decline is due to the fact that there are new and other job opportunities and this ILK is neglected because it is perceived as less useful in new socio-economic and cultural conditions. ILK encodes human cultural diversity and with the ongoing decline researchers and policy makers have shown increasing concern for its loss, especially the parallel decline of the world's biological and cultural diversity (Reyes-García et al., 2013).

Another study investigated the displacement commissioned by the Brazilian federal government of the indigenous group Kaiabi (Kawaiwete) of their territory in the Brazilian Amazon. The impact of this displacement led to long-term changes in artistic knowledge and native language among geographically displaced indigenous. The question of how indigenous knowledge systems will endure into the new millennium is primarily one of how indigenous peoples themselves can engage with non-indigenous institutions and development policies by using their ability to preserve, recreate, and innovate traditional knowledge (Athayde et al., 2017).

Often isolated communities or households acting alone for the defence of their rights for instance regarding land-use, and they are rarely well positioned in the conflict against central, bureaucratic power of the state or as well external threats (Londres et al., 2023).

There are also greater risks of hazards like diseases for remote, uncontacted Indigenous, because of no immunity. Encounters of indigenous and other parties (e.g. Wood feller) caused violent confrontations and even deaths (Survival International, 2011; Survival International, n.d.). The number of especially indigenous leaders and environmental activists being killed is increasing each year and across the whole Amazon rainforest. Examples of news reports are: logging businessmen were found guilty of masterminding the murder of four Indigenous leaders on the Peru-Brazil border (Pérez, 2023);

Brazilian 'forest guardian' killed by illegal loggers (Cowie, 2019), Killing of Indigenous Leader in Ecuador (Téllez Chávez, 2023). The exact number of how many indigenous people are killed in total, and how many because of their activism as leaders and defenders of their rights, territories and the environment, is uncertain, because different news reports have published distinct counts (Indriyatno, 2023; Yale Environment 360, 2019). Formally acknowledging Indigenous rights while taking historical contexts and reparations into account is necessary to address the long-lasting effects of colonialism, like the division of Indigenous Territories and the violent exploitation of Amazonian lands and peoples (Josse et al., 2024).

Through the usage of social media, IPLC are becoming more visible and engaged in national and worldwide arenas to draw attention to their issues and circumstances (Ferrari et al., 2015). There are various organisations that dedicate their efforts, funding and work to protect the Amazon rainforest and its inhabitants from the threats they face. For example Reducing emissions from deforestation and forest degradation (REDD+), Amazon Watch, Survival International, and Greenpeace, amongst others. The success of such efforts to show resistance through activism, exemplify Ecuador's historic national vote in August 2023 established a temporary prohibition of Oil Operations in Yasuni National Park. An estimated 1.67 billion barrels of crude oil will stay in the ground as a result of this vote to "keep the oil in the soil." This moratorium applies to both present and future drilling for oil in the Tambococha, Ishpingo, and Tiputini indigenous territories of the Yasuni National Park, which is one of the most intact areas of the Amazon River Basin in Ecuador. Additionally, it safeguards the rights of the Indigenous Tagaeri, Taromenane, and Dugakaeri peoples who choose to live in voluntary isolation (Juhasz, 2023). Such examples show success in the resistance and activism against illegal and unethical exploitation.

3.3.3 Knowledge Co-Production in the Amazon

Diversity is essential to global sustainability (Merçon et al., 2019). Numerous human-nature relationships—which are not entirely influenced by

dominant culture—are especially significant because, despite their historical invisibility, they play a vital role in sustainability and local and global well-being. To fully comprehend the relationships between humans and nature, it is vital to acknowledge the range of ontological systems that coexist on Earth (Merçon et al., 2019).

The Amazon rainforest has been a laboratory for development interventions, such as related to ILKs integration in environmental management (Brondizio et al., 2021a). ILK can offer for example useful data from long-term ecological monitoring to guide adaptive management and conservation objectives, particularly in situations with limited or poor data (Kadykalo et al., 2021). Furthermore, Indigenous approaches to [sustainable] transformation are often linked to Indigenous land rights, resurgence, and sovereignty initiatives related to specific lands, territories, and communities (West et al., 2024). A number of policy tools are encouraging biocultural conservation strategies.

The significance of using ILK to inform conservation on indigenous lands is underscored by developments in biocultural research (Fernández-Llamazares & Cabeza, 2018). As stated in the Global Biodiversity Framework, it also calls for the protection of endogenous research methodology and knowledge management plans, which are crucial for maintaining Indigenous traditions and guaranteeing Indigenous involvement in conservation initiatives (Josse et al., 2024).

3.4 Final Remarks and Key Messages

The Amazon rainforest, spanning eight South American countries (and French Guiana), represents **one of the most biologically and culturally diverse regions on the planet** (DeArmond et al., 2023; Eva et al., 2005). It contains over 40,000 plant species and 16,000 tree species (Foley et al., 2007; Butler, 2024) and is home to more than 40 million people, including 2.2 million Indigenous individuals across 375 ethnic groups (Flores et al., 2024; Walker et al., 2020). This biocultural diversity, sustained by **Indigenous peoples and local communities** (IPLC), plays a **critical role in climate regulation** and

ecosystem resilience (Loh & Harmon, 2005; Garcia et al., 2024; Tengö et al., 2014, 2021).

However, extractive industries, agro-pastoral expansion, infrastructure development, and climate change are driving deforestation and biodiversity loss (Londres et al., 2023; Laurance, 2005; Marengo & Souza, 2018). Oil and gas operations, mining, and agriculture have led to widespread contamination, habitat fragmentation, and displacement of Indigenous communities (Codato et al., 2019; Moulatlet et al., 2023; Téllez Chávez, 2023; Vallejos et al., 2020). These pressures also **erode** traditional knowledge systems **and threaten cultural survival** (Reyes-García et al., 2013; Athayde et al., 2017; Flores et al., 2024).

Projected **climate scenarios indicate** severe ecosystem disruptions, potentially **affecting nearly half of Amazonian forests by 2050** (Flores et al., 2024; Franco et al., 2025). In this context, integrating Indigenous and local knowledge into conservation and governance is increasingly recognized as essential for ensuring socio-ecological resilience (Merçon et al., 2019; Brondizio et al., 2021a; Kadykalo et al., 2021; Fernández-Llamazares & Cabeza, 2018; Josse et al., 2024).

The essential of this chapter's research exploration is that on one hand **IPLC can make a significant contribution to conservation efforts**, such as through the inclusion of their knowledge on how to sustainably use and manage amazonian ecosystems. On the other hand, c**onservation initiatives play a crucial role in ensuring the protection of an area for IPLC** to continue their **traditional lifestyle and cultural activities**. In any case, the involvement of the IPLC in the decision-making, management and governance of these regions (e.g. ancestral indigenous territories) should be guaranteed and enabled through collaborations and partnerships with other actors. **The question is, how to enable such knowledge and action collaborations with IPLC?**

4. IPLC/ILK Inclusion in the Amazon

Despite the array of diverse interconnected socio-ecological problems (chapter 3), collaborative development initiatives of ILK and practices of sustainable rainforest use and conservation in the Amazon already exist, including state-based developmentalism, market-based conservation, and community-based initiatives. In fact, the Amazon has become an incubator for efforts and local innovations that address present and future pressures. These place-based initiatives involving collective and individual actions, have increasing roles in promoting regional sustainability, but are often overlooked in academic contexts (Brondizio et al., 2021a). This indicates that there exists practical knowledge of past and currently established projects of knowledge collaborations (including ILK) in the Amazon. This begs the question: *What can we learn from these collaborations?* And more specifically to the research question of this thesis: *How did these collaborations achieve the inclusion of ILK?* And *what methods/tools/practices were used to succeed such efforts?* To answer these questions, 14 case studies have been selected to further investigate the inclusion of ILK in the Amazon.

4.1 Search and Selection of Case Studies

This study employs a comparative/multiple case studies design (Yin, 2018) within a regional/cross-national context. The case studies research seeks to forward the question: How did knowledge co-productions include ILK? The aim is to investigate the work processes in diverse national contexts, enabling cross-case comparison to identify diverse methods/tools, as also both generalizable patterns and context-specific differences.Three selection criteria and commonalities of all these case studies are defined, which are:

(1) knowledge collaborations which included ILK,
(2) related to sustainable development, sustainable natural resource/land and forest use, environmental management, environmental and cultural conservation,
(3) and Amazon based projects/studies.

Moreover, case study selection aims to represent initiatives from different countries sharing a part of the Amazon to increase diversity in terms of geographical location within the Amazon boundaries, as well as scales of intervention and diverse governance structures.. To identify suitable case studies we performed an initial web search, asked local scholars and reviewed contextual scientific literature.

4.1.1 Case Studies Locations

The result of the case study search is a selection of 14 case studies that fulfill the selection criteria mentioned above (Brazil: 4, Colombia 1, Peru 3, Venezuela 1, Guyana 1, Bolivia 2, Ecuador 1, and 1 case studies operating in more than one Amazonian country). The higher number of Brazil-based projects reflects the fact that Brazil covers the biggest area, with around 60% of the Amazon (Butler, 2020). Figure 9 provides the mapping of the location of the case studies one to thirteen (Case study nr. 14 is missing as this organisation operates in four Amazonian countries).

Figure 9: Map of case study locations (by Author, 2025)

4.1.2 Case Study Attributes

Table 3 includes a brief summary of case study key attributes. A more comprehensive illustration is presented in Appendix 1, including information about: project/study introduction, location, time frame, stakeholders (indigenous and non-indigenous), objectives and aim, conceptual framework, methods/tools/practices, results and outcomes of the projects/studies (where available).

Project	Country and Scale	Project Purpose	Methods and Tools	Outcomes
1. Floating Fab Lab	Peru, multi-regional	inclusion of local innovation, sustainable development, networking, social and environmental justice	self-help groups; technical and/or commercial supervisions; different types of workshops, field trips	impact in areas like industry, education, environmental conservation, and society
2. Cuia Colab	Brazil, regional with international components	investigating and reporting artisan Cuia molding and painting technique	participatory observation of traditional artisans' production, interviews, field trips	study discovers underappreciation of indigenous objects and techniques, emphasizing the potential of ancestral wisdom for Biodesign
3. Kayapo Project	Brazil, regional	indigenous territory protection through alliance between conservation organisation and indigenous NGO	support, surveillance infrastructure and administrative services; capacity building workshops; expeditions	successful protection of most of the Kayapo territory, ensuring territorial integrity and rights; strong partnerships; community-centered sources of income; equal access; Kayapo participation; preserved culture; financial sustainability
4. CoFruta	Brazil, regional	from grassroots social movements to Rural Workers' Unions forest-agricultural cooperative	networking, connect with diverse actors/institutions at multiple scales, co-design features, used retro-innovation, based on local or indigenous knowledge	multiple social-ecological outcomes: replacing annual monoculture crops, forest cover growth, enhancing biological diversity and environmental services, local workers incomes increased, empowerment, food security
5. Collaborative Fire Management	Venezuela, regional	collaboratively developing an intercultural fire management plan for national park	personal observations, conversations collaborative work in participatory process, meetings, workshops with participatory tools: oral testimonies, timelines, territory and community mapping, matrices, brainstorming, interviews, group/plenary discussions	developed fire management, cultural revitalization, achieving cognitive justice in conservation

6. Win-Win Conservation	Peru, regional	study investigates land use motivations and behaviors of local population reacting on conservation and development strategies	mixed method approach: meeting, mixed method visit, participant observation, (semi-)structured interviews, participatory workshops	findings provide reasons why joint conservation and development projects often fail, having a potential role of a reconceptualized of environmentalities
7. Alliances for National Park	Bolivia, regional	indigenous community and conservation organization partnership for national park	strengthening technical and administrative capacities, consolidating a land use planning and environmental monitoring program, designing and implementing a permanent environmental education program (no specific methods/tools mentioned)	trust two organizations, key accomplishment is the establishment of National Park and Integrated Management Area, designing and implementing research activities on ecology
8. Indigenous Approach on Biological Diversity	Guyana, regional with international components	community-based natural resource management, adaptive comanagement and environmental monitoring	Participatory and empowering processes, consultations, meetings, data collection tools to monitor, monitoring trips, participatory visual method for knowledge exchange, networking	development of a collective territorial management plan, community-based land use monitoring system, agreements on collective actions for sustainable land use, customary sharing of resources, contribution to Aichi targets
9. Indigenous Storytelling for Conservation	Bolivia, regional	linking biocultural revitalization to conservation practice by adding conservation practitioners repertoire	community-centered projects, “Free, Prior and Informed Consent”, guiding principles, promote local participation in conservation and dialogues	indigenous storytelling implementation in conservation, exhibition about Tsimane’ myths
10. Future Proofing Conservation	Colombia, multi-regional	new, robust management options and decision-making processes futures climate change adaptation	multi-stakeholder learning process with interactive, structured, dialogue-based activities, interviews and workshop programs including: Co-design, co- production, Brainstorming, Presentation, feedback, discussion, Lessons learned	generated shared documentation of priority benefits, outputs maps included specific locations of sacred sites
11. Community-based Monitoring	Peru, regional	community-based monitoring including ILK and people	Participatory action research included indigenous participants involvement in most of the study’s development stages and workshops	evidence of the effectiveness and sophistication of community monitoring develop a toolkit
12. Kawsak Sacha - Living Forest	Ecuador, first local, then turned into state wide	pluriversal education supporting socio-environmental justice and sustainable environmental stewardship	incorporation of indigenous knowledge into national intercultural education programmes (no specific actions mentioned)	from local concept to inspire a political and education program
13. Earth Innovation Institute	Brazil, all scales from local to international	sustainable development and Agroforestry education for stopping deforestation	aligning policy, markets, and finance in support of low-emission rural development, through dialogue, co-design and collaboration to enable partnership between indigenous communities and the state government	connection between public policy and forest-, community-, and climate-friendly rural development

14. Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services	Amazonian countries, international	rapid assessment of the biological diversity and ecosystem services in the Amazon	expert workshops, participatory mechanism, dialogue	Presentation of Assessment results to Scientific Committee, report assessment, Incorporating IPLCs perspectives in academia and policy-making, enhancing sustainable solutions ensuring dynamic adaptation

Table 3: Table of the Summary of Case Study Attributes, Source: Author 2025

4.2 Summary of Multiple Case Study Analysis

In this section the following summary presents our findings regarding the methods, tools and ILK practices (where available).

1. **FabLab Peru** focused on conducting workshops (e.g. training, virtual workshops, and in-person workshops) for diverse participants such as scholars, locals and indigenous in their communities. Key components are: seeking alliances, creating self-help groups and incorporation of academic, technical and/or commercial supervisions (Herrera Polo & Juarez, 2013; *Fablab Lima*, n.d.; Lourdes, 2023).
2. **Cuia Colab** used a mixed-method approach of participatory observation of traditional artisans' production for this transdisciplinarity project which included observing and interviewing traditional cuia artisans (Bandoni et al., 2024).
3. **Kayapo Project**: Indigenous-led NGO alliance to defend the Kayapo territory and rights from external threats through collaboration with members of the International Conservation Fund of Canada (ICFC), which provide and support surveillance infrastructure, administrative services and capacity building workshops (Kayapo Project, 2024).
4. **CoFruta:** factors for socially- and environmentally-successful place-based initiatives are grounded in ILK and worldviews, adopt multi-specialized activities, and connect with diverse actors and institutions at multiple scales. The number of outcomes increased when the initiative was initiated or led by local actors, was a community-based organization, had

co-design features, used retro-innovation, or engaged with cultivation and use of natural products based on ILK (Londres et al., 2023).

5. **Collaborative Fire Management**: this study reports general tasks, such as: personal observations and conversations; secondary data collected during participation or engagement; Community meetings and workshops; oral-based decision-making structure; informal discussions. More specific details are: participatory methods: (1) community workshops, (2) in depth–interviews, (3) site visits, and (4) a final meeting to discuss interview results with the community and Feedback. Participatory tools in workshops: oral testimonies, timelines, territory and community mapping, matrices, brainstorming, interviews, and group and plenary discussions (Rodriguez, 2007, 2017).
6. **Win-Win Conservation:** this study examines IPLC's well-being and them as long-term environmental stewards in conservation projects. Mixed methods like participant observation, visiting community and joining in daily activities were applied by the scholar to build trust quickly. Conduction of semi-structured and structured interviews with its design based and informed by half-day participatory workshops (Chambers, 2018; Chambers et al., 2019).
7. **Alliances for National Park:** this collaboration between an indigenous rights organisation and a conservation organization was to understand the interplay of different interests of protected areas. Support of technical and administrative capacities, conducting participatory research of ecology, wildlife population and designing appropriate management practices, consolidating a land use planning and environmental monitoring program, collectively designing and implementing a permanent environmental education program (Redford & Painter, 2006; Painter & Kretser, 2012).
8. **Indigenous Approach on Biological Diversity:** Participatory and empowering processes have been placed as a core element of this approach, as well as horizontal knowledge exchange of diverse participants (including IPLC). It started as a grassroots monitoring initiative for detecting and documenting illegal activities in Wapichan indigenous

territory and evolved to a comprehensive land use management plan. Using participatory visual methods (e.g. films and photostories) to identify and document their community owned solutions in order to later share their strategies with six other communities facing similar challenges. Planning work involved several meetings, extensive village-based consultations and collective inter-village meetings (Ferrari et al., 2015; Tschirhart et al., 2016).

9. **Indigenous Storytelling for Conservation:** this initiative strived to include indigenous storytelling as an addition to the conservation practitioners repertoire. This approach includes: linking conservation efforts to indigenous people's worldviews; fostering connections between indigenous peoples and their territory; facilitating transgenerations indigenous knowledge transfer; fostering conservation dialogue; and promoting conservation collaborations with local participation (Fernández-Llamazares & Cabeza, 2018).
10. **Future Proofing Conservation:** by exploring new ways of managing areas under protection this project seeks to develop adaptable and applicable strategies for protected areas with climate change impact. The development included: Phase 1: Co-design and co-production with 1. Initial scoping workshop; 3. co-design workshop (including diverse participants: academics, civil society, practitioners, advisers). Specific activities in these workshops were brainstorming, theory of change, small and large group discussion; presentation, feedback and discussion, further refinement and planning. Phase 2: Future-proofing conservation piloting, planning and implementation: Piloting meeting, Lessons learned workshop, knowledge governance interviews, structured discussion based on the questions, Feedback, Future Dialogue workshops (Van Kerkhoff et al., 2018).
11. **Community-based Monitoring:** Participatory Action Research, Radical Citizen Science approach; meaning indigenous participants are involved in most of the study's development stages, through workshops (Cartró-Sabaté, 2018; Ferrari et al., 2015).

12. **Kawsak Sacha (translated: Living Forest)**: Kichwa community developed a concept that was then adopted by the entire Kichwa nationality of Pastaza (Ecuador) inspiring a political programme. Included is an educational planning initiative that engages collective actions in forest protection. Involved are schools, non-indigenous students and teachers in pluriversal education regarding socio-environmental justice, to receive and perceive Indigenous epistemes forming part of the geopolitical present (Jimenez et al., 2022; Minoia et., al 2024).
13. **Earth Innovation Institute:** This organisation applied dialogues, co-design and collaborations to enable partnership between indigenous communities and the state government (Earth Innovation Institute, n.d-a.; DiGiano et al., 2018).
14. **Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES):** The collection of testimonies from Amazonian inhabitants ("Voices of the Amazon") is to include their perceptions regarding biodiversity, ecosystem services, recommendations and messages to decision-makers, to conserve and sustainably use natural resources. Testimonies as an innovative complementation of the Rapid Assessment called through in-person meetings, and expert workshops, diverse stakeholder webinars for intergenerational and intercultural dialogues (IPBES, 2023).

4.3 Synthesized Results: Looking for Patterns

Despite the 14 projects' distinct contexts, stakeholders, and methodologies, several converging themes and patterns emerge, offering valuable insights in the practical experience of knowledge co-productions.

1. **Centrality of Indigenous Epistemologies**

A recurring pattern across the case studies is that indigenous ontologies enable innovative, place-based approaches that bridge traditional wisdom and contemporary sustainability. The critical role of Indigenous knowledge systems in shaping more effective and culturally grounded

conservation and development strategies. Projects such as Cuia Colab, Collaborative Fire Management, and Kawsak Sacha demonstrated that aligning with Indigenous ontologies, besides incorporating traditional knowledge as data, enhances cultural relevance, ecological resilience, and legitimacy.

2. Participatory and Community-Led Methodologies

Most initiatives adopted participatory methods such as ranging from storytelling and workshops to co-design and co-create, to empower local actors. The Wapichan Territorial Monitoring, CoFruta, and Indigenous Storytelling for Conservation projects underscore the effectiveness of these approaches in fostering ownership, local agency, and intergenerational knowledge transfer. These participatory action research methods are foundational to trust-building and long-term impact.

3. Multiscalar Governance and Cross-Sector Alliances

Several projects highlight the success of multi-level collaboration between Indigenous communities, NGOs, academic institutions, and governments. The Kayapo Project, Earth Innovation Institute, and Alliances for National Park (CABI-WCS) illustrate how such partnerships can balance local autonomy with broader governance policies, especially when financial and technical capacity-building is involved.

4. Policy Impact through Evidence-Based, Hybrid Knowledge

The Inclusion of Indigenous perspectives in policy requires structural shifts and institutional openness to plural knowledge systems. Efforts such as IPBES Amazon Assessment and Future Proofing Conservation showcase the growing influence of evidence-based policy frameworks that integrate both scientific and traditional knowledge. However, these often face institutional inertia, resulting in incremental rather than transformative change.

5. Socio-Ecological Co-Benefits and Bioeconomy Potential

Culturally embedded bioeconomy models strengthen both livelihoods and ecosystems. Many projects yielded dual outcomes—improving ecological conservation while advancing socio-economic resilience. Examples include CoFruta's agroforestry model, the Kayapo's economic initiatives, and Cuia Colab's biodesign revival, all demonstrating the potential of bioeconomy pathways rooted in cultural heritage and sustainable use of biodiversity.

6. Rights-Based and Justice-Oriented Approaches

Environmental justice frameworks are essential for equitable and durable conservation outcomes. Projects increasingly framed conservation through rights-based lenses, emphasizing land rights, Free, Prior, and Informed Consent, and cognitive justice. The Collaborative Fire Management, Kawsak Sacha, and Storytelling for Conservation initiatives explicitly tackled historical marginalization by re-centering Indigenous agency within governance and discourse.

4.4 Final Remarks and Key Messages

Collectively, these case studies illustrate a paradigm shift in conservation and sustainable development—**from top-down, technocratic interventions to pluralistic, rights-based, and culturally grounded approaches**. The emerging patterns suggest that successful initiatives are those that: **prioritize indigenous-led governance; foster intercultural dialogue and co-production of knowledge; align ecological goals with social justice and local worldviews; create adaptive, inclusive institutions for long-term resilience; move beyond token inclusion to truly reconfigure power dynamics;** and **support indigenous self-determination within environmental governance**. Furthermore, extensive **process documentation and reporting is lacking** in the majority of the case studies. Most of these projects and studies do not inform sufficiently about the co-productions process. As the literature review from chapter 2 revealed, it was expected that this

analysis yielded limited insights of specific methods and tools, applied in knowledge collaborations.

Exceptionally lots of detailed information about the work process of ILK inclusion present just two case studies, which are the descriptions of case study 10. (Future Proofing Conservation). Here the authors reported two working phases and which type of workshops (e.g. dialogue workshop) were applied. Also mentioned are specific tasks such as presentations, feedback and discussion sessions and the diverse stakeholders participation in which stages of the process are described. And the case study 5 (Collaborative Fire Management) was a second comprehensively and well described example, the process of collaborating with the Pemon indigenous community members. Such as for example the participatory tools like oral testimonies, timelines, territory and community mapping, matrices, brainstorming, interviews, and group and plenary discussions.

Nevertheless, it can be **generalized** that the **participatory and collaborative methods** that were applied to include Indigenous peoples and Indigenous knowledge across the **majority of these initiatives include workshops**—both virtual and in-person—,widely used to facilitate training, co-design, and capacity building, engaging Indigenous communities, scholars, and local participants (e.g. Floating Fab Lab; Kayapo Project; Earth Innovation Institute). **Mixed-method approaches** combining participatory observation, interviews, and site visits enabled in-depth understanding of Indigenous practices, such as traditional artisanal production (Cuia Colab) and community fire management (Collaborative Fire Management). **Tools like storytelling, oral testimonies, participatory mapping,** and **visual methods** enabled the projects grounding in indigenous worldviews and epistemologies (Indigenous Storytelling for Conservation; Indigenous Approach on Biological Diversity). Emphasis was placed on **Free, Prior and Informed Consent, horizontal knowledge exchange**, and **data sovereignty**, fostering trust and equitable partnerships (Community-based Monitoring; IPBES). **Iterative feedback processes** and participatory governance structures, including community meetings, workshops, and environmental education programs, supported

adaptive management and long-term stewardship (Win-Win Conservation; Future Proofing Conservation). Multiple cases have in common that the collaboration process took place in the indigenous/local communities or territories. Moreover, the case studies highlight activities related to conversational activities such as e.g. dialogue, discussion, and interviews, which matched with the fact that ILK is transmitted mostly in an oral way (Malapane et al., 2024).

Overall, these integrative methods and practices demonstrated the importance of culturally responsive engagement and capacity building in the effective inclusion of Indigenous knowledge within conservation, development, and research frameworks. Although the question remains: ***What methods, tools, activities and practices exactly and more specifically were applied to facilitate and include ILK?*** This case study analysis already gives valuable insight in the work process, but to accomplish a more enhanced picture of the topic, semi-structured interviews were conducted with stakeholders of three case studies in order to investigate in depth the methods and tools that were used in the process to include ILK, detailed information in the next chapter 5.

5. Data Collection and Analysis

The case studies analysis presented in the previous chapter gave limited understanding and details about the specific methods, tools and activities that had been applied in knowledge collaborations processes. The conduction of interviews will accomplish further investigations and shed light on the process of including ILK in knowledge co-productions in these cases. Given the exploratory nature of the research and the need to capture in-depth personal experiences, qualitative semi-structured interviews were chosen as the method of data collection. This approach allowed for a nuanced understanding of how individuals perceive the process of knowledge co-production. The aim is to obtain a qualitative and subjective report from participants about which practices were used, which worked well, and which did not, to include ILK. This chapter contains information regarding the interview type, interviewee selection, interview guide and the conduction of the interviews. Finally the findings of the interview answers are summarized and compared (details in Appendix 3).

5.1 Interviews

5.1.1 Development of Interview Guide

In order to design the interview guide adequately 11 core themes were selected out from the initial literature review (Chapter 2). These were introduced in the main structure of the interview guide, which consists of two components: “During Development Process” includes questions regarding the process of the conduction of the collaboration while the category “After Completion” refers to questions regarding the results and later impact of the project. We now explain and justify how interview questions articulate with the core themes.

The first four questions in the interview guide in the category “***During Development Process***” are to disclose how much and how the involvement of IPLC and ILK in the project was and regarding the participants role and involvement in the project. They belong to the theme “***Representatives***”. This keyword was identified in the literature as an obstacle because participation processes do not always guarantee that every representative can contribute

significantly or produce inclusive results (Díaz-Reviriego et al., 2019). The diversity of representatives of knowledges such as ILK is crucial when working in multiple knowledge co-productions for sustainability, but the low level of knowledge-holder inclusiveness hinders true inclusion (Kadykalo et al., 2021). This raises the question of how the selected case studies tackled this issue and through which methods.

The theme "***Constraints"*** was included to investigate challenges and limitations of the project's processes. One limitation can be a relatively short time frame of the collaboration which hinders the participants to build up a relationship and gain the necessary trust to entrust their knowledge to others (Kadykalo et al., 2021). Another constraint can be the inappropriate methods that were identified as not useful in the co-working process. This can inform future knowledge collaborations about what methods didn't work well (Lam et al., 2020). For these reasons, several questions are dedicated to restrictions.

The next theme is "***Knowledge Treatment***" and transfer. This refers to the ways in which knowledge was transmitted and in which circumstances. Knowledge gaps in the literature remain such as regarding the problem of protecting intellectual property rights. This issue has to be better addressed when bridging ILK with others (Hill et al., 2020a), to ensure that later decisions are made with the full involvement, collaboration and consent of IPLC themselves (Kadykalo et al., 2021). For this reason the various knowledge system holders must be included in all stages of the collaboration, for example the analysis and negotiation process, when bringing them together, regardless of whether they overlap, diverge, or converge (Tengö et al., 2017). Furthermore the problem of a lack of appropriate and inclusive methods and tools to enable the mobilization and transmission of ILK is tackled (Tengö et. al., 2014, 2017, 2021). That's why several questions regarding how ILK was included in the case studies are listed in the interview guide. Particularly the topic of the methods, tools and practices are the core questions of the interview as they are directly connected to the research question of this thesis.

"***Power and decision making***" imbalances can be problematic in participatory processes because they might prevent certain indigenous

participants from sharing their knowledge in knowledge co-production (Kadykalo et al., 2021) and create hierarchies within such processes. Therefore, it is essential to carefully review and reflect on these processes in order to uncover the understandings, visions, and values of the various individuals engaged (Norström et al., 2020). Especially ILK representatives have worked on overcoming structural obstacles in knowledge co-production processes (in fields like science, policy, and governance), particularly with regard to centralization, power disparities, and decision-making by dominant, powerful actors, in order to meet interconnected goals of bolstering the effort to recognize ILK (Tengö et al., 2021). The question emerges, Who decided in the case studies which knowledge was included?

The theme "***Common understandings***" refers to all representatives from various knowledge systems who must be able to understand the varying knowledge contributions. For IPLC, scientific knowledge must be easy to understand, and for researchers, ILK must be comprehensive (Tengö et al., 2017). Furthermore, shared understanding refers to appropriate language, commonly known key terminology and concepts (Norström et al., 2020). ILK has to be mobilized through culturally suitable methods (Tengö et al., 2017). If commonly understood communication was given and still different perspectives remain, it is necessary to respect this diversity (Norström et al., 2020). Because of these reasons one question regarding the shared understanding is included in the interview guide.

Knowledge co-production gains from meaningful and precise "***joined problem definition***" which should arise from a collective comprehension of the challenge(s) or topic the project wants to tackle (Norström et al., 2020). A cooperative problem-definition process is therefore essential to facilitating knowledge transfers (Hill et al., 2020a). Because the joint issue formulation contributes crucially to successful outcomes of multiple knowledge collaborations (Malmer et al., 2020). That's why it is relevant to know if this was applied in the case studies.

Like mentioned above, the topic of "***mutual trust***" is of particular interest, because building mutual trust and respect amongst various actors and

knowledge holders is a fundamental contributor, especially in areas with historical injustices and legal violations of IPLC's rights (Malmer et al., 2020) like it is the case in the Amazon.

The "***scale***" of a co-production is a crucial factor. The majority of knowledge co-production processes have involved pluralistic partnerships at the local and regional levels, while research institutes and NGOs are increasingly operating on a global scale (Norström et al., 2020). It is stated that multi-level governance is the best way to meet global sustainability goals (Sterling et al., 2017). Therefore, the question of the scale of the project is included.

The "***After Completion***" category, includes questions to evaluate if the methods, tools and activities applied in the case studies were suitable to achieve the desired result. The themes "***outcome***", "***impact***" and "***output***" are included, because across different approaches to evaluate co-production or transdisciplinary research processes, common metrics are the process (as mentioned above), outputs, outcomes as well as impacts. Direct and indirect impact incorporates intangible impacts and more concrete products and outputs (Norström et al., 2020) to the research context.

The following Figure 10 presents the completed interview guide, its 26 questions organized in its categories and core themes.

CATEGORIES	THEMES	QUESTIONS	Nº
During Development Process	Representatives	Have you directly worked with IPLC?	1
		Was IPLC/ILK included in the project?	2
		Your role/job in the project?	3
		Did you meet regularly with all participants?	4
	Knowledge Treatment	How did ILK contribute to the project?	5
		How was ILK included?	6
		Have there been particular practices of ILK inclusion/generation?	7
		What methods/tools/practices were used to include ILK?	8
		Helpful /useful methods/tools/practices for ILK inclusion?	9
	Constraints	Were there any challenges or problems regarding working with IPLC/ ILK?	10
		When did you join the project?	11
		Any not useful methods/tools/practices for ILK inclusion?	12
		For how long have you been working in this project?	13
	Power and Decision Making	How did you decide which ILK is included?	14
	Common Understandings	Commonly known, appropriate language and terminology/concepts?	15
	Joined Problem Definition	Has there been a joined problem definition at the beginning?	16
	Mutual Trust	Has there been mutual trust among all participants?	17
	Scale	Was it a regional, national, global project?	18
		How long was the time period of the project?	19
After Completion	Outcome	What was the outcome of the project?	20
		Do you have updates from the project now?	21
		Were there any unexpected benefits?	22
	Impact	How did you measure the impact of the project?	23
		What was the indirect impact?	24
		What was the direct impact?	25
	Output	What was the output of the project?	26

Figure 10: Interview Guide, Source: by Author, 2025

5.1.2 Interviewees

The recommended number of interviewees depends on the topic, purpose and varies in the literature (Creswell, 2007). According to Bekele and Ago (2022) “the issue lacks a concrete guideline which is clear and easy [...]. No universal rule dictates the maximum and the minimum number of interviews for a qualitative research” (Bekele & Ago, 2022). However, ultimately the number of participants depends on the willingness and availability of the interviewees, which is one uncontrollable variable.

The distribution of the two interviewee types was as follows: one participant that was in the role of the receiver of ILK (e.g. scholar) and a second person of the same project, that was in the ILK transmitter position. This dual-interviewee decision was due to the fact that the transmitter and the receiver of ILK could have experienced the process in different ways and/or opinion distinctly about what methods, tools or practices worked or not, in order to transmit and implement ILK in the project. Through the inclusion of the opinions from both participant types (receiver and transmitter), an equal distribution is provided which prevents the bias of one dominant interviewee type. Figure 12 presents the interviewee distribution Plan, including the distribution and number of different stakeholders.

In total 6 people were interviewed, distributed equally among three case studies. Figure 11, provides details about the 14 Case study, of which 24 participants were contacted (based on availability of contact information) and then 7 agreed on conducting an interview, lastly 6 interviews were valid (one interviewee turned out to be not directly involved in the work with IPLC). The Interviews were conducted in April-July 2025.

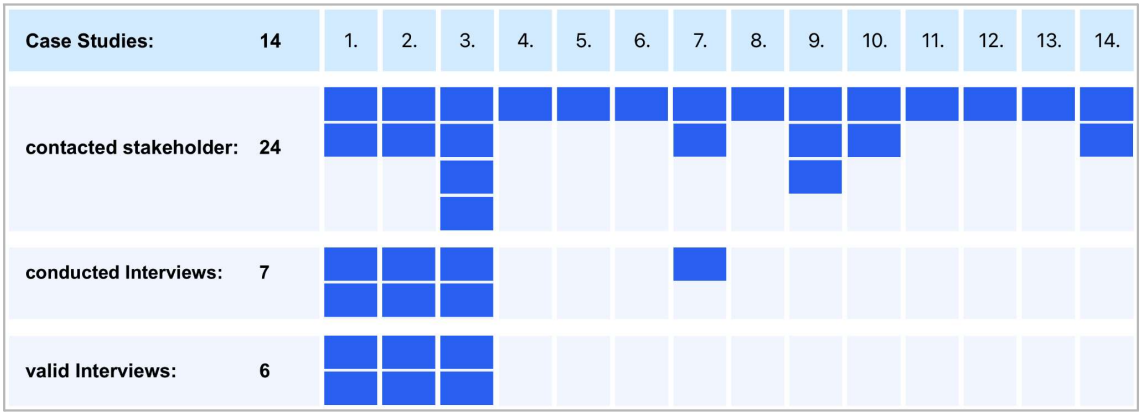

Figure 11: Contacted and Interviewed Persons, by Author 2024

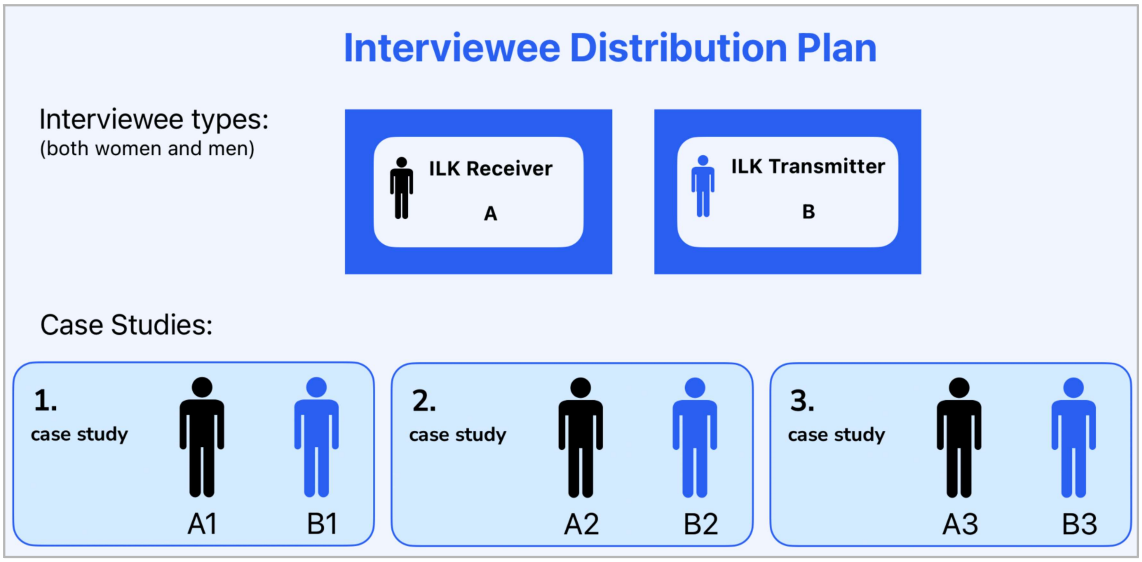

Figure 12: Interviewee Distribution Plan presents the division and amount of Interviewees, by Author 2024

5.1.3 Interview Preparation

During the case study research (chapter 4) stakeholders of each project and their contact information (email and other social media profiles) were identified through a web-based search.. When participants responded affirmatively to the interview requests, then the online meetings were scheduled and the interviews were conducted. The decision to carry out the interviews

remotely and not in person was due to the fact that the participants were located in different countries (globally).

Later when interviewing, they were asked to enable the contact to the ILK holders of the projects. With everyone's consent the contact information of ILK holders were shared to request an interview with them as well, which was also conducted online after their approval and agreement.

Each interview was conducted either in English, Portuguese or Spanish, depending on the native language and the level of english of each interviewee and their preferred language. All Interviews were held online on the platform Google Meet and WhatsApp.

When starting the interviews, some standards and advice such as the eight principles of pre-interview preparation were included in the process: (1) choosing a setting without distraction; (2) explain interview purpose; (3) address confidentiality terms; (4) explain interview format; (5) indicate approximate length of interview (amount of questions and approximate time); (6) inform interviewee about contact information for later questions; (7) assuring that participant has no questions before starting; and (8) asking for permission to record the interview (Ian, 2024). Before starting the interview, these confidentiality terms were presented and confirmed/agreed on.

The question's wording varied slightly to ensure a natural conversation flow, also the amount of questions differed as well depending on the participants answers (e.g. participants gave an answer in advance before the question was asked) but all interviews include the same keywords mentioned in section above. The average length of the interview was about 40 min. The interviews are all recorded and later transcribed (see Appendix 2).

Finally the interview transcripts were analysed applying an thematic analysis (see Appendix 3), then the data was evaluated and discussed (see next section and Chapter 6).

5.2 Findings of Comparative Analysis

These three comparative summaries present each two viewpoints on the same project. Interviewee A's perspectives (non-indigenous participant) are

compared with interviewee B's perspectives (indigenous participant) on the project/study process in which they participated. Their shared perceptions and divergences are presented. Particularly which methods, tools and approaches were applied. Table 4 presents the interviewees of each project, and their categorisation in group A and B.

Case study names	FabLab	Cuia CoLab	Kayapo Project
non-indigenous participants	Benito Juarez (A1)	Andrea Bandoni (A2)	Matthew Aruch (A3)
indigenous participants	Zoila Ochoa (B1)	Silvane Almeida Maduro (B2)	Poyre Mekragnotire (B3)

Table 4: Interviewees names, roles and projects, by Author 2025

5.2.1 Case Study 1: FabLab Peru

Both participants report the project's employment of co-creative, participatory methodology for various project components. The collaboration was inclusive from the outset, promoting mutual learning across all project phases, all co-designed with the community such as developing a prototyping model. The knowledge sharing process during the project was documented, primarily for educational use. A1 explains that initially led by an academic vision, the approach was adjusted in response to community feedback, (confirmed by B1) prioritizing sensory and hands-on learning methods like regular workshops and near-weekly meetings, both in-person and via WhatsApp, fostering sustained engagement, before introducing theoretical concepts. The project team first demonstrated their own activities to build trust, then invited community members to share their practices.

Both interviewees emphasize the importance of community participation and trust-building as foundational elements of the project. A1 describes a co-creative approach that involved Indigenous partners across most stages of the project—from design to implementation—though the initiative originally

began as an academic endeavor. B1 similarly acknowledges the central role of community agency, especially in forming associations and defining participation. However, B1 expresses concerns over past experiences of knowledge appropriation, which made initially trust fragile and collaboration more cautious.

Both accounts reflect a strong commitment to ethical engagement and recognition of Indigenous knowledge as valid and necessary—not supplementary. A1 discusses the integration of holistic ecological and cultural knowledge into strategies for land regeneration and bioproduct development. B1 highlights practical knowledge such as medicinal plant use and fiber processing, transmitted through embodied practices and women's involvement, (A1 and B1) through workshops of plant essence extraction, traditional weaving with natural fibers, and crafting biodegradable paper from local plant materials.

Despite alignment in goals—particularly regarding sustainability and economic empowerment—the two interviews reveal different perceptions of power dynamics. While A1 views the project as inclusive and evolving toward community ownership, B1 notes some structural dependency on external actors, especially regarding infrastructure (e.g., electricity) and decision-making control. They also differ in project scale and duration: A1 frames the work within a national sustainable development initiative, while B1 experiences the project as a short-term intervention with limited follow-up, if there is no provision of electricity and water supply, raising concerns about its sustainability.

5.2.2 Case Study 2 Cuia Colab

In this case, both interviewees describe the project centered on traditional artisanal knowledge, specifically the embodied practice of Cuia-making (molding and painting). A2 had two visits to B2's community. In the first, artisans demonstrated how to check Cuia gourd ripeness and prepare them for dyeing. A2 gained deeper understanding through multiple full-day immersion, observing the step-by-step process of B2's practical presentation. The core methodology: knowledge, in this study traditional Cuia techniques, was best understood when practiced, learning by doing, and co-working. Both (A2 and B2) emphasize that this knowledge is passed on through sensory, lived experiences, not easily

translated into written formats. A2 reported methods centered on experiential learning and co-creation, though implementation faced logistical difficulties—long, costly boat travel limited the visits, and transporting samples was complex. Artisans, with limited time due to other work, were hesitant to invest in unfamiliar processes.

Both participants describe trust and communication as essential, maintained through digital tools and in-person visits, although personal contact through visits was clearly preferred by both. However, A2 reports cultural and linguistic challenges, despite a shared official language (Portuguese), communication was shaped by different explanatory styles, as local knowledge was more effectively transmitted through observation and practice than theoretically. Moreover, A2 describes difficulties in explaining technical design concepts, protocols or materials unfamiliar to B2. B2, by contrast, highlights the existing trust and clear goals that enable smooth collaboration.

Cultural sensitivities also shaped the project's dynamics, as some techniques—such as the use of urine in paint-making—led to fears of prejudice among artisan participants. A2 respected ethical engagement protocols, asking artisans how they wished to be referenced and clarifying the use of their knowledge.

Artisans—mostly women—play a central role as knowledge holders and transmitters. While both agree on the importance of respectful collaboration and knowledge autonomy, their perspectives diverge regarding project structure and leadership. A2 describes a researcher-led initiative with consultation and emphasizes that artisans retained the power to decide what to share and how to participate. Furthermore, A2 acknowledges a more externally shaped process, rooted in academic and design research goals and requirements, B2's viewpoint suggests a balanced and negotiated dynamic. In terms of outcomes, A2 focuses on documentation, sustainable design research, and ethical engagement, while B2 points to a successful international exhibition where artisan products were sold—offering both cultural visibility and economic benefit. Overall, both share a positive view of the collaboration.

5.2.3 Case Study 3 Kayapo

A3 and B3 describe the project as a deeply embedded, Indigenous-led project rooted in the Kayapo people's systems of governance. They emphasize collective decision-making, autonomy, and the strategic use of Indigenous and local knowledge for territorial monitoring, conservation, and political self-determination.

Both participants (A3 and B3) reported the project centers on cultural valorization and storytelling to protect and strengthen Kayapo traditional knowledge and territory. Methods emphasize ethical, long-term collaboration, rooted in free, prior, and informed consent, and relational engagement through shared experiences such as walking and talking in the forest. Communication technologies have enhanced coordination, enabling real-time exchanges among Indigenous leaders, particularly during annual general assemblies that serve as platforms for collective planning and reflection. The collaboration is guided by transgenerational consensus and the authority of shamanic leaders. Methodology shifted from top-down approaches to inclusive village visits and dialogue with community members of all ages, allowing the project to evolve organically and respectfully.

Their accounts highlight the long-term nature of the collaboration, supported by well-established institutions such as Kayapo associations, assemblies, and partnerships with NGOs and government agencies. A3 emphasizes the role of territorial governance, monitoring tools, and multi-scalar collaboration. B3 complements this by focusing on cultural transmission, particularly the importance of Kayapo knowledge and educational efforts to reconnect youth with Indigenous identity—addressing concerns about urban migration and cultural erosion.

Both interviewees underline the significance of trust, internal communication, and shared leadership, with B3 noting recent progress toward gender parity in organizational roles. A3 shares similar reflections, underscoring the role of long-term trust-building through lived experiences and consistent engagement—what they call "collaboration at the speed of trust."

While they agree on core goals—environmental protection, economic empowerment, and cultural preservation—their perspectives reveal different emphases. A3 details quantifiable outcomes such as satellite imagery of forest cover and NGO growth as indicators of success. B3 highlights the cultural and social dimensions, viewing knowledge as both a protective tool and a source of community resilience. Similar opinions are shared regarding challenges that differ slightly as well. A3 focuses on external threats such as illegal logging and bureaucratic hurdles, while B3 discusses more internal social challenges, including youth disconnection and limited resources for ongoing education.

5.3 Final Remarks and Key Messages

The three case studies demonstrate **distinct but converging approaches** to co-creation, ethical engagement, and knowledge exchange with Indigenous and local communities. Across all cases, **participatory and relational methodologies—grounded in trust, experiential learning, and long-term commitment**—were critical to project success.

In Case Study 1, participants highlighted a shift from an academically driven initiative to a genuinely co-creative process with Indigenous communities, emphasizing mutual learning and shared ownership. Knowledge sharing was primarily for educational use and took place through regular workshops and informal communication channels. While both interviewees underscored community agency, they differed in perceptions of power dynamics: one saw a move toward community-led development, while the other noted lingering structural dependencies and sustainability concerns.

Case Study 2 focused on traditional Cuia-making practices and underscored the primacy of embodied, sensory knowledge transmitted through practice rather than theory. While both participants valued respectful collaboration, logistical challenges and differences in communication styles—despite a shared official language—impacted the process. Trust and reciprocity were maintained through in-person visits and digital tools, though both favored face-to-face engagement. Diverging views on leadership emerged: the researcher described a more externally guided project, while the artisan

perceived a balanced, negotiated dynamic, with outcomes ranging from academic documentation to successful cultural product exhibitions.

In Case Study 3, the project was described as Indigenous-led from inception, rooted in Kayapo governance systems, cultural valorization, and storytelling. Both participants emphasized long-term ethical collaboration, guided by transgenerational consensus and shamanic authority. The methodology relied on inclusive village visits, real-time digital communication, and assemblies for planning and evaluation. While one account emphasized measurable environmental outcomes and institutional partnerships, the other focused on cultural resilience, gender inclusion, and intergenerational education as key impacts. Trust and autonomy were central themes, with collaboration described as progressing "at the speed of trust."

6. Discussion and Conclusion

How to better include ILK in Sustainability research and practice in the Amazon? To find answers to this question, this study examined the dynamics of collaboration, specifically the process in which methods, tools and activities were applied, between external actors and indigenous people and local communities (IPLC). The analysis of findings across three case studies showed, each case featured perspectives from both external facilitators (A1, A2, and A3) and IPLC participants (B1, B2 and B3), offering a dual lens on knowledge exchanges, power negotiation, and sustainability-oriented innovation. The analysis of the participants' answers revealed both shared challenges and case-specific trajectories, providing insights into the enabling and constraining factors that shape knowledge co-creative practices with IPLC. Common core themes are: 1. Negotiating Collaboration and Participation, 2. Embodied Learning and Knowledge Transmission, 3. Infrastructure, Sustainability, and Long-Term Impact, 4. Trust, Ethics, and Knowledge Sovereignty, 5. Youth, Gender, and Social Transformation. Conclusions are drawn articulating the previous literature research in chapter 2 and the interviews presented in chapter 5.

6.1 Discussion of Findings

1. Negotiating Collaboration and Participation

Across all three case studies, collaboration emerged as a complex, iterative process shaped by the histories, expectations, and institutional contexts of both external teams and IPLC. However, the degree of shared decision-making and power distribution varied significantly. Which are already recognized common key issues in multiple knowledge collaborations according to multiple scholars (Tengö et al., 2021; Chambers et. al., 2021, 2022; Hill et al., 2020a).

In Case Study 3, collaboration was characterized by a high degree of internal leadership. The Kayapo communities maintained control over project direction, design, and execution, with clearly defined governance structures such as the warrior house and age-based decision-making bodies. External

actors operated largely in supportive or facilitative roles. This degree of self-determination enabled long-term planning, sustained engagement, and project continuity.

In contrast, Case Study 1 involved more uneven participation. While the external participant (A1) emphasized co-creation and mutual learning, the local community member (B1) expressed dissatisfaction with the lack of infrastructural continuity. The disconnection between initial project ambitions and lasting benefits—particularly regarding access to electricity, product commercialization, and community empowerment—suggests a need for more structural follow-through and resource investment from external partners.

Case Study 2 demonstrated a more balanced dynamic, with mutual respect and trust established between the designer (A2) and the riverine artisans (B2). The interviewee (B2) acknowledged the external actor's curiosity and commitment, and described the process of hands-on observation and experimentation as meaningful and non-invasive. However, the project remained highly dependent on individual relationships and lacked broader institutional embedding, raising questions about long-term continuity and community-wide participation.

2. Embodied Learning and Knowledge Transmission

In all three case studies, Indigenous and local knowledge was shared primarily through practice-based, experiential methods, rather than abstract or textual instruction. Across interviews, both indigenous and non-indigenous participants emphasized that understanding occurred most effectively (A2) “when you see someone doing it,” and (A3) “through walking and talking in the forest”. Brondizion and colleagues (2021b) agree with this perception: “Indigenous and local knowledge, [...] often emphasizes the importance of learning about the environment from experience on the land rather than from didactic teaching in classrooms” (Brondizio et al., 2021b, p.490).

Communication methods such as interviews, presentations and conversations were common amongst the three cases. On this statement agrees Chambers, et al. (2022), who state that effective iterative and reflective

methods are surveys, interviews, reflection essays, amongst others. As well as Norström et al. (2020) who states regular conversations and interactions among all actors during the project process are fundamental because these interactions influence the knowledge co-production quality.

This insight was most explicitly realized in Case Study 2, where the designer (A2) was immersed in the artisanal processes of Cuia production. The artisan explained that repeated explanations of technique were insufficient without practical engagement. Similarly, in Case Study 3, field-based knowledge sharing—especially through forest walks and storytelling—was key to building trust and transmitting ecological and cultural expertise across generations. This matches with findings from other scholars like Lam and colleagues (2020), who support the use of analysing stories and songs as a method to examine ILK for conservation, and Chambers and colleagues (2022), who also identified “walkshops”, walking and talking as an suitable activity for ILK transmission.

However, Case Study 1 revealed challenges in this regard. While practical workshops were conducted, their effectiveness was limited by perceived absence of follow-up support. These findings indicate that embodied learning must be sustained over time and supported with infrastructure and feedback mechanisms to be fully effective.

To ensure successful and long-lasting results, it is essential to design a process that is deemed beneficial for all parties involved (Malmer et al., 2020).

3. Infrastructure, Sustainability, and Long-Term Impact

A critical concern across all cases was the sustainability and continuity of project impacts. While short-term engagement often introduced useful tools, knowledge, or training, lasting benefits were sometimes undermined by systemic constraints—particularly in Case Study 1. The local participant (B1) voiced frustration that the project brought temporary resources (e.g., electricity) but left the community without sustainable alternatives. The lack of electricity, for instance, was seen as a fundamental barrier to continuing the activities initiated during the project. Furthermore, infrastructural barriers can hinder project documentation with digital tools and digital communication. This reflects

a broader pattern where infrastructural gaps can undo the gains of participatory initiatives, unless long-term strategies are integrated from the outset.

In contrast, Case Study 3 was able to achieve continuity and institutionalization through the leadership of Indigenous associations. Programs such as territorial monitoring, educational activities, and forest-based economies were embedded into local governance structures, supported by consensus-building processes and administrative capacity. This model suggests that when Indigenous institutions have control over project design, long-term ecological and social goals are more likely to be realized.

Case Study 2 occupied a middle ground. While the collaboration produced tangible outputs—such as exhibitions, product sales, and knowledge exchange—the reliance on personal relationships and external platforms raised questions about whether benefits would continue beyond the duration of the project. The artisans also pointed to the declining number of younger practitioners and limited collective organization, which could threaten future sustainability of traditional techniques such as the Cuia production.

4. Trust, Ethics, and Knowledge Sovereignty

Building and maintaining trust was a recurring theme across all case studies. In Case Study 3, long-standing relationships with external partners and careful attention to consultation protocols helped build confidence and shared purpose. Trust was seen as the foundation for both project legitimacy and community uptake. Furthermore, cultural practices such as consensus-building and the central role of shamans were respected and integrated into decision-making processes. Similar findings like Malmer et al. (2020), who highlight equity is maintained through practical ways e.g. protocols concerning intellectual property, research agreements and as well as free, prior, and informed consent.

In Case Study 2, trust developed through personal engagement, transparency about knowledge use, and respect for artisans' perspectives on how their knowledge should be shared and represented. The absence of

contractual or legalistic barriers—while potentially problematic in formal terms—was offset by an ethics of mutual respect and relational accountability.

However, in Case Study 1, historical experiences of biopiracy and extractive research created skepticism. The indigenous participant (B1) expressed concern that external actors "take our knowledge and leave us alone," pointing to a deeper need for fair benefit-sharing mechanisms, recognition of ILP contributions, and ongoing support. This underscores the importance of addressing knowledge sovereignty and the risk of intellectual appropriation, particularly in communities with histories of marginalization.

5. Youth, Gender, and Social Transformation

Finally, social dynamics related to youth and gender were identified as both opportunities and challenges. In Case Study 3, a conscious effort was made to include women equally in governance structures, and to design educational programs that engaged youth in environmental monitoring and conservation technologies. This inclusion was framed not only as equitable, but as essential to the community's long-term viability.

In Case Study 1, women's empowerment was central to the project's goals, yet the ILP perspective emphasized that workshops alone are insufficient. Empowerment requires material tools, access to markets, and continued capacity-building in order to sustain the project in the future. Without these, aspirations for economic independence and social transformation remain unfulfilled.

In Case Study 2, the lack of collective organization and the migration of youth to urban centers were flagged as existential risks to the continuity of traditional practices. These patterns suggest that co-creative projects must be situated within broader social transitions, and that youth inclusion and cultural transmission should be considered core components of sustainability efforts.

In short, collaboration dynamics between external actors and Indigenous People and Local Communities (IPLC) across these three case studies,

revealed shared challenges and context-specific factors shaping co-creative knowledge practices. Five major themes emerged:

1. **Negotiating Collaboration and Participation:** Collaboration varied from externally led to IPLC-driven models. Case 3, led by Kayapo, demonstrated strong self-determination and long-term continuity, while Case 1 showed uneven participation and limited structural follow-up. Case 2 achieved balanced, trust-based cooperation but lacked institutional embedding.
2. **Embodied Learning and Knowledge Transmission:** Knowledge exchange occurred mainly through experiential, practice-based methods like forest walks, storytelling, and artisanal work. Success depended on sustained engagement and infrastructural support, highlighting the importance of “learning by doing.”
3. **Infrastructure, Sustainability, and Long-Term Impact:** Sustainable impact relied on local governance and continuity planning. Projects without infrastructural or institutional support (Case 1) struggled to sustain benefits.
4. **Trust, Ethics, and Knowledge Sovereignty:** Trust, transparency, and respect for Indigenous protocols were essential. Historical inequities and fears of knowledge exploitation underscored the need for fair benefit-sharing and ethical partnerships.
5. **Youth, Gender, and Social Transformation:** Inclusive participation of women and youth strengthened sustainability, but economic and social support remained vital to ensure empowerment and cultural continuity.

Overall, the findings highlight that successful knowledge-based collaborations with Indigenous communities depend on respectful, long-term engagement, adaptive methodologies, and recognition of Indigenous knowledge as central—not supplementary—to sustainable development and cultural preservation.

6.2 Conclusions

Across all three case studies, the interviews revealed that a common key topic was the centrality of trust, long-term engagement, and ethical collaboration as foundational to successful knowledge exchange with Indigenous and local

communities. Each project employed participatory, co-creative methodologies that prioritized relational processes, emphasized local agency, and recognized Indigenous knowledge as essential rather than auxiliary. In all cases, knowledge was best transmitted through experiential, embodied practices such as workshops, shared work, or walking through the forest together. These methods fostered mutual learning and helped bridge cultural and linguistic differences, particularly where traditional knowledge was place-based. Storytelling, observation, and collaborative doing were consistently more effective than theoretical or extractive approaches.

Participants highlighted the importance of free, prior, and informed consent, transparent decision-making, and clear communication—often supported by digital tools but strengthened through in-person engagement. Projects that adapted to local rhythms and forms of governance, particularly through dialogue with elders, women, and youth, were more likely to generate sustained participation and community ownership.

Despite different contexts and focus areas—from artisanal practices and land-based knowledge to territorial governance—all projects faced challenges related to power asymmetries, logistical constraints, and sustainability.

The three case studies reveal that successful collaboration with IPLC depends not only on ethical intentions or participatory methods, but on structural commitments to shared governance, infrastructural support, and long-term engagement. Co-creation is most effective when IPLC retain meaningful agency in decision-making, when learning is grounded in embodied practice, and when benefits are equitably distributed and sustained. However, they also revealed that projects rooted in respect, patience, and shared experiences can foster meaningful, long-lasting collaborations and reinforce the cultural, ecological, and political resilience of Indigenous communities.

While each context requires tailored approaches, the findings suggest common principles for future work: prioritize local leadership, build long-term relationships, align project timelines with community rhythms, and treat ILK not as extractable content but as living, dynamic systems embedded in social, ecological, and cultural life. Only then can co-creative projects avoid the pitfalls

of short-termism and deliver on their promise of mutual learning, justice, and transformation.

This work affirms the need for more inclusive, pluralistic and practical approaches to sustainability that bridge Indigenous and scientific knowledge systems through adequate methods. By foregrounding Indigenous people and knowledge, sustainable resource use and development in the Amazon can become more just, effective, ethical and resilient.

6.3 Limitations and Future Research

This study is subject to possible limitations related to the researcher's positionality as a northern European woman. The researcher's sociocultural background and lived experiences may have influenced the research, including interpretation of empirical material. While systematic efforts were made to engage with diverse actors and perspectives and to apply critical reflexivity throughout the research process, complete neutrality cannot be assumed.

Furthermore, these thesis results are limited by the number of relatively few interviews conducted, respectively interviews of only three case studies. Causing difficulties to identify patterns and to generalize, because findings were rather case specific. With a greater number of interviewees, the results would be more decisive and more diversity of methods and tools could be identified, as well as similarities amongst the findings. Therefore, future research on the topic methods, tools and practices of ILK inclusion in knowledge co-production should include findings from a greater array of data sources.

Furthermore, these thesis results of methods to facilitate collaborations could bear the risk of misuse. Attention should be paid to creating mechanisms (e.g. policy, laws, etc.), to prevent exploitation, cultural appropriation and unethical collaborations and protect indigenous people.

7. Epilogue

This master thesis process gave me valuable insights in the rich wisdom of indigenous knowledge, and seeing nature from the perspective of indigenous people, being the fundament of their culture, identity and lives.

My personal appreciation for this knowledge system grew, as I learned about the strong connection between people and their environments, as well as the ancestral knowledge resulting from this long lasting relationship.

Furthermore, I understood that these knowledge systems play a crucial role in Amazon's sustainable development and conservation efforts. They are not ancillary—they are fundamental to achieving long-term ecological resilience and social equity. That is why adequate methods to bridge, enable and facilitate just, effective, and ethical collaborations are so essential to achieve such sustainability efforts.

This epilogue marks the end of my academic journey of this master thesis but also points toward continued research, dialogue, and collaboration in the pursuit of more sustainability and equitable environmental and social futures.

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