

Socio-Ecological Resilience: 'Weaving' to scale Nature-based Solutions

**Sally Hussain
Carolina Obara
Leon Seefeld
Tijn Tjoelker**



**Blekinge Institute of Technology
Karlskrona, Sweden
2022**

»In a real sense all life is inter-related. All men are caught in an inescapable network of mutuality, tied in a single garment of destiny. Whatever affects one directly, affects all indirectly. I can never be what I ought to be until you are what you ought to be, and you can never be what you ought to be until I am what I ought to be.

This is the inter-related structure of reality.«

— *Martin Luther King Jr*

Socio-Ecological Resilience: 'Weaving' to scale Nature-based Solutions

Sally Hussain
Carolina Obara
Leon Seefeld
Tijn Tjoelker

Blekinge Institute of Technology
Karlskrona, Sweden
2022

Thesis submitted for completion of Master of Strategic Leadership towards Sustainability,
Blekinge Institute of Technology, Karlskrona, Sweden.

Abstract:

The sustainability challenge is a complex interplay of interconnected challenges that requires an integrated and systemic approach. Nature-based Solutions (NbS) are seen as a key tool for addressing such challenges but are currently not mainstreaming and scaling to the landscape level. The emerging leadership practice of *Weaving* is believed to help cohere fragmented change-making efforts and increase the adaptive capacity and resilience of socio-ecological systems. However, scientific research on NbS and *Weaving* is scarce and studies on their intersection are non-existent.

To investigate how *Weaving* practices could foster the conditions for scaling NbS to the landscape level, rapid literature reviews and semi-structured interviews were conducted with academic experts, *Weaving* practitioners, and grass root entrepreneurs. On this basis, two conceptual frameworks were iteratively developed that serve as a basis for two practical toolkits. They comprise (1) seven barriers and nine enablers for scaling NbS to the landscape level and (2) a *Weaving* working definition and five core *Weaving* practices.

There are indications that *Weaving* practices have the potential to address several of the barriers and enablers for scaling NbS if approached with a systematic lens. Ultimately, interconnected challenges, such as barriers and enablers to scaling NbS, require interwoven approaches as provided by *Weaving*.

Keywords: Weaving, leadership practices, Nature-based Solutions, barriers, enablers, landscape scale

Statement of Contribution

This thesis research project was conducted by us, Sally, Carolina, Leon, and Tijn. All curious and eager to broaden our horizon about holistic landscape restoration approaches that do not ignore pressing social challenges, we were passionate about this project from the very beginning. Throughout the process, we have become friends who appreciate the commonalities and celebrate the differences. As a highly diverse team with all different nationalities, life and work experiences, and a huge set of different superpowers, we brought vastly diverse perspectives to the research. We carefully balanced team and task time and made sure that cultivating our in-group relationships was as important as producing high quality outcomes. Our work was always based on a lot of trust in and caring for one another. This thesis is a collaborative effort to which all of us contributed to the best of their ability and individual strength. Together we truly embodied symbiotic mutualism, as our collaboration gave rise to a whole that we could have never created alone.

Sally

Sally was the warm-hearted soul of our team and because she relates well with people, she was our main coordinator of communications with teaching staff. She was the one in charge of scheduling as well as preparing meetings with our advisor Giles and taking care of collecting questions that came up during the work. Together with Tijn, Sally has made major contributions to the *Weaving* practices sections. For the data collection phase, Sally has worked on all the related formalities that needed to be in place for the interviews (e.g. the consent form, interview invites, etc) and has been a master in harvesting key insights while being part of almost every interview. Sally has a critical and reflective mind that spots inconsistencies and ambiguities where they need to be resolved.

Carolina

Carolina was our sense- and temperature check that helped us strategically zoom out and identify when we were stuck and needed a shift in our approach. She was the one in our team who ensured that we balanced the project work with team building and individual well-being. Carolina has made major contributions to finding possible directions for our overall research. Because of her background in science and experience with interview-based research, she led the preparation and organisation for the data collection phase. Carolina has helped to collaboratively lead our team in internal meetings and has acted as a communication anchor for our contact person in Commonland, Pieter as well as several others. Carolina has led the methodology section alongside Leon and contributed to writing and editing within several other areas of the paper.

Tijn

Because Tijn is a very visual thinker who needs Miro-mapping for his own mental clarity and sense-making, he has made major contributions to our collective sense-making and mapping of content. Beyond that, he has been diving deeply into the scientific literature on *Weaving* and has led the development of the conceptual framework on *Weaving* including the lead on all *Weaving* interviews and *Weaving* writing. Beyond relentless sense-making, reading, and processing, Tijn contributed a lot in terms of prior knowledge and experience in the field of NbS and Commonland's work in large scale landscape restoration. He was invaluable for

contextualising and reality-checking ideas. Overall, Tijn is incredibly literate and can always recommend at least a couple of books and articles on any given topic.

Leon

Leon was a grounding and convergent force within our team. He persisted with his calm and confident nature as well as a generative drive and logical reasoning to help us move forward when we felt stuck. “We need to break through the wall” was his infamous line that allowed us to see the light at the end of the tunnel. He has a natural ability to abstract and give structure to complex information. This made him a perfect research lead for developing the conceptual framework on barriers and enablers and leading the NbS-related interviews. Leon has often been referred to as a “writing wizard” as his writing skills allowed him to make major contributions to the final text in several areas, specifically the introduction, methodology, barriers and enablers, the discussion, and conclusion. He was also constantly finetuning the document and taking care of the format and citations.



Sally Hussain



Carolina Obara



Leon Seefeld



Tijn Tjoelker

Acknowledgements

Firstly, we would like to express our gratitude to our families, partners, and friends for generously supporting us throughout the entire MSLS programme and particularly during the heightened period of writing this thesis. Thank you for being with us!

The same applies to our wonderful MSLS community reaching from fellow students to the staff team, alumni, guest lecturers, and everyone else who was involved in creating this special learning opportunity. Furthermore, we would like to express a great appreciation to both our main supervisor Giles Thomson and second supervisor Pierre Johnson for their continuous work in providing new input, valuable feedback, and constructive criticism. We deeply value their flexibility and spontaneity, as well as their positive encouragement for the research project that we were able to work on.

Beyond all the academic and scientific support that we received, we want to sincerely thank Pieter Ploeg as our main contact person at Commonland/ BWL and practical supervisor. It was Pieter who made this research project possible and supported us with the practical BWL perspective throughout the process. We extend this gratitude to the Bioregional Weaving Lab collective, who provided us with the interesting research project, co-created the research questions, and trusted us with the exploration of the topic AND to all interviewed experts without whom none of the generated insights would have been possible. We genuinely thank you for your time and the richness of knowledge that you shared with us over the course of this research project: Adrian Röbbke, Aldo de Moor, Astrid Vargas, Bruce Goldstein, Dieter Van den Broeck, Florentina Bajraktari, Jenny Andersson, June Holley, Karin Müller, Katie Stubbley, Kyra Sacks, Matthieu Grosjean, Michael Sillion, Niki Frantzeskaki, Piet Haeren, Roos van der Deijl, Ross Hall, Sandra Waddock, Sarah Prosser, Shahryar Sarabi, Sven Jense, and Ties van der Hoeven as well as several other contributors who wished to stay anonymous.

Together we have built this thesis. We could not have achieved it without you all, a network of changemakers dedicated to developing clarity, relationships, and action towards sustainable development. Finally, we would like to thank Mother Nature for providing us with her wisdom and fresh perspectives when they were needed in the research and group process.

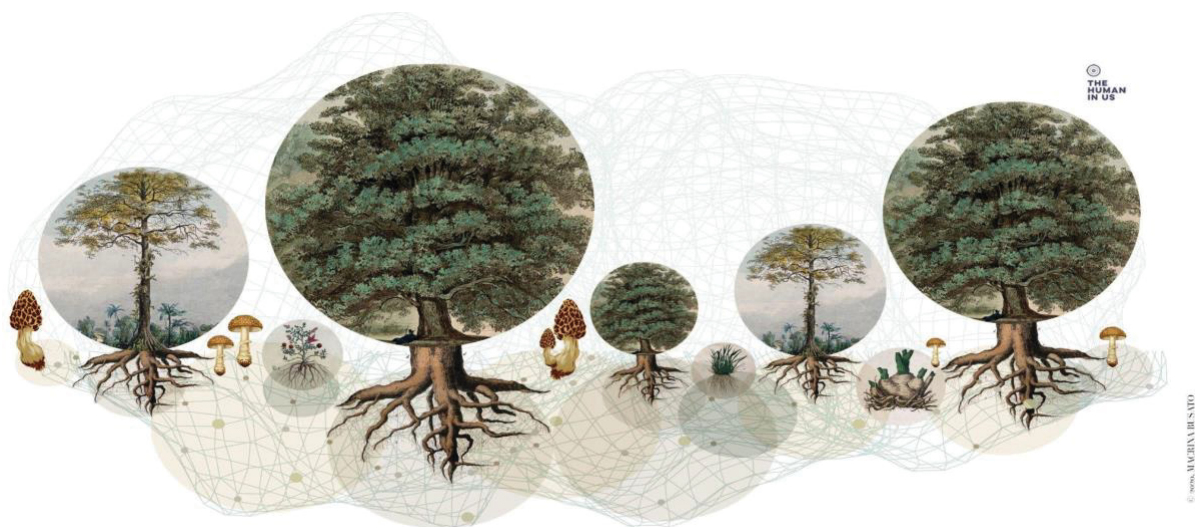


Figure 0.1. The Fascinating Social Network of Trees (Busato 2020).

Executive Summary

Introduction

The sustainability challenge is a complex and wicked interplay of interconnected challenges that requires an integrated and systemic approach. Nature-based solutions (NbS) are widely acknowledged as a key tool for addressing the complexity and interconnectedness of the challenge but are currently not mainstreaming and scaling to the landscape level. The emerging practice of *Weaving* is believed to help cohere fragmented change-making efforts and increase the adaptive capacity of socio-ecological systems. However, scientific research on both topics is scarce and studies on their intersection are non-existent.

The Bioregional Weaving Labs (BWLs) collective is one example of a community of practice that aims to tackle the complexity of the sustainability challenge holistically by bringing together the practice of *Weaving* and NbS. The collective, consisting of 25+ international system-changing organisations, aims to start restoring, protecting, and regenerating at least one million hectares of Europe's land and sea by 2025. As a key player at the intersection of *Weaving* and NbS, BWLs have been a co-initiator as well as core anchor point and source of data for this study and its conclusions.



Purpose and Research Questions

The purpose of the research is to investigate how *Weaving* could foster the conditions for scaling NbS to the landscape level. The researchers aim to contribute to the scientific discourse by clarifying the term *Weaving* and the associated *Weaving* practices as well as to advance the current literature on barriers and enablers to scaling NbS for the landscape level. Additionally, the research aims to generate two practical toolkits centred around the two core themes of this thesis: NbS and *Weaving*. In doing so it hopes to re-integrate generated knowledge into societal practices such as the BWL collective, enhancing their efforts to tackle the sustainability challenge holistically.

The research question for this thesis is:

‘How could *Weaving* practices foster the conditions for NbS to be scaled to the landscape level?’

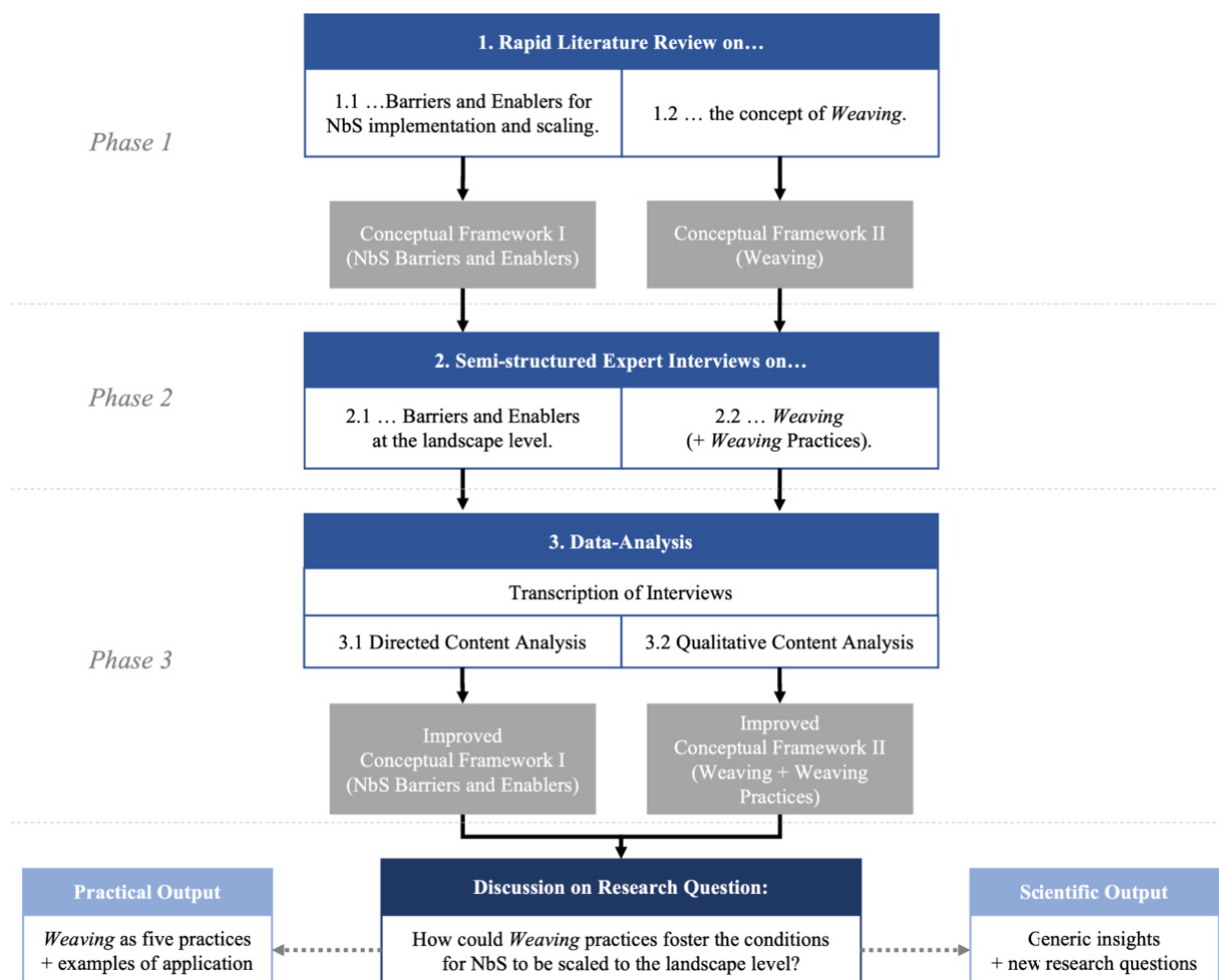
The following two sub questions (SQs) were defined to collect data and help answer the overall research question:

SQ 1: What are Barriers and Enablers for scaling NbS to the landscape level?

SQ 2: What is *Weaving* and what are *Weaving* practices?

Methodology

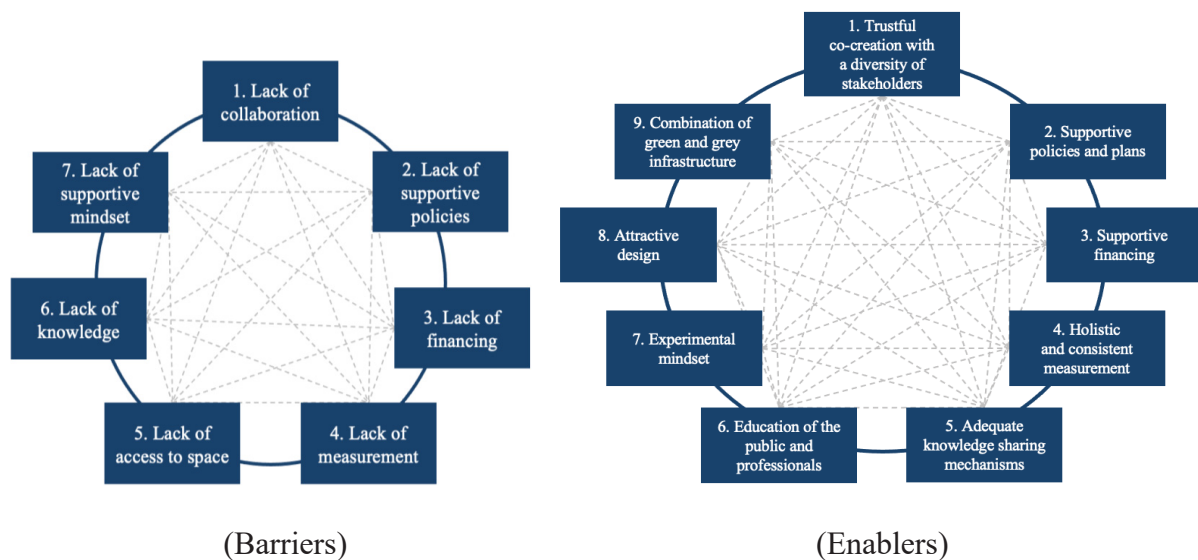
The research was developed in an iterative manner that extracted and consolidated theory from literature to build conceptual frameworks, used these to inform the data collection through interviews, and applied the insights again to the conceptual frameworks. The following represents the three main phases of the research design and workflow that was used to carry out this research.



1. **Rapid Literature Review** for sub questions 1 and 2 to build conceptual frameworks to be validated in the interviews
2. **Semi-structured Interviews** to improve and validate conceptual frameworks for sub question 1 and 2
3. **Data Analysis** through transcription, Direct Qualitative Content Analysis for sub question 1, and inductive Qualitative Content Analysis for sub question 2 to improve the two conceptual frameworks

Results and Discussion

The first conceptual framework that was developed established a set of seven interconnected barriers and nine interconnected enablers for scaling NbS to the landscape level.

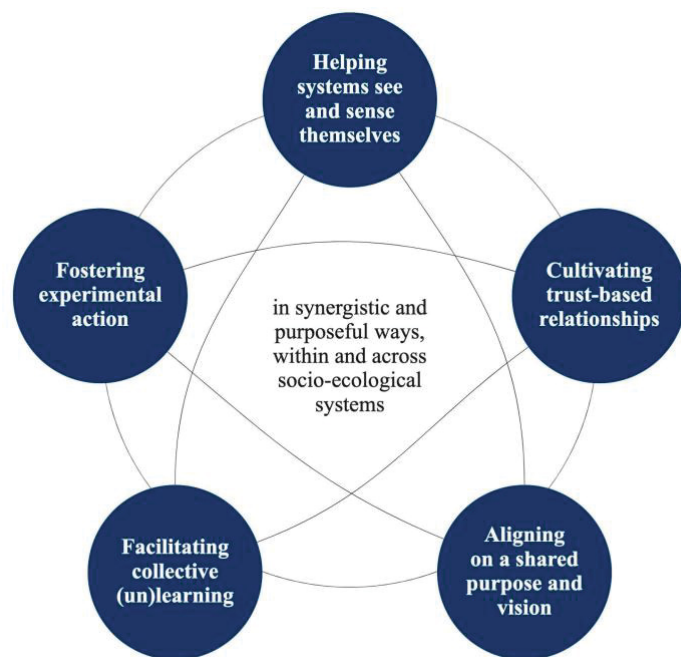


NbS on the landscape level have a huge potential to help mankind strategically overcome sustainability issues, but it is also the social systems and constructs like legislations and power structures that prevent these solutions from being implemented widely. This research confirmed that, with current barriers so structurally rooted and deeply interwoven, society is realistically still far from a more sustainable trajectory. The complexity of NbS as a tool is an underlying issue that causes several barriers but has also been portrayed as the beauty of NbS that inherently provides a more holistic view and forces implementers to think in interconnected systems. Lacking alignment and no shared vision among key stakeholders have emerged as an underlying theme with many ripple effects on other identified barriers too. Bringing relevant parties together as well as building trust and safe spaces for new ideas have been emphasised as underlying enablers that can counteract several structural conditions that underpin important barriers. Overall, the identified barriers and enablers can be clustered into those that describe *what* is lacking or needs to be created and *how* the work needs to be done (for categorisation see Table 5.1). Further research is required to better understand the interrelatedness and context-dependency of individual barriers and enablers, to further illuminate the underlying structural conditions for barriers and concrete supportive actions for enablers, and to explore the role of communities of practice like BWLs in the process of overcoming barriers and creating enabling conditions for NbS.

The second conceptual framework provides an overview of *Weaving* and five interrelated *Weaving* practices. *Weaving* was found to be an emerging concept in both practice and scientific literature. This research aimed to craft a practical working definition of *Weaving* to serve as a steppingstone in creating more alignment around the concept. *Weaving* can be defined as:

“the practice of cultivating meaningful relationships, within, between and across socio-ecological systems for synergistic purposes”.

The notion of ‘within and between’ speaks to the understanding that *Weaving* happens in accordance with a holarchy, seeing systems as a nested wholes, and linking local systems up to the global and vice versa, through both horizontal and vertical interactions. The notion that ‘*Weaving* aims to cultivate meaningful relationships’ speaks into *Weaving* as an emerging form of sustainability-focussed leadership that helps cohere fragmented change-making efforts and can increase the adaptive capacity of socio-ecological systems. This is amplified through the power of the narrative and use of metaphors in *Weaving*, like a mycelium network or a relational tapestry. These metaphors evoke social imagination, mobilise change, and embody the “story of interbeing” by acknowledging our relational nature and fundamental interdependence with the web of life. Lastly, five key *Weaving* practices were identified: *Helping systems see and sense themselves*, *cultivating trust-based relationships*, *aligning on a shared purpose and vision*, *facilitating collective (un)learning*, and *fostering experimental action*.



While being interrelated and interdependent, the practices are not completed by one person but work alongside other weavers to act as strategic leverage points towards sustainable development. The process of defining *Weaving* and “naming” weavers, can help connect them into a nourishing community of practice that, together, can illuminate seeds of a more sustainable system while gracefully hospicing the old, unsustainable system. Recommended future research for *Weaving* pertains to how *Weaving* capacities can be cultivated effectively, performing a multilevel social–ecological network analysis (SENA) as well as contextualizing the *Weaving* narrative and metaphors to local contexts, cultures, and communities.

While the practice of *Weaving* is an emerging facet of leading in complexity and illustrates *how* the sustainability challenge could be tackled, nature-based solutions can be considered one part of *what* needs to be done to combat the current crises. While addressing the research question of “How *Weaving* practices could foster the conditions for scaling NbS to the landscape level”, the researchers found several indications of potential direct and indirect leverage points. It is likely that *Weaving* practices can indirectly affect the ‘what barriers’ but have the potential to directly influence the ‘how barriers’. Among the most obvious examples is the potential for overcoming the *lack of collaboration*, which weavers, as trans-boundary actors, can address with the practices of *cultivating trust-based relationships* and *helping systems see and sense themselves*. Both help to break silos within and bridge gaps between different organisations. Through strengthening collaboration and helping to *align on a shared vision and purpose*, *Weaving* also has the potential to indirectly address ‘what barriers’ like *lack of supportive policies*, *lack of financing* or *lack of access to space*, for example.

Despite these and other first indications, it became clear that a linear one-to-one mapping of *Weaving* practices on all barriers and enablers would not do justice to the complex and interconnected nature of both sides. Instead of problem-solving in a mechanistic way, the *Weaving* practices are based on sensing into the systems and responding not to symptoms, but rather the underlying structural conditions that hold the system in place. Thus, more research is needed to further qualify the potential of *Weaving* and *Weaving* practices to address specific barriers and enablers or the entire complexity of scaling NbS to the landscape level.

Conclusion

Nature-based solutions are acknowledged as a key tool for addressing the complex and interconnected sustainability challenge but are currently not mainstreaming and scaling to the landscape level. To give an overview of the impediments, this research developed a conceptual framework that establishes a list of barriers and enablers for scaling NbS to the landscape level. The conceptual framework contributes to the scientific discourse around NbS uptake as much as it provides the basis for a practical toolkit for NbS practitioners. On the topic of *Weaving*, this thesis contributes by further coining it as an emerging leadership practice that is believed to help cohere fragmented change-making efforts and increase the adaptive capacity and resilience of socio-ecological systems. To illuminate the new leadership practice and compensate for the scarcity in academic literature on *Weaving*, the second conceptual framework of this thesis comprises a *Weaving* working definition and five core *Weaving* practices. It is also the basis for a practical toolkit that introduces aspiring weavers to the concept and helps them assess their current *Weaving* capabilities.

Based on the two conceptual frameworks, this research investigated how *Weaving* practices could foster the conditions for scaling NbS to the landscape level. First indications show that *Weaving* practices have the potential to address several of the barriers and enablers. However, a mechanistic, direct mapping was found to not do justice to the complex, interconnected ways in which both barriers and enablers and *Weaving* practices work. On the premise that interconnected problems, like barriers and enablers to scaling NbS, need interwoven solutions that respect their complexity, the potential of *Weaving* is believed to be high, and requires further investigation.

Glossary

Adaptive Capacity	The capacity to change and adjust to the sometimes quickly changing environment. It is the essence of what allows systems to be sustainable over the long run (Robèrt et al. 2019, 185).
Bioregion	From an ecologic point of view, a bioregion is “a specific geographic area that is distinct from others by the characteristics of its natural environment” (Müller et al. 2022, 94).
Bioregional Weaving Lab	A facilitated multi-stakeholder partnership process for a bioregion that supports local innovators and stakeholders to engage their communities in collaborative systems change. This is done by co-creating strategies for collaborative systems change that can shape the right conditions for successful integration and scaling of NbS (Müller et al. 2022, 104).
Carbon Sinks	A carbon sink is anything that absorbs more carbon from the atmosphere than it releases – for example, plants, the ocean and soil (ClientEarth 2021).
Green Infrastructure	A strategically planned network of natural and semi-natural areas with other environmental features designed and managed to deliver a wide range of ecosystem services (EC 2013, 3).
Greenwashing	Behaviour or activities that make people believe that an organisation is doing more for sustainability than it really is (Cambridge Dictionary n.d.).
Grey Infrastructure	Man-made, constructed infrastructure approaches that often serve one single objective (EC 2013).
Holarchy	Ecosystems are made of the many smaller systems nested within them, and they are also themselves nested within larger systems. This structure of nestedness, called holarchy, is inherent in all living systems. Each constituent system within the whole is called a holon (Benne and Mang 2015, 45).
Holon	Something that is an autonomous whole in itself, while being part of a larger whole (Koestler 1967, 47).
Knowledge Weaving	A process through which multiple types of knowledge are equitably brought together to enable the reciprocal exchange of understanding for mutual learning and application (Henri et al. 2021, 2).
Landscape Restoration	The improvement of degraded land on a large scale that rebuilds ecological integrity and enhances people’s lives (Future Terrains n.d.).

Leverage Points	Places within a complex system where a small shift in one thing can produce big changes in everything (Meadows 1999, 1).
Nature-based Solutions	Actions to protect, sustainably manage and restore natural or modified ecosystems that address societal challenges effectively and adaptively, simultaneously providing human well-being and biodiversity benefits (Cohen-Shacham et al. 2016, 5).
Network Weaving	Done by network weavers through helping people identify and strategically form mutual relationships, circulating ideas and practices, promoting a shared identity that provides the foundation for a common practice and purpose, and serving as a catalyst for self-organizing groups (Goldstein et al. 2017; 2018).
Scale-linking	Connecting the molecular to the planetary and the local to the global — adaptive cycles of any particular system at any particular scale are linked to multiple adaptive cycles that are taking place simultaneously for smaller systems contained by that system and for the larger systems within which that particular system is embedded (Wahl 2017).
Social Entrepreneurs	Individuals with innovative solutions to society’s most pressing social, cultural, and environmental challenges (Ashoka, n.d.).
Socio-ecological System	A combined system formed by complex interaction between the biosphere and the society nested within it (Robèrt et al. 2019, 193).
Sustainability Challenge	A combination of the systemic errors of societal design that are driving human’s unsustainable effects on the socio-ecological system, and the serious obstacles to fixing those errors (Robèrt et al. 2019, 9).
Theory U	A change management model focussed on social innovation and inner leadership capacities. It uses a U-shape process of co-initiating, co-sensing, co-evolving, co-creating and presencing to create awareness-based systems change. Developed by MIT Economist, Otto Scharmer (Scharmer 2016).
Transformation Catalyst	Entities that “work catalytically with actors in a transformation system (T-system) to enhance their collective speed and ability to address the complexity and scale associated with transformation” (Waddock and Waddell 2021, 169).

List of Abbreviations

BTH	Blekinge Institute of Technology
BWL	Bioregional Weaving Lab
CF	Conceptual Framework
DQCA	Directed Qualitative Content Analysis
EbA	Ecosystem-based Adaptation
EC	European Commission
e.g.	lat. “exempli gratia”, for example
i.e.	lat. “id est”, that is
IPBES	Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services
IPCC	Intergovernmental Panel on Climate Change
IDGs	Inner Development Goals
IUCN	International Union for Conservation of Nature
NbS	Nature-based Solutions
NCS	Natural Climate Solutions
QCA	Qualitative Content Analysis
SES	Social-Ecological Systems
SENA	Social–Ecological Network Analysis
SPs	Sustainability Principles
SQ	Sub Question
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
WWAP	World Water Assessment Programme

Table of Contents

1	Introduction	1
1.1	The Sustainability Challenge	1
1.2	Nature-based Solutions (NbS)	2
1.3	Weaving	4
1.4	Bioregional Weaving Labs	5
2	Purpose	8
2.1	Research Questions	9
2.2	Scope and Limitations.....	9
3	Methodology.....	11
3.1	Philosophical Stance	11
3.2	Research Design.....	12
3.2.1	Rapid Literature Review.....	13
3.2.2	Semi-structured Interviews.....	14
3.2.3	Data Analysis.....	15
3.3	Ethical Considerations	16
4	Results and Analysis.....	17
4.1	What are Barriers and Enablers to scaling NbS to the landscape level?	17
4.1.1	Barriers and Enablers as portrayed in the Literature	17
4.1.2	Barriers as validated for the landscape level	20
4.1.3	Enablers as validated for the landscape level	24
4.2	What is <i>Weaving</i> and what are <i>Weaving</i> practices?	29
4.2.1	Weaving as portrayed in the Literature	29
4.2.2	Relation to other Leadership practices	32
4.2.3	Weaving practices	35
5	Discussion	38
5.1	Discussion on barriers and enablers to scaling NbS	38
5.2	Discussion on <i>Weaving</i> and <i>Weaving</i> practices	41
5.3	Discussion on the intersection of barriers and enablers to scaling NbS and the practice of <i>Weaving</i>	45
6	Conclusion	48
	References	49
	Cited References	49
	Additional References.....	62
	Appendices	65
	Appendix A – Conceptual Frameworks 1.0	65
	CF I 1.0 – Barriers & Enablers to scaling NbS to the landscape level	65

CF II 1.0 – <i>Weaving</i>	67
Appendix B – Conceptual Frameworks 2.0	68
CF I 2.0 – Barriers & Enablers to scaling NbS to the landscape level	68
CF II 2.0 – <i>Weaving</i> and <i>Weaving</i> Practices	70
Appendix C – List of Interviewees	70
Appendix D – Interview Questions (Student Team)	73
Interview Questions for Sub Question 1	73
Interview Questions for Sub Question 2	74
Appendix E – Interview Questions (Ashoka)	75
Appendix F – Codes for SQ 1	75
Appendix G – Codes for SQ 2	77
Appendix H – List of Barriers & Underlying Structural Conditions	79
Appendix I – List of Enablers & respective Rationale	80
Appendix J – Weaving-Related multi-level Collaborations Terms	82
Appendix K – Various Paradigms indicating the emerging Model of Leadership	83
Appendix M – Mapping of <i>Weaving</i> Practices and Barriers & Enablers	84

List of Figures and Tables

Figure 0.1. The Fascinating Social Network of Trees (Busato 2020).....	IV
Figure 1.1. BWL at the intersection of Weaving and NbS.	5
Figure 2.1. Conceptual Model of an Ideal-typical Transdisciplinary Research Process (adapted from Lang et al. 2012).....	8
Figure 3.1. Research Design Workflow.	12
Figure 4.1. List of seven consolidated Barriers.....	20
Figure 4.2. List of nine consolidated Enablers.....	24
Figure 4.3. The Multiple Evidence Base approach (Tengö et al. 2014).	30
Figure 4.4. Holons in Body Holarchy and Nested Systems (adapted from Benne and Mang 2015).....	31
Figure 4.5. Weaving Metaphors (From Visual Glow, Olena Panasovska, Oleksandr Panasovskyi, and Akriti Bhusal).	33
Figure 4.6. Weaving Holarchy in BWLs.....	34
Figure 4.7. Nested dimensions of the concept of Weaving.....	34
Figure 4.8. Five interrelated Weaving Practices.	35
Figure 5.1. Fragmentation of Responsibility on the Landscape Scale (Herrick et al. 2019). ..	39
Figure 5.2. The Berkana Two Loops Model (Bond 2017, based on Wheatley and Frieze 2006).	42
Table 1.1. Examples of NbS (Cohen-Shacham et al. 2016, 10).....	2
Table 3.1. Rapid Literature Review Parameters.	13
Table 3.2. Overview of Semi-structured Interviews based on Sub Questions.....	15
Table 4.1. Barriers to scaling NbS as portrayed in the Literature.	18
Table 4.2. Enablers for scaling NbS as portrayed in the Literature.	19
Table 5.1. WHAT- and HOW-Barriers and Enablers to scaling NbS to the landscape level. .	40

1 Introduction

1.1 The Sustainability Challenge

Over the last two decades, the emerging field of sustainability science has made a considerable contribution to the understanding that environmental, social, and economic systems are deeply interconnected (e.g. Kates et al. 2001). It has also been established that the Earth is a closed system with finite resources and complex interplays of physical processes that keep the system at a dynamic equilibrium and enable life (Broman and Robèrt 2017). Although the resilience and adaptive capacity of this system are immense, recent developments have increased its fragility and threatened its capacity to support thriving life. While the world has seen unprecedented economic development and increasing prosperity since the industrial revolution, this period in history has also supported rapid population growth as well as unsustainable production and consumption. Climate change, biodiversity loss, land degradation, and pollution of land and sea are among the direct consequences that this Great Acceleration has caused (Steffen, Broadgate, et al. 2015; IPCC 2022; IPBES 2019). With the current trajectory, humanity continues to cross planetary boundaries and pushes the Earth's system closer to collapse (Steffen, Richardson, et al. 2015). Besides devastating effects on all life in general, for humanity itself, the unsustainable trajectory is arguably driving one of the most existential crises our species has ever faced. As humans, our physical, mental, and spiritual well-being depends on healthy ecosystems and rich biodiversity for food-security, recreation, and a sense of purpose to name only a few (Seddon et al. 2020; Wamsler et al. 2020; Müller et al. 2022; Dudley et al. 2021). With further increases in pressure on the socio-ecological system, humanity's possibilities to manoeuvre and navigate the challenges decline and chances to reverse critical developments shrink (Broman and Robèrt 2017).

The nature of this crisis, the sustainability challenge, is complex and it is the interplay of several interconnected challenges that makes it a 'wicked problem' (Rittel and Webber 1973; Lee and Waddock 2021). This wicked complexity requires an integrated, systemic, and strategic approach, realizing deeply interconnected problems cannot be solved through individual, linear solutions (Buchanan 1992; Schad and Bansal 2018; Carmenta et al. 2020; Mansourian and Parrotta 2018). If the sustainability challenge is not tackled in an integrated manner and with a systems perspective, there is a risk of worsening negative feedback loops for some problems while implementing well-intended solutions to others. Due to the pressing and time-critical nature of many of the individual challenges, being strategic with interventions is paramount to not waste precious time and resources on solutions with little to no effect. To be explicit: If we are not taking a holistic and strategic approach, the collapse of current human civilisation on Earth might be the consequence.

To avoid misguided developments yet leave sufficient flexibility for adaptation to how events unfold in this wicked setting, a scientifically backed, principles-based definition for sustainability is critical. Robèrt and Broman (2017) provide a unified definition of sustainability through eight Sustainability Principles (SPs) which universally state that in a sustainable society, nature is not subject to systematically increasing (1) concentrations of substances extracted from the Earth's crust, (2) concentrations of substances produced by society, and (3) degradation by physical means, while people are not subject to structural obstacles to (4) health, (5) influence, (6) competence, (7) impartiality, and (8) meaning-making. In the absence of such a context-independent definition society will continue to work in its inefficient and fragmented

efforts to overcome the current socio-ecological degradation, rather than move collectively towards a unified definition of sustainability success.

1.2 Nature-based Solutions (NbS)

While being deeply anchored in many traditional and indigenous peoples' worldviews for centuries, and already pointed at by Alexander von Humboldt in the early 19th century, the fundamental importance of ecosystems and their integrity has only become widely discussed in the modern scientific literature since the 1970s (Wulf 2015; Cohen-Shacham et al. 2016; Osaka, Bellamy, and Castree 2021). In the following 30 years, the understanding that more holistic and systemic approaches were needed to understand and work with human-nature relationships matured (Cohen-Shacham et al. 2016). In the early 2000s, the term 'Nature-Based Solution' was coined and marked an important paradigm shift away from humans as "passive beneficiaries of nature's benefits" to recognising that "they could also proactively protect, manage or restore natural ecosystems as a purposeful and significant contribution to addressing major societal challenges" (Cohen-Shacham et al. 2016, 3). Large institutions like the World Bank started promoting the uptake of NbS when searching for effective ways to mitigate climate change effects while also protecting natural ecosystems and sustainably improving societal life (Mittermeier et al. 2008). In the political field, more and more actors began to see nature conservation and global development ambitions not as separate, conflicting interests but as compatible and even synergistic (Cohen-Shacham et al. 2016; Nesshöver et al. 2017). By now, nature-based solutions have widely been acknowledged as one of the most critical and promising solutions to combat the complexity of interconnected sustainability challenges (UNEP 2019; Laforteza et al. 2018; EC 2015; Kabisch et al. 2016; Cortinovis et al. 2021). They are seen as an approach that seeks to tackle the sustainability challenge holistically by working with natural processes and simultaneously creating societal and economic opportunities (see definitions below). Overall, NbS help to strengthen the adaptive capacity and resilience of the Earth's socio-ecological system (UNEP 2019; Fastenrath, Bush, and Coenen 2020; Laforteza et al. 2018; Kabisch et al. 2016).

As with any new concept, the term 'NbS' has been defined and used in various ways. Seddon et al. (2020, 2) describe NbS as "an 'umbrella concept' for other established 'nature-based' approaches such as ecosystem-based adaptation (EbA) and ecosystem-based mitigation, eco-disaster risk reduction and green infrastructure". According to the International Union for Conservation of Nature (IUCN), nature-based solutions can include anything of the following (see Table 1.1).

Table 1.1. Examples of NbS (Cohen-Shacham et al. 2016, 10).

Category of NbS approaches	Examples
Ecosystem restoration approaches	Ecological restoration Ecological engineering Forest landscape restoration
Issue-specific ecosystem-related approaches	Ecosystem-based adaptation Ecosystem-based mitigation Climate adaptation services

	Ecosystem-based disaster risk reduction
Infrastructure-related approaches	Natural infrastructure Green infrastructure
Ecosystem-based management approaches	Integrated coastal zone management Integrated water resources management
Ecosystem protection approaches	Area-based conservation approaches including protected area management

Two of the most established definitions of NbS were developed by the European Commission (EC) and IUCN. The European Commission, as a prominent supporter of the concept, has defined NbS as “*[s]olutions that are inspired and supported by nature, which are cost-effective, simultaneously provide environmental, social and economic benefits and help build resilience. Such solutions bring more, and more diverse, nature and natural features and processes into cities, landscapes and seascapes, through locally adapted, resource-efficient and systemic interventions*” (EC 2015, 5). IUCN, which has been at the forefront of NbS work since 2009, defines them as “*[a]ctions to protect, sustainably manage and restore natural or modified ecosystems that address societal challenges effectively and adaptively, simultaneously providing human well-being and biodiversity benefits*” (Cohen-Shacham et al. 2016, 5). Despite differences in the details, the two definitions have been acknowledged as “broadly similar” (Cohen-Shacham et al. 2016, 5) and thus, together depict the understanding of NbS that underlies this research. Most important for this research is that NbS are developed to work with natural solutions to tackle the sustainability challenge holistically by simultaneously providing environmental, social, and economic benefits.

With their inherently systemic approach, NbS have the potential to authentically contribute towards sustainable development, as opposed to being used as another fragmented solution or for greenwashing. While recognising that NbS is an umbrella term and analyses need to be made specifically for any given NbS implemented, it can be argued that the general concept as defined by the EC and IUCN complies with the principles-based sustainability definition of Robèrt and Broman (2017). In addition, it may have the potential to go beyond compliance with the SPs and help reverse harm that was done in the past. Ecological solutions such as the restorations of wetlands, for example, are known for sequestering carbon dioxide (Mitsch and Gosselink 2015) that was emitted in the usage of fossil fuels (being a violation of SP 1). Similarly, permaculture restores soil (Hathaway 2016) that has been degraded by the usage of artificial fertilisers (being a violation of SP 2) and reforestation can help to restore landscapes (Brancalion and Chazdon 2017) that were destroyed by physical means (being a violation of SP 3). Social touchpoints may include empowering local and indigenous populations to co-create the future of a landscape where they have previously been oppressed and forcefully relocated (Farrell et al. 2021) (being a violation of SP 5, 7 & 8) or improving air quality in cities (Seddon et al. 2020) through green-roofing and, thus, removing structural obstacles to health (SP 4). This is not to say that NbS cannot be implemented in a way where they violate SPs too. Establishing design standards that require NbS to comply with the SPs could help to ensure a clear trajectory towards sustainable development.

While many institutions have realised the potential of NbS and started implementing them in recent years, social entrepreneurs stand out as actors with high potential to succeed (Müller et al. 2022). Social entrepreneurs are “individuals with innovative solutions to society’s most pressing social, cultural, and environmental challenges” (Ashoka, n.d.). Implementing NbS in close collaboration with local communities and various stakeholders to create spaces in which both nature and humans (as part of nature) can thrive, social entrepreneurs combine top-down and bottom-up approaches of landscape restoration. Müller et al. (2022, 24) argue that “*due to its participatory and creative nature, social innovators are uniquely positioned to foster the regeneration movement to reverse climate change and halt biodiversity loss, as the challenges are multifaceted and require societal shifts towards more sustainable behavioural patterns*”.

But despite the critical potential of NbS for tackling the interconnected sustainability challenges and social entrepreneurs’ continuous effort to scale their impact, they are not yet mainstreaming on a larger scale (Dorst et al. 2022). A review of existing literature suggests that research on barriers and enablers has primarily focussed on urban settings thus far (e.g. Sarabi et al. 2019; 2020; Seddon et al. 2020; Dorst et al. 2022; Håkanson 2021). Hence, one of the questions this thesis attempts to answer is: *What are Barriers and Enablers to scaling NbS to the landscape level?*

1.3 Weaving

In face of the dramatic urgency of the sustainability challenge, global awareness on the multitude of problems is rapidly growing. And with increasing acknowledgment in politics, business, and civil society, more and more action is mobilised, for example through the attempts of implementing NbS. However, change-making efforts are often “largely fragmented and unconnected, with few ways of cohering, coordinating, and connecting to amplify their intended positive impacts or truly bringing about the purposeful system change that is desired” (Waddock and Waddell 2021, 166). To counteract further fragmentation, a new role has emerged among sustainability and systems-thinking practitioners, referred to as the ‘weaver’ (Goldstein et al. 2017; Spencer-Keyes, Luksha, and Cubista 2020). An organisation that tries to support weavers in their work, The Weaving Lab, defines the practice of *Weaving* as “interconnecting people, projects and places in synergistic and purposeful ways” (The Weaving Lab n.d.). Weavers are described as “co-creating thriving networks and communities that enhance the wellbeing of self, society and nature. [They] cultivate spaces and projects for learning, connection and innovation that develop meaningful relationships between people, ideas, teams, projects, organizations, networks, places and nature” (The Weaving Lab n.d.). Weavers acknowledge our fundamental interdependence with each other and the rest of nature and see the need for collaborative processes, diverse communities, interdisciplinary projects, and local-to-global perspectives (The Weaving Lab n.d.; Müller et al. 2022).

From a systems-thinking perspective, *Weaving* seems to strengthen the socio-ecological fabric and the system’s resilience by addressing the vital and relational aspects of trust, common meaning, diversity, capacity for learning, and capacity for self-organization, which are the foundation for the social SPs (4-8) as described by Missimer, Røbert, and Broman (2017). It appears to be an emergent practice that aims to tackle wicked problems in systemic ways rather than fostering old paradigms of mechanistic problem solving (Müller et al. 2022). Despite these promising first insights from the field, academic literature on the concept is scarce and a clear and non-wordsmithed definition as well as a validated description of concrete *Weaving* practices is still missing. Even among practitioners, there is no clear agreement on what

Weaving entails and what not. Consequently, the second question for this research was: *What is 'Weaving' and what are Weaving practices?*

1.4 Bioregional Weaving Labs

The Bioregional Weaving Labs (BWLs) collective is one example of a community of practice that aims to tackle the complexity of the sustainability challenge holistically by bringing together the practice of *Weaving* and NbS (Figure 1.1).



Figure 1.1. BWL at the intersection of *Weaving* and NbS.

BWLs and The Weaving Lab, as one of the co-initiating organisations, have been at the forefront of coining the term *Weaving* in the field of community-based approaches to landscape restoration and scaling NbS. The BWL collective, consisting of 25+ international system-changing organisations, aims to start restoring, protecting, and regenerating at least one million hectares of Europe’s land and sea by 2025 (Ashoka 2022). Among the co-initiators are Ashoka Europe Fellowship, Commonland Foundation, Presencing Institute, Drawdown Europe Research Association, and The Weaving Lab as well as several social entrepreneurs who work with NbS in the field of large-scale land and seascape restoration (Ashoka 2022). Together, the goal is to establish BWLs in ten different bioregions across Europe “that build capacity and catalyse multi-stakeholder partnerships, mobilising at least 100 000 changemakers per bioregion” (Ashoka 2022, 5). The BWL collective is founded on the premise that “We are nature”. Overall, it aims to generate mindset shifts in people to become more aware of their role in nature and how we are all active agents in the system (Ashoka 2022, Respondent #1).

Bioregional Weaving Labs try to bridge gaps between various, often fragmented stakeholder groups through the practice of *Weaving* (Ashoka 2022). They recognise that there are already plenty of social innovators with ready-to-scale NbS, caring citizens who hold ideas for a more sustainable future, progressive policymakers with the ambition to design more holistic policies, collaborative scientists and researchers willing to share insights open-source, and financiers understanding that returns need to be measured more holistically. Through “geographically grounded and carefully curated multi-stakeholder partnership process[es]”, the labs “weave together people and solutions, equipping and helping them to organise for transformative change” (Ashoka 2022, 6). By using the change management model of Theory U (Scharmer 2016), BWL aims to create awareness-based systems change amongst key local stakeholders

such as farmers, fishers, landowners, investors, corporate leaders, shareholders, policymakers, and others who represent the given region. Stakeholders are invited to come together and collectively understand their socio-ecological system's liabilities and role, co-create shared visions, and identify leverage points for collaborative intervention. The importance of such multi-stakeholder partnerships and trust-based relationships for successful landscape transformation has been highlighted throughout the literature (Sloan and Oliver 2013; Williams, Sikutshwa, and Shackleton 2020; Dentoni, Bitzer, and Schouten 2018; Höhl et al. 2020; Robinson et al. 2021). The convened coalition of stakeholders is introduced to and educated about NbS from the global network of social entrepreneurs and their potential as integrated solutions with multiple co-benefits (Ashoka 2022). To catalyse scalability of the concept, BWLs facilitate an overarching learning network to “continuously learn, build expertise and exchange best practices” across bioregions (Ashoka 2022, 7).

As a functional unit in which to restore healthy human-human and human-nature relationships, the BWLs use *bioregions* which are ecologically and geographically defined areas that can expand beyond geopolitical country borders (Vilhena and Antonelli 2015). While being sufficiently large to holistically account for different ecological and geo-physical processes, they are considered a well-suited context in which humans can reconnect to ecological and cultural heritage, learn together, and reimagine possible futures of the land and seascape (Ashoka 2022). The vision of BWLs is to, within those bioregions, scale and replicate pioneered social innovations that “turned the complexity and interconnected nature of the [above-mentioned] crises into an opportunity” for both nature and humans (Schops et al. 2021, 15).

Info box: Origins of the BWL idea

Whilst the terminology of ‘*Bioregional Weaving Labs*’ is new, similar concepts like ‘*bioregional learning centres*’ (Meadows 1982), ‘*learning ecosystems*’ (Spencer-Keyes, Luksha, and Cubista 2020; Smitsman, Baue, and Thurm 2021) or ‘*learning networks*’ (Goldstein et al. 2018) have been established before. Bioregional Weaving Labs can be considered as the realisation of bioregional learning centres, which were first envisioned by Donella Meadows in 1982. She described how a group of systems scientists noted that: “Each agro-economic region is so unique that the concept of transfer of technology is irrelevant. What’s relevant is the transfer of the capacity to develop technology and institutions that are consistent with the cultural endowment and the resource endowment of each region” (Meadows 1982, 1). According to Meadows, Bioregional learning centres would help build the capacity for people to solve their own problems in ways that fit the local culture, environment, and context. She envisioned bioregional learning centres for each discrete bioregion, fostering place-based learning, systems-thinking, longtermism, information aggregation and dissemination, inclusivity, and diversity (Meadows 1982). The centres would collect, make sense of, and disseminate information about the state of the local people and the ecosystems. Besides being data repositories, publishing, broadcasting and teaching centres, they would serve as “experiment stations and extension agents”, knowing about the latest technologies, and the traditional ones, and when to use which (Meadows 1982, 2). And whilst the centres serve their particular regions, they would also be connected through their “own informal network”, exchanging methods, ideas and data, to “join together to work on issues or problems that cross regional boundaries” (Meadows 1982, 3). In many ways, this is what BWLs embody today.

To date, five BWLs have been agreed upon (one in Sweden, Romania, Ireland, Spain, and the Netherlands respectively) and four of these have started planning for first multi-stakeholder dialogues in the beginning of 2022.

As a key player working at the intersection of *Weaving* and NbS, Bioregional Weaving Labs have been a co-initiator as well as core anchor point and source of data for this study and its conclusions. However, until future research proves otherwise, the findings are suggested to be applicable to a broader context beyond BWL.

2 Purpose

As common for transdisciplinary sustainability science research, the purpose of this thesis is two-fold (see Phase C in Figure 2.1). It addresses both scientific and societal/practical knowledge gaps.

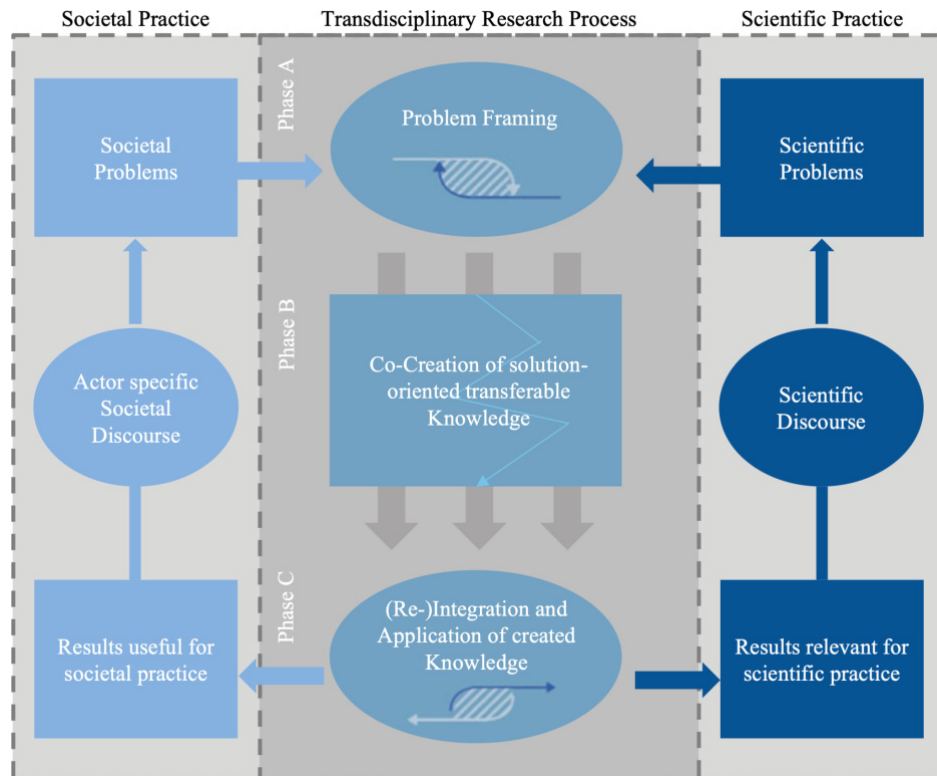


Figure 2.1. Conceptual Model of an Ideal-typical Transdisciplinary Research Process (adapted from Lang et al. 2012).

On the one hand, this study intends to contribute to the scientific discourse around its two key themes. Its objective is to help clarify the term *Weaving* and the associated *Weaving Practices* as well as to advance the current literature on barriers and enablers to scaling NbS by investigating them specifically for the landscape level. With this, the study aims for scientifically relevant results both in the form of generating new insights (i.e. finding answers) and pointing at potential further research gaps (i.e. identifying further relevant questions).

On the other hand, this research aims to generate practical results that can be re-integrated into societal practice, for example in the BWL collective, to help them become more effective in their approach of tackling the socio-ecological challenges at a landscape and societal level. For this, generated insights will be translated into two practical toolkits. One will help NbS practitioners through a framework of reflection questions to use the identified set of barriers and enablers in their own work and region. The other will describe *Weaving* and the five core practices as well as concrete methods that can be used to act on the practices and a set of questions for aspiring weavers to assess their current capabilities against the five practices.

As a whole, the purpose of this research is to bring the two topics of NbS and *Weaving* together and contribute to the discussion of whether *Weaving* practices could help foster the conditions for NbS to be scaled to the landscape level, i.e. help overcome barriers or create enablers.

2.1 Research Questions

To address these scientific and practical knowledge gaps on NbS and *Weaving*, this research aims to answer the following question:

‘How could *Weaving* practices foster the conditions for NbS to be scaled to the landscape level?’

The following two sub questions (SQs) were defined to collect data and help answer the overall research question:

SQ 1: What are Barriers and Enablers for scaling NbS to the landscape level?

SQ 2: What is *Weaving* and what are *Weaving* practices?

2.2 Scope and Limitations

The initial scope of the research was to create a case study on the European Bioregional Weaving Labs. However, as BWL was still in its infancy when this study was conducted, the concept of *Weaving* was relatively new within the organisations and NbS have not been implemented through BWLs. This led the researchers to investigate the concepts and practices in the larger sustainability context. The scope was shifted from a case study on BWL to a research project in which the findings of *Weaving* and *Weaving* practices as well as barriers and enablers to scaling NbS to the landscape level could be applied to the wider sustainability setting.

While generic and purposeful sampling was selected to ensure that the interviewee’s expertise was relevant to the research question, the researchers acknowledge that this may have led to a lack of more diverse voices and potential bias held by the advocates for *Weaving* and NbS. Given a longer time frame and larger network reach, a more focussed transdisciplinary approach with various stakeholders such as policy makers or members of civil society may have provided a more diversified discussion.

For the section pertaining to SQ 1 (barriers and enablers to scaling NbS), the focus was narrowly set on ‘NbS’ as the object of study, excluding several similar and related terms due to the given time constraints. While the research establishes a list of barriers and enablers for the landscape scale and it acknowledges that they are both context-dependent and interlinked, this study does not shed more light on these two features and invites further research on this. For the section pertaining to SQ 2 (*Weaving* and *Weaving* practices) an overview of leadership practices was created, however, the scope of which was limited due to both time constraints and a greater extent focus being placed on the research question itself rather than a cross-comparison.

In the first draft of the research scope, the researchers aimed to have a third sub question, SQ 3 (How can *Weaving* help overcome identified barriers and create enablers?), in which *Weaving* practitioners would map the *Weaving* practices to the barriers and enablers for scaling NbS. In doing so the researchers aimed to discover where the practices could help create conditions for scaling NbS as well as identify potential areas of improvements, through expert opinions.

However, given the complexity of the data and the limited time scale, this question was shifted from a research question to a discussion point. And in this, the potential personal bias of the researchers as well as missing validation have to be mentioned as limitations of this study. Despite it being a complex and adaptive process with the said limitations, the researchers still believe that the indications presented in the discussion section could be a prototype for further conversations within and beyond the BWL collective.

Overall, the target audience for this report are *Weaving* and NbS practitioners who seek to understand their own work from a scientific perspective. Furthermore, it can help them to understand why NbS are not scaling and gives indications about the potential of *Weaving* to create more supportive conditions. This report is also aimed at academics who want to further the scientific discussion on the emerging concept of *Weaving* as well as NbS on a landscape scale.

3 Methodology

3.1 Philosophical Stance

In qualitative academic research, the ontological and epistemological view as well as research perspective of the researchers matter (Potter 1996 cited in Savin-Baden and Howell Major 2013). While an objective view on the research question(s), data, practical applications, etc. is aimed for, the research work will, to some degree, always build on assumptions and preconceived views held by the researchers. The way the researchers see the world and the creation of knowledge does influence the entire research (Savin-Baden and Howell Major 2013). It is impossible to eliminate all personal biases, even more so when the research is characterised by significant time and scope constraints, like this one is. Hence, it is important to at least be transparent about the researchers' perspective.

In this thesis, a pragmatist worldview underlies the knowledge generation. Located in the middle of the spectrum between objectivism (all reality is objective and external to the mind and knowledge is reliably based on observed objects and events, *American Heritage Dictionary* 2011) and subjectivism (all knowledge is limited to experiences by the self and transcendent knowledge is impossible, *Collins English Dictionary* 2012), pragmatism states that truth is context-dependent and established over time through a constant assessment of what is useful (Savin-Baden and Howell Major 2013). Truth is, therefore, neither bound to what can objectively be observed in the world nor to what is subjectively constructed in the mind. It is to be discovered by finding the most useful explanation, considering the given circumstances (Savin-Baden and Howell Major 2013). Findings from this research are aimed at providing the best possible and most useful explanation to the given research question that can be derived at this point in time and given the situation that the research is carried out in. To arrive at this context-dependent, temporary truth, knowledge was generated through a social constructivist approach which acknowledges that reality and knowledge are socially, i.e. collectively, constructed. Knowledge is believed to emerge through conversation, interaction, and negotiation between individuals (Vygotsky and Cole 1978). In the case of this study, the interaction and dialogue happened between the researchers as well as with external experts and project partners. It was the researchers' task to capture, interpret, and validate the perspectives of all individuals who contributed to the knowledge generation (Savin-Baden and Howell Major 2013).

Apart from the interpretation of the data, also the overall research design as presented in section 3.2 was informed by the pragmatist approach in a way that methods were selected based on usefulness for generating insights to answer the said research questions (Savin-Baden and Howell Major 2013).

3.2 Research Design

This research project had an iterative character that extracted and consolidated theory from literature to build conceptual frameworks, used these to inform the data collection through interviews, and applied the insights again to the conceptual frameworks. Research questions were revised and adapted based on new findings. Maxwell (2012) describes this as an ‘interactive approach’ to qualitative research. Figure 3.1 represents the research design and workflow that was used to carry out this research. While allowing for iterations between steps as previously mentioned, the process was broadly divided into three main phases.

1. **Rapid Literature Review** for sub questions 1 and 2 to build conceptual frameworks to be validated in the interviews
2. **Semi-structured Interviews** to improve and validate conceptual frameworks for sub question 1 (18 interviews) and sub question 2 (13 interviews)
3. **Data Analysis** through transcription, Direct Qualitative Content Analysis (DQCA) for sub question 1, and inductive Qualitative Content Analysis (QCA) for sub question 2 to improve the two conceptual frameworks

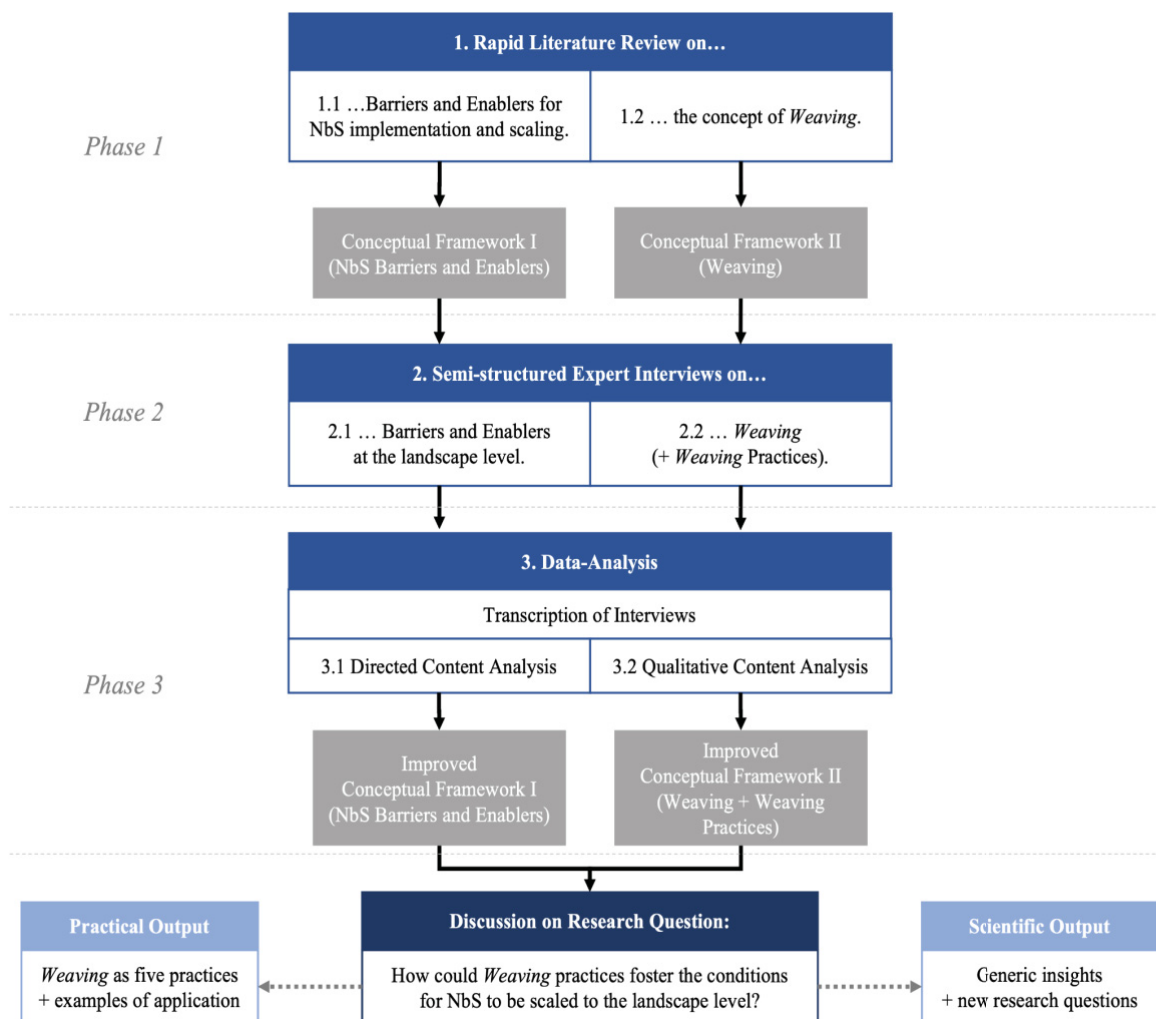


Figure 3.1. Research Design Workflow.

Based on the two revised conceptual frameworks, the discussion contributes to a discourse around the two themes of this research (barriers and enablers and *Weaving*) as well as their potential intersections. Although further research is required, first conclusions were drawn on how *Weaving* practices could foster the conditions for NbS to be scaled to the landscape level.

3.2.1 Rapid Literature Review

A “rapid review” was performed to build two independent conceptual frameworks that would organise the findings from the literature (Bryman 2012). Rapid reviews are suited for studies that require an “assessment of what is already known about a [...] practice issue, by using systematic review methods to search and critically appraise existing research” (Grant and Booth 2009, 95) while also being constrained by time, “resources available [...] or] the expertise or experience of reviewers” (Grant and Booth 2009, 104). For the creation of Conceptual Framework I (CF I), 55 publications were studied on NbS and 18 of them were considered for the analysis of barriers and enablers for scaling. While acknowledging this as a limitation, publications on NbS-related terms like ‘Natural Climate Solutions’ (NCS), ‘landscape restoration’, ‘conservation’ or ‘green infrastructure’ were intentionally not considered in this rapid review as their justification and differentiation would have conflicted with given time and scope constraints. CF I entails two representations, one of consolidated key barriers including structural underlying conditions and one for consolidated key enablers including supportive action for implementation and the rationale for each enabler. Through the second rapid review, Conceptual Framework II (CF II) was produced to detail *Weaving* as portrayed in the literature. For this, 22 academic papers were found and 12 analysed in more detail. The framework comprised a working definition and a list of core practices. The two conceptual frameworks were built to function as a basis for the conversation with experts on both NbS and *Weaving*. Table 3.1 provides more detailed information on how the rapid review was conducted for both conceptual frameworks.

Table 3.1. Rapid Literature Review Parameters.

<i>Search path (databases)</i>	Summons, Scopus, and Google Scholar
<i>Scholarly paper types</i>	Empirical research reports, evaluation reports, research reviews / syntheses, conceptual / theoretical papers, and descriptive reports
<i>Scholarly publication sources</i>	Peer reviewed journals, non-peer reviewed journals, books, grey literature, and internet resources
<i>Search string for CF I (Barriers and Enablers)</i>	Barriers OR Enablers AND Nature-based Solutions
<i>Search string for CF II (Weaving)</i>	Weaving AND Collaboration OR Networks OR Knowledge NOT Textile

3.2.2 Semi-structured Interviews

In phase 2 of the research process, semi-structured interviews were conducted as a qualitative and primary data collection method to validate and improve the Conceptual Frameworks I and II. The conceptual frameworks acted as an anchor point to orientate the participants on the subject matter and were revised throughout the process as new data emerged such as on the *Weaving* practices (Bryman 2012).

The semi-structured interviews allowed for systematic preparation and execution of interview questions centred around the sub questions, as well as providing probes to evoke more elaborate and intuitive responses. Provisional planning of the interviews supported the researchers in identifying credible respondents behind the said sub questions as well as the number of interviewees required to ensure an adequate sample size. As with qualitative research, it is a “delicate balancing act between ensuring data saturation and at the same time not undertaking a deep case-orientated analysis” (Bryman 2012, 425). For the time and scope of the research a sample size of 10+ interviews for each sub question was seen as appropriate.

Generic purposeful sampling was chosen to establish a strategic approach in ensuring the selected interviewees were relevant to the research questions (Bryman 2012). Within this framing the researchers aimed to provide a transdisciplinary approach through the inclusion of (1) academics, (2) experts who work with *Weaving* or NbS on a meta-level and (3) grassroots entrepreneurs. In doing so the inclusion criteria for participants in the semi-structured interviews were (1) academics with 5+ scientific papers published regarding the said sub question, or (2) experts with 3+ years of experience in the subject matter, and (3) grassroots entrepreneurs having 5+ years of working in the field.

For sub question 1 and CF I, 9 academics and experts knowledgeable about the difference in barriers and enablers between urban and landscape settings were interviewed as most of the literature that was considered in the rapid review focused on urban settings and the findings needed to be validated for the landscape level. In addition, another 9 pre-existing interviews from grassroots entrepreneurs conducted by the BWL partner Ashoka Netherlands were considered as data points. For sub question 2 and CF II, 13 interviews were conducted with both academics who have published scientific literature surrounding the term *Weaving*, as well as experts and grassroots *Weaving* practitioners working in the field, to ensure a grounded understanding of both the term *Weaving* and *Weaving* practices. (See Table 3.2).

Within the interview design process, clear objectives, plans, and consent forms for each sub question were created to ensure reliable and valid data collection. Each participant was emailed with an overview of the research and asked if they would like to participate. Upon verification the participants were provided with the interview questions and a conceptual framework as a means of providing a foundational and reliable starting point of the themes. All interviews were conducted online via Zoom over a three-month period and each sub question had a formal lead researcher in the team who conducted all the interviews within the sub question to ensure consistency of framing and questions asked.

Table 3.2. Overview of Semi-structured Interviews based on Sub Questions.

Sub Question	Objective	Interviewees
SQ 1: What are Barriers and Enablers for scaling NbS to the landscape level? (See interview questions in Appendix D)	Present Conceptual Framework I to experts and collect their academic and field-experience-based feedback. Clarify if barriers and enablers to scaling NbS are the same at a landscape level as they have been identified for urban settings. Validate and improve CF I. (See Conceptual Framework I in Appendix A & B)	9x NbS landscape experts (See interviewees in Appendix C)
SQ 1: What are Barriers and Enablers for scaling NbS to the landscape level? (See interview questions in Appendix E)	Transcripts were provided and one embedded question in larger interview for BWL specifically asked about barriers to NbS implementation.	9x NbS social entrepreneurs interviewed by Ashoka (See interviewees in Appendix C)
SQ 2: What is <i>Weaving</i> and what are <i>Weaving</i> practices? (See interview questions in Appendix D)	Present Conceptual Framework II to experts on <i>Weaving</i> and/ or <i>Weaving</i> practices to receive their academic and in-field-experience-based feedback. Validate and improve CF II, comprising a working definition, and a list of core practices. (See Conceptual Framework II in Appendix A & B)	13x <i>Weaving</i> experts (See interviewees in Appendix C)

This research had features of a revelatory case study as it investigated parts of what the BWL collective does as a “phenomenon previously inaccessible to scientific investigation” (Bryman 2012, 70). Similarly, it could also be argued that it featured elements of an exploratory case study as it sought to “gain initial insights into a subject not well understood” (Savin-Baden and Howell Major 2013, 155). However, the research design cannot, in its entirety, be described as a case study as its purpose was not to deliver “an intensive examination of the setting” of the case (i.e. BWL) or “an in-depth elucidation of it” and the case was not “the focus of interest in its own right” (Bryman 2012, 67–69). The objects of interest for this study were rather, *Weaving*, for which BWL is one of the uprising communities of practice, and barriers and enablers for scaling NbS, which BWL are aiming to address. Hence, BWL served as a practical anchor point and example for what is discussed in this thesis rather than a case and “object of interest in its own right” (Bryman 2012, 69).

3.2.3 Data Analysis

Once the interviews were conducted, they were transcribed using *otter.ai* software to produce viable qualitative data. After transcription, a minimum of two researchers reviewed the interview material to ensure unbiased analysis and interpretation of data. For the analysis and coding, Qualitative Content Analyses (QCAs) were performed. QCAs can be carried out in an inductive or deductive way (Mayring 2014; Kibiswa 2019). While the inductive way draws categories and themes from the data directly, the deductive way (also called ‘directed way’) uses pre-existing theories to build categories and themes for coding (Mayring 2014; Hsieh and

Shannon 2005; Kibiswa 2019). The inductive category development is also called ‘open coding’ in Grounded Theory according to Strauss (1987) and Strauss and Corbin (1990).

For the interviews on sub question 1 (including interviews conducted for this study and the interviews conducted by Ashoka Netherlands), a Directed Qualitative Content Analysis (DQCA) was performed. As DQCAs are used “to test, to corroborate the pertinence of the theory/ies guiding the study or to extend the application of the theory/ies to contexts/ cultures other than those in which that/those theory/ies was/were developed” (Kibiswa 2019, 2059), the method was well-suited for validating barriers and enablers from the urban context for the landscape scale. As findings from the interviews were compared against prior findings from the literature, deductive category application helped to code the answers given in interviews. Previously established barriers and enablers as well as underlying structural conditions, supportive actions, and rationales served as codes in this phase (see Appendix F). The results of the DQCA helped to improve CF I and findings were incorporated into a new refined version of it (see Appendix B).

On the transcripts for sub question 2 an inductive QCA was performed to enrich the three parts of CF II. Inductive category development was chosen for the qualitative interpretation as the topic was rarely discussed in academic literature and the first version of CF II needed further unguided enrichment through the experts’ insights (for codes see Appendix G). Additionally, deductive coding methods were used to validate, falsify, or improve already established insights on *Weaving* and *Weaving* practices (Appendix G). All insights from the analysis of this data were included in a second, more comprehensive version of CF II (see Appendix B).

3.3 Ethical Considerations

Ethical consideration was undertaken throughout the research process to adhere ethical principles as outlined by the Swedish Ethical Review Act: “respect for human dignity, human rights and fundamental freedom, interest in the development of new knowledge through research and the well being on humans shall be given priority ahead of the needs of society and science” (Ministry of Education 2004). No experiments or research involving threats of safety to participants were conducted. Additionally, a consent form was delivered to the participants prior to the interview process. The consent form outlined the subject matter, expected interview process, choice of anonymity at all points of the research, and use of data both during and after the research. Data was stored on a Microsoft SharePoint, hosted by Blekinge Institute of Technology (BTH), to ensure compliance with GDPR regulations. The research process was voluntary with considerations made to ensure full respect and dignity of the research participant, as well as clear and transparent communication to ensure no misleading information. Clearance from an ethics board was not deemed necessary for the purpose of this research based on the factors mentioned above as well as adherence with BTH data protection protocols. In addition, the study did not involve adolescents, vulnerable groups or sensitive topics that may have otherwise required a review process.

4 Results and Analysis

4.1 What are Barriers and Enablers to scaling NbS to the landscape level?

Despite the acknowledgement, promotion, and large-scale support for NbS as critical solutions to tackle the sustainability challenge holistically, they are not yet implemented on a large enough scale. There are several factors that hinder the uptake, scaling, and mainstreaming of NbS, which are referred to as ‘barriers’. Factors that support the implementation of NbS are called ‘enablers’. For the sake of this study, no distinction is made between the ‘implementation’, ‘uptake’, ‘scaling’ or ‘mainstreaming’ of NbS. The following provides further insights into barriers and enablers.

4.1.1 Barriers and Enablers as portrayed in the Literature

The current literature presents several lists of barriers and enablers. Generally, more publications on barriers were found than on enablers. For this study, 18 articles and reports not older than 2016 were considered for barriers and 6 for enablers. The lists of barriers and enablers from the most significant publications are presented in Tables 4.1 and 4.2. No comprehensive list of barriers or enablers was published specifically for the landscape scale or rural settings. All listed publications explicitly base their findings on urban settings. Although lists of barriers and enablers might exist for similar related terms like ‘natural climate solutions’ or ‘ecosystem-based adaptation’, this study focused on the term ‘nature-based solutions’ due to time and scope constraints.

Table 4.1. Barriers to scaling NbS as portrayed in the Literature.

Theme	Sarabi et al. 2020	Dorst et al. 2022	Seddon et al. 2020	Schmalzbauer 2018	Price 2021	McQuaid et al. 2021
<i>Collaboration & citizen engagement</i>	<ul style="list-style-type: none"> • Misalignments between short-term plans and long-term goals • Lack of public awareness and support • Silo mentality 	<ul style="list-style-type: none"> • Low private sector engagement • Citizen engagement challenges • Knowledge, data and awareness challenges • Limited collaborative governance 		<ul style="list-style-type: none"> • Citizen involvement • Social inclusion • Public acceptance 		<ul style="list-style-type: none"> • Lack of general public awareness of NBS concept
<i>Policies</i>	<ul style="list-style-type: none"> • Lack of political will and long-term commitment • Lack of sense of urgency among policymakers • Lack of supportive policy and legal frameworks 	<ul style="list-style-type: none"> • Insufficient policy development, implementation and enforcement oriented at NBS 	<ul style="list-style-type: none"> • Challenges to governing nature-based solutions 	<ul style="list-style-type: none"> • Political support 	<ul style="list-style-type: none"> • Inflexible and highly sectoralised policy, regulatory environments, existing direct and indirect subsidies and governance challenges, continue to favour grey, engineered solutions 	<ul style="list-style-type: none"> • Lack of political will and urgency to invest in NBS, silo barriers, short-term policies • Fragmented/ inconsistent regulation
<i>Financing</i>	<ul style="list-style-type: none"> • Perceived high cost • Lack of available financial resources • Lack of financial incentives 	<ul style="list-style-type: none"> • Insufficient public resources (incl. maintenance challenges) 	<ul style="list-style-type: none"> • Lack of investment in nature-based solutions 	<ul style="list-style-type: none"> • Financial support 	<ul style="list-style-type: none"> • Lack of accessible funds and flawed approaches to economic appraisal lead to underinvestment in NbS • Many benefits from NbS are difficult to monetise 	<ul style="list-style-type: none"> • Lack of financing and reliance on public financing • Lack of alignment with private sector investment interests
<i>Measurement</i>	<ul style="list-style-type: none"> • Lack of design standards and guidelines for maintenance and monitoring • Functionality and performance uncertainties 		<ul style="list-style-type: none"> • Difficulties in measuring effectiveness 	<ul style="list-style-type: none"> • Challenges for Evaluation 	<ul style="list-style-type: none"> • Measuring the effectiveness of NbS is difficult 	<ul style="list-style-type: none"> • Inconsistent approaches to measurement
<i>Knowledge</i>	<ul style="list-style-type: none"> • Lack of skilled knowledge brokers and training programs 			<ul style="list-style-type: none"> • Knowledge gaps 	<ul style="list-style-type: none"> • Lack of awareness/understanding of NbS approaches and nature's critical role in adaptation (entrenched attitudes and norms) • Limited availability of knowledge and evidence to help make the business case for their use (especially against business-as-usual alternatives) 	<ul style="list-style-type: none"> • Uncertainty over effectiveness of NBS • Lack of evidence of effectiveness and resilience of NBS to climate change
<i>Land</i>	<ul style="list-style-type: none"> • Property ownership complexities • Space constraints 	<ul style="list-style-type: none"> • Competition over urban space 				<ul style="list-style-type: none"> • Competing land use priorities
<i>Other</i>	<ul style="list-style-type: none"> • Risk aversion and resistance to change 	<ul style="list-style-type: none"> • Literature based on NBS in urban development 		<ul style="list-style-type: none"> • Governance of multifunctional green infrastructure • Balancing trade-offs while delivering multiple goals • Challenges for upscaling 	<ul style="list-style-type: none"> • Technical challenges and gaps in capacity that impede wider implementation 	<ul style="list-style-type: none"> • Public procurement challenges • Lack of skilled suppliers in the private sector • Complexity of governance

Table 4.2. Enablers for scaling NbS as portrayed in the Literature.

Theme	Sarabi et al. 2019	Martin et al. 2021	Frantzeskaki 2019	McQuaid et al. 2021
<i>Collaboration & citizen engagement</i>	<ul style="list-style-type: none"> Partnership among stakeholders 	<ul style="list-style-type: none"> Co-design (innovative stakeholder participatory processes that influenced the final NBS) 	<ul style="list-style-type: none"> Nature-based solutions experiments require and feed into trust between the city and its citizens both for the aim of the experiment and for the experimenting process itself Different for a co-creating nature-based solutions are needed that include and learn from urban social innovation Nature-based solutions require a collaborative governance approach. Nature-based solutions are often initiated by local governments and require multiple actors to be designed, implemented and linked to urban life. An inclusive narrative of mission for nature-based solutions can bridge knowledges and agendas across different departments of the city and tackle with departmental disputes. 	<ul style="list-style-type: none"> Co-production with local community/ entrepreneurs, partnerships/ collaborative governance; intermediaries
<i>Policies</i>	<ul style="list-style-type: none"> Plans, acts and legislations 	<ul style="list-style-type: none"> Polycentric governance (novel arrangements in the public administration that involved multiple institutional scales and/or sectors); 		<ul style="list-style-type: none"> Strong policy endorsement of NBS Pro-environmental policy and regulation
<i>Financing</i>	<ul style="list-style-type: none"> Economic instruments 	<ul style="list-style-type: none"> Financial incentives (financing community-based implementation and monitoring of NBS) 		<ul style="list-style-type: none"> Policy measures (subsidies, fiscal)
<i>Measurement</i>	<ul style="list-style-type: none"> Effective monitoring and Valuation systems for implementation process and benefit 			<ul style="list-style-type: none"> New approaches to measure impact, knowledge sharing, technology
<i>Knowledge sharing</i>	<ul style="list-style-type: none"> Knowledge sharing mechanisms and technologies Education and training 			<ul style="list-style-type: none"> Awareness of the benefits of NBS for climate change mitigation/adaptation
<i>Mindset</i>	<ul style="list-style-type: none"> Open innovation and Experimentation 			
<i>Other</i>	<ul style="list-style-type: none"> Combining NBS with other urban elements and grey infrastructures Appropriate planning and design 	<ul style="list-style-type: none"> Pro-NBS interest and coalition groups (organized pressure groups that advocated for an NBS) 	<ul style="list-style-type: none"> Nature-based solutions need to be aesthetically appealing for citizens to appreciate and protect them Nature-based solutions create new green urban commons Nature-based solutions need to be designed in such a way and scale that lessons for their effectiveness can be easily harvested and as thus, to be easily replicated into other locations 	

Based on the findings from the literature, expert interviews were conducted both with academics and practitioners to validate the list of barriers and enablers for the landscape level.

4.1.2 Barriers as validated for the landscape level

The following provides an overview of the seven main categories of barriers (see Figure 4.1) that were validated by nine interviewed experts (see Appendix C) to be relevant to the landscape scale. At first, it appeared as if the listed barriers co-existed next to each other. However, it quickly became apparent that linkages exist between the individual barriers (Sarabi et al. 2020). How and to which degree they are interlinked, will not be assessed in this study due to time and scope constraints (see Discussion section 5.1 for suggestions on further research).

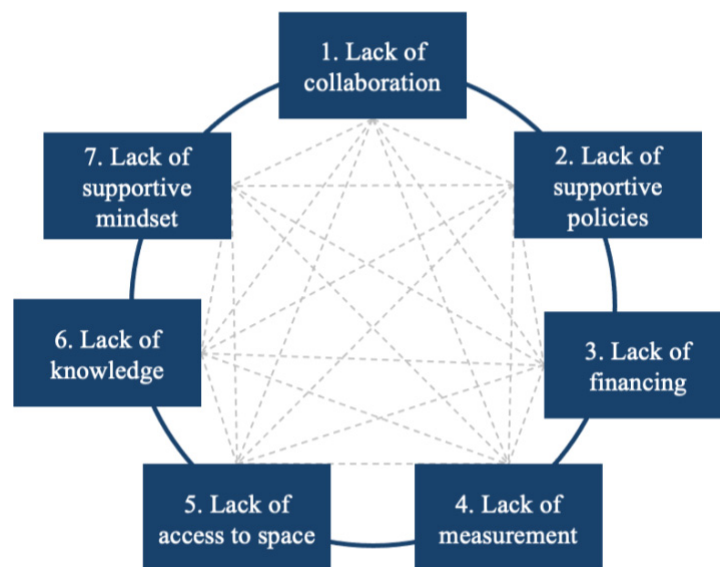


Figure 4.1. List of seven consolidated Barriers.

1. Lack of collaboration

Several studies have shown the vital role of multi-stakeholder collaborations for successful and holistic landscape restoration projects (e.g. IPBES 2019). Hence, a lack of collaboration between stakeholders has been identified as a key barrier and consists of various facets. Often highlighted is the fact that within institutions, departments work in very traditional, siloed structures and different silos use different languages (Müller et al. 2022; Sarabi et al. 2020; Kabisch et al. 2016; Thorn et al. 2021). This often contradicts the multi-functionality of NbS and their inherent need for cross-departmental and cross-sectoral collaboration in planning, implementation, and maintenance (Schmalzbauer 2018). Müller et al. (2022, 59) attribute this siloed institutional approach partially to a “systemic failure of not fully recognizing the interconnectedness of the environmental, social and economic crises” (also see UNDP 2017, 9).

Beyond a silo-mentality within institutions, Müller et al. (2022) found conflicting operating time frames of NbS work and critical stakeholders to be a major reason for a lack of collaboration. Where NbS practitioners operate in periods of decades, decision-makers in politics, corporates, and financing institutions often operate in much shorter

cycles of years or months, creating a discrepancy in expectations and incompatibility for collaboration. And even among those who implement NbS, collaborations are rare as practitioners are “absorbed by their own hard work to change systems and create multiple benefits at the same time, dealing with a myriad of stakeholders”, leaving little time for inter-initiative exchange which could unlock new financing and other opportunities (Müller et al. 2022, 61).

But also with regards to the general public and other stakeholders, a lack of engagement and commitment is pointed out as a key barrier (Müller et al. 2022; Dorst et al. 2022; Sarabi et al. 2020). Reasons for this appear to include (but are not limited to) a general lack of public awareness about NbS (Sarabi et al. 2020; McQuaid et al. 2021), a lack of common language and communication strategies to promote NbS (Müller et al. 2022; Thorn et al. 2021), an underappreciation of natural assets for social and economic resilience in general (Price 2021), and a fear of change (Schmalzbauer 2018). Sarabi et al. (2020, 3) specifically point to the lack of “trans-boundary actors skilled in speaking the language of different groups, and connecting stakeholders” and Müller et al. (2022, 59) found that rising polarisation between stakeholders “prevents people from finding true dialogue and co-creating solutions together”. As a consequence of critical stakeholders not collaborating sufficiently, there is a lack of shared vision for the future which, in turn, becomes a barrier again for streamlining efforts towards NbS success. NbS social entrepreneur Respondent #26, interviewed for the Bioregional Weaving Lab’s Insights Report, specifically points to the “need to shift from a national approach to a regional based vision, to restore trust between people” (quoted in Müller et al. 2022, 59).

2. Lack of supportive policies

A second, often-mentioned barrier is the lack of supportive policies (e.g. Sarabi et al. 2019; Dorst et al. 2022; Müller et al. 2022). Besides the overall lack of policies that promote NbS uptake, Dorst et al. (2022) and McQuaid et al. (2021) also highlight that extensive regional differences and inconsistencies in policies make it hard to implement NbS on a larger scale (nationally or even internationally). Müller et al. (2022, 60) argue that existing legal frameworks are often “out of touch with reality” and, therefore, stifle NbS uptake rather than support it. Seddon et al. (2020, 9) also mention examples like “rural development payment schemes, post-disaster recovery policies, [and] policies promoting intensive agriculture” that can clash with NbS interests.

The literature finds several underlying structural conditions for this lack of supportive policies that range from a lack of political will/urgency and short-termism to power-relations and path dependencies that drive decisions for grey (i.e. man-made/ constructed) infrastructure solutions over NbS (Sarabi et al. 2020; Kabisch et al. 2016; Schmalzbauer 2018; Price 2021; Seddon et al. 2020). Seddon et al. (2020) found that cognitive factors like a lack of awareness of ecosystem services provided by NbS and a lack of perceived responsibility for climate action in public institutions foster a reluctance to change policies in favour of NbS. McQuaid et al. (2021) also point to the fact that there is limited access to policymakers for those who promote NbS to influence decision-making, while social entrepreneurs interviewed for the Bioregional Insights Report 2022 note that competing solutions often have stronger lobbying power (Respondent #26). NbS expert Respondent #7 supports this and argues that such power imbalances between the incumbent and new solutions are the key challenge that underlies almost all other barriers.

3. Lack of financing

Generally, a lack of financing has been reported as a key barrier to NbS implementation and scaling (e.g. Sarabi et al. 2020; McQuaid et al. 2021; Thorn et al. 2021). Experts specify that it is in fact not an absence of available funding that is the problem, but the right allocation of existing money (Respondent #1; Respondent #2; Respondent #4; Respondent #6). Because financing can happen both through public funding and through private investments, there are two sides of problems that contribute to this barrier of fund allocation. On the public funding side, both traditional cost-performance measurement systems and a high-risk perception of NbS due to longer time frames and more uncertainties were found to favour single-purpose grey infrastructure over NbS in public funding decision-making (Price 2021). Interviews with entrepreneurs and experts also confirmed that budgets are often held by departments or ministries (like Ministry of Agriculture) which often do not have a direct interest in NbS while those that do (like Ministry of the Environment), do not have power over the money (Respondent #6; Respondent #24). Furthermore, maintenance costs for NbS are considered particularly vulnerable to budget cuts and, thus, increase the risk of NbS benefits not realising fast enough before funding for maintenance is stopped (Schmalzbauer 2018).

On the private investment side, the most significant problem appears to be a misalignment between investors interests and NbS characteristics (McQuaid et al. 2021; Respondent #1; Respondent #2; Respondent #4). While investors are often looking for clearly measurable, predictable, and rather short-term results, NbS are still novel interventions needing a lot of testing, monitoring, and evaluation which increases costs and decreases predictability in returns (Schmalzbauer 2018). And even if successfully implemented, the economic, societal, and environmental impact of NbS is naturally delayed and takes long time frames to realise, creating inherent uncertainties (Respondent #2). Furthermore, data on NbS-related benefits is often limited or restricted, which makes investment decisions difficult (Price 2021). Müller et al. (2022) also point out that there is a lack of adequate financing infrastructure for large scale investments and Price (2021) notes that existing barriers in the enabling environment of NbS make them even less attractive to investors. The same applies to the fact that benefits associated with NbS can often “not be capitalised by any one party or organisation”, creating externalities that impact on risk sharing and the attractiveness of investments (Seddon et al. 2020, 8; Price 2021, 17). Finally, Müller et al. (2022) stress that the carbon market is not yet working for social innovators with NbS as compensators usually favour projects that optimise for carbon sequestration, instead of strengthening holistic ecosystem resilience (also emphasised by Respondent #8).

4. Lack of measurement

A lack of harmonised metrics for monetary and nonmonetary valuation as well as inconsistent measurement of co-benefits and design standards is another barrier that is described extensively in the literature and confirmed by experts (e.g. Müller et al. 2022; Sarabi et al. 2020; McQuaid et al. 2021; Thorn et al. 2021; Schmalzbauer 2018; Raymond et al. 2017 cited in Price 2021). Müller et al. (2022) point to the fact that natural capital and climate accounting practices are still at an early stage in their development and Seddon et al. (2020) emphasise that assessments often still fail to fully consider trade-offs between ecological and socio-economic benefits. They even argue that “simple standardized metrics of NbS effectiveness that work across different scales, or that comprehensively capture the social–ecological dimensions of effectiveness, are unlikely

to be found” and, thus, context-specific metrics will be the only way to generate reliable data (Seddon et al. 2020, 7). Both Seddon et al. (2020) and Respondent #5 suggest that the lack of adequate measurement is due to the complexity in which NbS work and the interdependence of factors that constantly fluctuate over time. This was further confirmed by Respondent #2 who stated that “[NbS] and their implementation are inherently complex, considering the range of ecosystem services, their multi-functionality, and the trade-offs between functions, and across temporal and spatial scales. This complexity makes their interests, impact, and value particularly difficult to exhaustively consider and assess.”

5. Lack of access to space

While a lack of space has been mentioned several times in the literature focussed on NbS in urban settings (e.g. Sarabi et al. 2020; Dorst et al. 2022; Thorn et al. 2021), experts have clarified during the interviews that on a landscape scale, the problem rather manifests in ownership complexities and privatisation of land and water bodies (Respondent #4; Respondent #6; Thorn et al. 2021). It is, thus, more a problem of competing interests and demands for the land than a physical lack of space. Respondent #8 has also mentioned that landowners often lack the knowledge to fully understand the benefits of NbS and, thus, do not support their implementation. Moreover, it has been highlighted that ecosystem scales often exceed land ownership, administrative boundaries, and political authority and, therefore, increase complexity around land usage (Kapos et al. 2019 cited in Price 2021).

6. Lack of knowledge

The lack of knowledge is described two-fold. Firstly, it is stated that uncertainties remain about the functionality and performance of NbS (Sarabi et al. 2020; McQuaid et al. 2021; Schmalzbauer 2018). It is suggested that while there is a lot of theoretical appraisal of the potential of NbS, practical evidence for their effectiveness, resilience, and upscaling successes is still scarce (Sarabi et al. 2020; McQuaid et al. 2021; Schmalzbauer 2018). Furthermore, information about NbS and their performance is mostly scattered and “existing evidence is often presented in such a way that is challenging for policy and decision-makers as well as the general public to understand, and frequently not in a ‘ready-to-apply’ format, or tailored to the specific local challenge” (Schmalzbauer 2018, 10). This makes it difficult for political decision-makers to adequately evaluate and compare NbS to other alternatives (Price 2021). Price (2021) also points out that the evidence base is still too poorly consolidated to make the (business) case for NbS. Secondly, the knowledge is not sufficiently disseminated through educational and training programmes which leads to professionals being educated for traditional solutions but not NbS (Sarabi et al. 2020). While validating all the above as a general problem for NbS uptake, Respondent #5 also hypothesized during the interview that academics mainly publishing on the problems of NbS and practitioners mainly talking about the successes of NbS hints at a mismatch or gap in communication that could add another factor hindering NbS success.

7. Lack of supportive mindset

The lack of supportive mindset was repeatedly mentioned by experts and practitioners during the interviews. The literature supports this through a discourse pertaining to a deeply rooted fear of the unknowns, risk aversion, and resistance to change that hinder

NbS as a new type of intervention to be scaled (Sarabi et al. 2020; Kabisch et al. 2016; Solheim et al. 2021). Interviewees pointed out how stakeholders on all levels lacked an adequate understanding of the holistic ways in which nature works and named a general detachment from nature as a core underlying condition that leads to overall underappreciation of ecosystem services and overemphasis on technological solutions to socio-ecological problems (Respondent #4; Respondent #8). Commonly mentioned was also the inherent short-termism of the human mind and, thus, a lack of capacity to think in a visionary way (Respondent #1; Respondent #4; Respondent #8). Lastly, an observed lack of willingness to learn together was brought up as a key mindset that hinders NbS implementation and scaling (Respondent #4; Respondent #8).

Appendix H provides further consolidated insights into underlying structural conditions that contribute to the seven barriers. Structural conditions are systematically embedded structures that cause barriers to emerge (compare Dorst et al. 2022).

4.1.3 Enablers as validated for the landscape level

The following list of nine enablers (Figure 4.2) has, just like the seven barriers, been validated for the landscape scale by the nine interviewed experts. Similarly to the barriers, it was suggested by all interviewees that enablers are interlinked. The linkages, however, are not the focus of this study (see Discussion section 5.1).

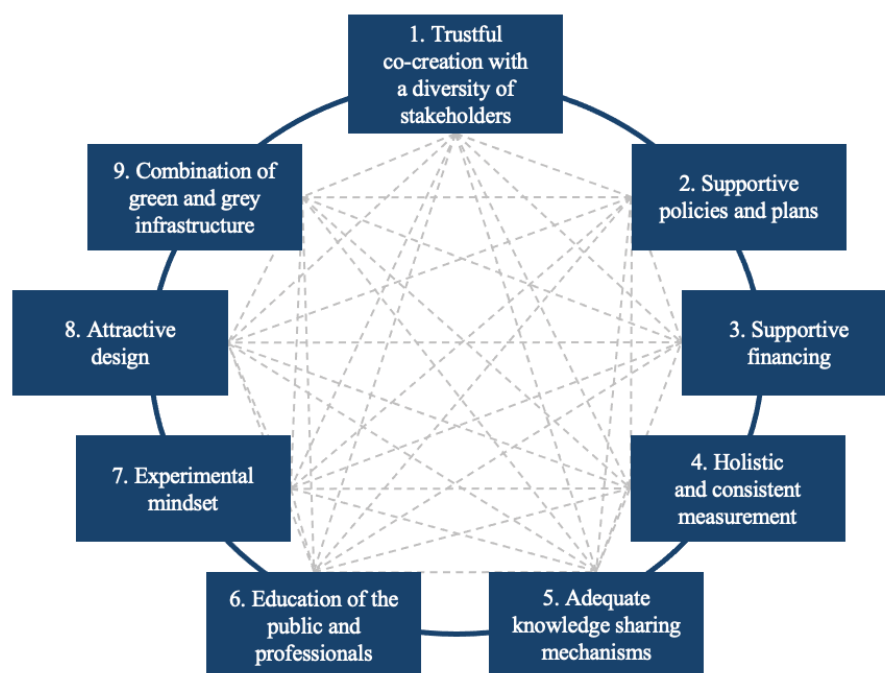


Figure 4.2. List of nine consolidated Enablers.

1. Trustful co-creation with a diversity of stakeholder groups

Synergistic partnerships among and co-creation with various stakeholder groups in planning, implementation, and maintenance is by far the most-mentioned enabler in the literature (McQuaid et al. 2021; Martin et al. 2021; Schmalzbauer 2018; Sarabi et al. 2019; Frantzeskaki 2019; Cohen-Shacham et al. 2016, Somarakis et al. 2019 and WWAP/UN-Water 2018 cited in Price 2021). The rationale for this enabling factor is multi-faceted. Sarabi et al. (2019), for example, argue that due to the multidisciplinary nature of NbS vertical and horizontal cooperation is needed to generate the multitude of benefits and outcomes that NbS have the potential to create. The authors further highlight that collaboration is critical for developing a shared vision as well as common understanding of NbS and nature in general. When a vision for the landscape is co-created with a diversity of stakeholder groups, they feel more stewardship and acceptance, trust, and connection with the project (Sarabi et al. 2019; Schmalzbauer 2018; Somarakis et al. 2019 cited in Price 2021). With an increase in public awareness around environmental and societal issues, the willingness to co-create and to legitimize efforts has risen (McQuaid et al. 2021).

Critical in this part, however, is that inclusion and equity concerns need to be considered carefully, and open dialogue needs to be established between parties to avoid domination of the process by one or few powerful parties (Sarabi et al. 2019; Schmalzbauer 2018; Somarakis et al. 2019 and WWAP/UN-Water 2018 cited in Price 2021). Innovative and participatory stakeholder co-creation processes and different fora with “inclusive narratives of mission” are suggested for this to involve affected people as early as possible in the process (Martin et al. 2021; Frantzeskaki 2019, 108). An early involvement also helps to consider, negotiate, and calibrate the diversity of goals and priorities that exist among relevant stakeholders as well as identifying potential synergies and conflicts (Schmalzbauer 2018; Somarakis et al. 2019 cited in Price 2021). Frantzeskaki (2019, 108) argues that “early scepticisms, criticism, even negativity can be turned into constructive points for improving the design and the process of planning and co-creation of a nature-based solution”. Similarly, Sarabi et al. (2019, 10) found that bringing in local and indigenous knowledge increases the likelihood of success for interventions as they become more “[tailored] to the local context”. Multi-stakeholder approaches are also said to help break path dependencies that would otherwise continue to favour known solutions and social learning can happen among local actors which, from a systems perspective, strengthens the socio-ecological resilience of a given community (Sarabi et al. 2019). Public-private partnerships have been found to support implementation and scaling by combining top-down regulation with flexibility and through complementing technical and financial resources (Schmalzbauer 2018; Sarabi et al. 2019).

But not only the trustful co-creation among different stakeholder groups is important. Martin et al. (2021) and Schmalzbauer (2018) also argue that a polycentric governance structure within organisations is critical to overcome silo-structures through cross-departmental collaborations and novel arrangements in public administration for example. Close collaborations with pro-NbS interest groups and champions can increase pressure or mobilise engagement among peers both on institutional and local community levels (Martin et al. 2021; Cohen-Shacham et al. 2016 cited in Price 2021). Sarabi et al. (2019) and Schmalzbauer (2018) explicitly highlight the critical role of transboundary actors that are not affiliated with any involved party but facilitate and coordinate between stakeholder groups. This was further emphasised by Respondent #5 who emphasised transboundary actors as the biggest leverage point for scaling enabling conditions.

2. Supportive policies and plans

Policies and political plans have an enormous steering function and can significantly influence the uptake of NbS (Sarabi et al. 2019; McQuaid et al. 2021; Somarakis et al. 2019 cited in Price 2021). Plans, acts, and legislations can empower communities to manage land in favour of NbS and can even enforce the usage of NbS (Sarabi et al. 2019). By setting and communicating international, national, regional, or local targets and plans, administrations send signals about the overall direction for development and incentivise actors to work towards those commonly agreed upon targets. Hence, a proactive and explicit policy steering towards NbS on all political levels can be a strong leverage point for NbS uptake (McQuaid et al. 2021). During the interviews for the Bioregional Weaving Lab Insights Report 2022, NbS entrepreneurs have also mentioned that debureaucratization on all governmental levels is urgently needed for NbS policies to be implemented efficiently and effectively (e.g. Respondent #25).

3. Supportive financing

The financing of NbS is closely linked to other factors such as the availability of data and policies. Again, several interviewees suggested that an absence of available funding is not the problem, but the right allocation of existing money (Respondent #1; Respondent #2; Respondent #4; Respondent #6). The two main streams of financing for NbS are public funding including economic policy instruments and private sector investments. On the public side, price-based economic instruments like fees for ecosystem services can raise funds to be invested in NbS and incentivise further investments in NbS rather than in traditional solutions (Droste et al. 2017; Martin et al. 2021). Fiscal instruments like the inclusion of ecological criteria in subsidy distribution or grants can further direct capital towards solutions that generate holistic benefits, like NbS (McQuaid et al. 2021; Droste et al. 2017). Schmalzbauer (2018) specifically emphasises the need for public-private partnerships as a means to channel private capital into NbS while providing securities through coherent and consistent policy and regulatory regime. During the expert interviews, Respondent #4 highlighted the importance of NbS projects acknowledging private sector financier's needs and interests and Respondent #1 pleaded for more digitalised and democratised financing infrastructures that distribute capital to a multitude of different solutions.

4. Holistic and consistent measurement

To improve NbS implementation and make better decisions, data is needed about NbS effectiveness and value generation (Sarabi et al. 2019; McQuaid et al. 2021; Global Commission on Adaptation 2019 cited in Price 2021). Due to the inherent multi-dimensionality of their benefits, measuring NbS is complex (Respondent #5). It requires nested multiscale assessment systems that consider and stack the holistic value that NbS create (Sarabi et al. 2019; Respondent #8). Natural capital approaches appear to be promising tools to help value nature's benefits (Price 2021). For measurement systems to be improved and harmonised, Respondent #1 points out the importance of granting developers access to data from the field and Respondent #9 emphasises the need for external support with this as those implementing NbS are often too occupied with other work so that measurement and data collection naturally fall short. With that goes a need for measurement systems to be practical and easy to use. Beyond technical measurement systems, Respondent #8 also points out the need for including local people in the measurement and building on their knowledge.

5. Adequate knowledge sharing mechanisms

As NbS are still a novel approach and high degrees of collaboration are needed for successful implementation and scaling, efficient knowledge sharing mechanisms are key. Technologies can be used to share ideas, experiences, and lessons learned across different regions and between different parties as well as getting feedback from critical stakeholders and mapping NbS issues (Sarabi et al. 2019; McQuaid et al. 2021). Frantzeskaki (2019, 108) even argues that NbS themselves should be designed in a way that “lessons for their effectiveness can be easily harvested” and replication in other locations becomes easier. Respondent #1 suggests giving others open access to data from the field once an NbS is implemented to enable collective learning. Sarabi et al. (2019) highlight that increased flows of information may also encourage more investments in NbS. The Global Commission on Adaptation (2019 cited in Price 2021) emphasises the importance of increasing both the flows of scientific and indigenous knowledge, the latter commonly having adaptive capacity and a systems perspective deeply embedded. Overall, this approach helps to speed up the uptake of NbS and increases the likelihood of success for other projects (Respondent #1).

6. Education of the public and professionals

The education of the public can decrease uncertainties and doubts regarding the functionality of NbS and catalyse public support for their implementation and scaling (Sarabi et al. 2019). The authors plead for both formal (in the classroom) and informal education (e.g. through media) in this regard. Interviewees agree with Schmalzbauer (2018) that early age education plays a critical role in the overall uptake of NbS. Specifically, Respondent #4 emphasised the need for working with the young generation to shift mindsets from “man vs. nature” to “we are nature” and Respondent #1 mentioned the importance of cultivating trust and empathy from a young age to ease multi-stakeholder collaborations later on. Sarabi et al. (2019) argue that not only the public should be educated about the NbS, also professionals need to be trained to handle both decision-making and practical work with NbS appropriately (Sarabi et al. 2019). More and more experts will be needed to plan, implement, and maintain the NbS over time (Respondent #2). Finally, Nesshöver et al. (2017 cited in Price 2021) state the need for carefully managed expectations through educating both the public and professionals about benefits, functionality, costs, and overall complexity of NbS.

7. Experimental mindset

Experimentation is not only important for iteratively finding the best strategies for NbS development and to learn from mistakes without significant losses (Sarabi et al. 2019). An experimental approach also helps to make NbS more tangible for stakeholders, decrease uncertainty, and de-risks the innovative solutions (Frantzeskaki 2019). Experiments, therefore, have the potential to invite for discussions, can alter perceptions, and build trust and appreciation among important parties (Sarabi et al. 2019; Frantzeskaki 2019). Respondent #8 argues that it can give people a way to break loose from a negative mental spiral in face of the sustainability challenge. Combined with the right knowledge sharing mechanisms, an experimental mindset can facilitate innovation diffusion through, for example, open innovation approaches (Sarabi et al. 2019). Furthermore, an experimental mindset helps individuals and organisations with learning to fail and working with the unknown (Respondent #4). Respondent #9 highlights the importance of applying this experimental mindset not only to NbS as the product but also to resources,

rules, roles, and ways of working. For an experimental mindset to be applied, Respondent #7 points out the need for a safe space in which ideas are nurtured with sufficient budget and governance protection while still being fragile.

8. Attractive design

Paying attention to the aesthetical aspects of NbS is often mentioned as a critical factor for their successful uptake by the public (Sarabi et al. 2019; Frantzeskaki 2019). Although functionality being relatively more important than aesthetics on the landscape level, interviewees confirmed that, for example in the case of grey interventions like wind turbines or coastal protection measures, aesthetics mattered as well (Respondent #1; Respondent #4; Respondent #5). Many people visit rural areas for recreational purposes and do care about the aesthetics of whatever solution is being implemented (Respondent #1). Hence, planners carefully need to consider different perspectives while planning NbS implementation.

9. Combination of green and grey infrastructure

While mainly mentioned in the literature for NbS in urban settings (Sarabi et al. 2019; Martin et al. 2021), a combination of green and grey infrastructure also seems important on a landscape level, as supported by several expert interviewees (e.g. Respondent #4 and Respondent #6). Despite being less dominant in rural settings, combining existing grey infrastructure with natural solutions can help break path dependencies towards grey infrastructure options and ease the way for NbS to become more widespread. Particularly in the fields of water management and energy, the combination was highlighted as a promising enabler.

Appendix I provides consolidated insights into the respective rationale for why the given enabler helps NbS to scale.

4.2 What is *Weaving* and what are *Weaving* practices?

Whilst *Weaving* is being used in practical applications such as the BWL collective, it is a relatively new term in the scientific literature. Scientific articles pertaining to *Weaving* in the sustainability context were first published in 1995 by Starik et al. (1995), after which 22 articles were found. 12 studies were deemed relevant for this study based on their relevance to sustainability. None of the said articles clearly define the concept of *Weaving*. To build a common understanding around *Weaving* and position it in the larger sustainability context, the mentioned rapid literature review on *Weaving* and associated terms was performed and expert interviews with academics and practitioners were conducted. This process allowed for an iterative approach of reviewing, synthesising, and improving the specified term. The following provides insights into the findings.

4.2.1 Weaving as portrayed in the Literature

Knowledge weaving

“*Weaving*” is described as ‘Weaving knowledge systems’, especially in the context of ‘braiding’ or ‘bridging’ indigenous and scientific knowledge systems (Cavanaugh, Saa, and Cheney 2002; Johnson et al. 2015; Tengö et al. 2017; Dreise and Mazursk 2018; Alexander et al. 2019; Hopkins et al. 2019; Malmer et al. 2020; Wilkinson et al. 2020; Henri et al. 2021; Ryder et al. 2019). As there have been critiques on suggesting the assimilation of Indigenous Knowledge Systems into a dominant and overarching Western scientific paradigm, *Weaving* moves beyond the narrative of ‘integrating’, ‘incorporating’ or combining knowledge systems (Johnson et al. 2015; Henri et al. 2021, 2). Instead of blending drops of knowledge into a uniform ocean, *Weaving* braids multiple strands of knowledge together whilst maintaining the integrity of each knowledge system (Kimmerer 2013; Tengö et al. 2017; Wilkinson et al. 2020; Chambers et al. 2022). Henri et al. (2021, 2) defines ‘Weaving knowledge systems’ as “a process through which multiple types of knowledge are equitably brought together to enable the reciprocal exchange of understanding for mutual learning and application”. An example of *Weaving* knowledge systems is the Multiple Evidence Base approach (see Figure 4.3), where diverse knowledge systems go beyond integrating knowledge and contribute to an enriched picture that can serve as a legitimate starting point for further analysis and knowledge generation (Tengö et al. 2014). Thus, *Weaving* is a means to respect the integrity of each knowledge system (Tengö et al. 2017; Johnson et al. 2015; Tengö et al. 2014; de Moor 2015).

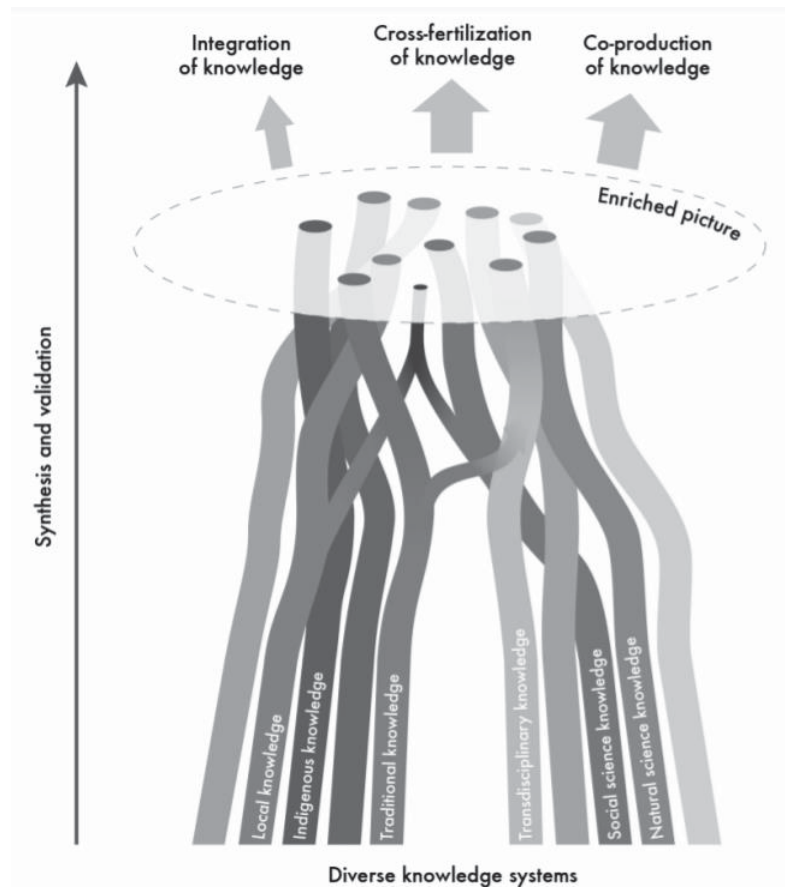


Figure 4.3. The Multiple Evidence Base approach (Tengö et al. 2014).

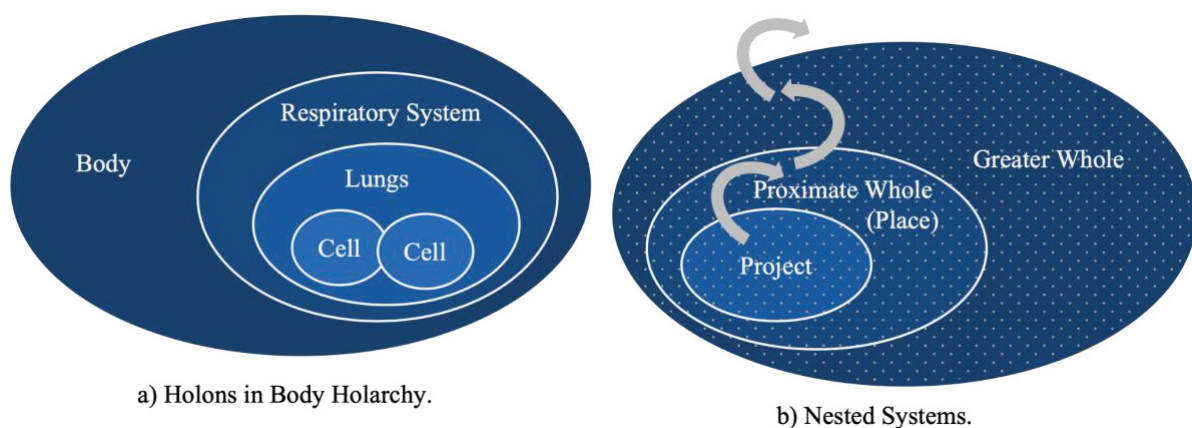
Network Weaving

Another type of *Weaving* is ‘*Network Weaving*’ or ‘*Netweaving*’ (Holley 2012; Vance-Borland and Holley 2011; Krebs and Holley 2006; Goldstein et al. 2018). A network weaver is a well-connected network facilitator who is aware of the networks around them and explicitly works to make them healthier (Krebs and Holley 2006; Goldstein et al. 2018). Network weavers do this by helping people identify and strategically form mutual relationships, circulating ideas and practices, promoting a shared identity that provides the foundation for a common practice and purpose as well as serving as a catalyst for self-organising groups (Goldstein et al. 2017; 2018). Besides netweavers, there are other concepts that describe leaders who use non-hierarchical means to knit together human dynamics and structural realities of a network, e.g. transformational leadership (Goldstein et al. 2018), collaborative capacity builders (Weber and Khademian 2008), process catalysts and systems conveners (Wenger-Trayner and Wenger-Trayner 2015). Network weavers also show considerable similarities to ‘*Transformation Catalysts*’, which are entities that “work catalytically with actors in a transformation system (T-system) to enhance their collective speed and ability to address the complexity and scale associated with transformation” (Waddock and Waddell 2021, 169). Transformation catalysts are one of the latest evolutions of collaborative or participatory approaches (Waddock and Waddell 2021), succeeding, for example, multi-stakeholder partnerships and cross-sector collaborations (Waddell 2005; Selsky and Parker 2005), Global Action Networks (Waddell 2005), catalytic alliances (Waddock and Post 1991; 1995), field catalysts (Hussein, Plummer, and Breen 2018), and innovation brokers or intermediaries (Klerkx, Hall, and Leeuwis 2009;

Klerkx, Aarts, and Leeuwis 2010). What makes Network Weaving unique is the distinct focus on systemic transformation, orientation to weaving together already existing and potentially emerging initiatives, and the use of a metaphor (Waddock and Waddell 2021). The definitions and distinctions of these related terms on multi-level collaboration are shown in Appendix J.

Holonic Weaving

Weaving does not only happen within, between or across networks (Goldstein et al. 2017). *Weaving* happens at various levels, within, between and across various boundaries of socio-ecological systems (Lee and Waddock 2021). Socio-ecological systems consist of numerous interacting subsystems, or ‘*holons*’ – something that is an autonomous whole in itself, while being part of a larger whole (Koestler 1967; Broman and Robèrt 2017; Benne and Mang 2015; Fischer et al. 2015). Holons are connected in a nested hierarchy of other holons, a ‘*holarchy*’, which is a fundamental quality of the architecture of living systems (Koestler 1967; Benne and Mang 2015; Smitsman, Baue, and Thurm 2021). Engineers describe a holarchy as a “*system of systems*” (Maier 1998, 267), whilst ecologists call it a “*panarchy*” (Allen et al. 2014; Gotts 2007; Holling 2004). Living systems depend upon connections through different levels of biological organisation, and these connections are always immediate and nearby, going from local to global: “*There is an unbroken continuum from cell to organism to the larger ecosystem and beyond to the bioregion and on again ultimately to the whole planet*” (Todd and Todd 1993, 25). Because of the essential interdependence of holons, the health of one holon influences the health of the whole, as is shown in Figure 4.4 (Benne and Mang 2015). Transformation approaches towards sustainability often do not sufficiently link processes of change at the micro level to deep leverages of change in wider system structures, causing ‘*spatial scale mismatches*’ (Folke 2006; Pelosi, Goulard, and Balent 2010; Barnes et al. 2017; Sayles and Baggio 2017; Sievers-Glotzbach and Tschersich 2019). There are often spatial mismatches between social systems and ecological and biophysical patterns due to either low landscape or socio-ecological connectivity (Bodin and Tengö 2012; Bergsten, Galafassi, and Bodin 2014; Sayles and Baggio 2017; Cumming, Cumming, and Redman 2006). The socio-ecological connectivity links the structure and function of networks at the landscape scale and can inform how landscape-scale networks can support the interdependent human wellbeing and ecological resilience (Mitchell, Bennett, and Gonzalez 2013; Frazier et al. 2019; Borgström 2019; Egerer and Anderson 2020).



*Figure 4.4. Holons in Body Holarchy and Nested Systems
(adapted from Benne and Mang 2015).*

4.2.2 Relation to other Leadership practices

Similarities with other leadership practices

Weaving is an emerging leadership practice that shows many similarities to other sustainability-focused leadership practices such as liminal leadership, systems and systemic leadership, integral or regenerative leadership to only name a few (Spencer-Keyes, Luksha, and Cubista 2020; Respondent #10; Respondent #16; Respondent #20). These practices are both evolutionary and developmental in their approach to shift the behavioural paradigms of industrial, competitive, command-and-control types of leadership, towards ones which act in more collaborative and co-creative manner, facilitating networks and communities to work and learn together (Spencer-Keyes, Luksha, and Cubista 2020; Respondent #10; Respondent #16; Respondent #20). Rather than approaching the challenges with a siloed and mechanistic mindset, leadership practices such as *Weaving* strategically connect diverse groups of actors in their pursuit to engage with the challenges at hand (Respondent #10). In doing so, they cross an ontological threshold in how they orientate themselves around complexity (Respondent #16). An overview of these leadership practices can be found in Appendix K.

A shared Narrative that Binds People

An emerging theme from the data was the use of *Weaving* as a metaphor and narrative to evoke “social imagination” (Respondent #17) and mobilise change (Respondent #1). Respondent #17 shared that “the whole beauty of Weaving is that it's a metaphor. Every human can understand metaphors and learn from them”. *Weaving* practitioners often linked *Weaving* to recurring patterns of nature or life like spirals and fractals (Respondent #10; Respondent #16; Respondent #20). Some natural metaphors that were used to describe *Weaving* are “the mycelium in a forest ecosystem” (Respondent #10), “cultivating the social soil” (Respondent #20), “nurturing the roots of trustful relationships” (Respondent #20), “weaving a relational web” (Respondent #10, Respondent #17), “braiding sweetgrass” (Respondent #21), “braiding river streams” (Respondent #20), or “radiating waves of energy” (Respondent #20). Cultural metaphors that were used are “knitting networks”, “stitching together the broken strands” (Hawken 2021), “weaving a relational tapestry” or “weaving a social fabric” (Respondent #10), where individual threads with a diversity of colours, materials, and sizes are woven into a variety of patterns that together form a greater whole (Respondent #15; Respondent #21). One respondent mentioned that *Weaving* can also be described as solving a jigsaw puzzle, realizing that the puzzle pieces (i.e. *solutions*) we need are there, but need to be integrated and connected into a greater whole (Respondent #14). Respondent #10 said that “scientific terms like partnership brokering and systems innovation do not seem to touch a wide range of people while *Weaving* brings more soul and aliveness that people seem to feel attracted to and seem to identify with”. The term has “a certain elegance and poetry to it” (Respondent #10) and it allows for a “sense of translation” beyond the academic field (Respondent #12) that everyone can bring their own meaning and motivation to. Interviewees highlighted how the *Weaving* terminology unites and inspires a community of practice and a sense of identity, functioning as “a strange attractor” (Respondent #10; Respondent #13; Respondent #20). Thus, the term *Weaving* can be seen as a powerful sense making tool (de Moor 2015) that evokes an embodied narrative of connectedness to others, to nature and the system as a whole. The following images represent some of the emerging metaphors (see Figure 4.5).

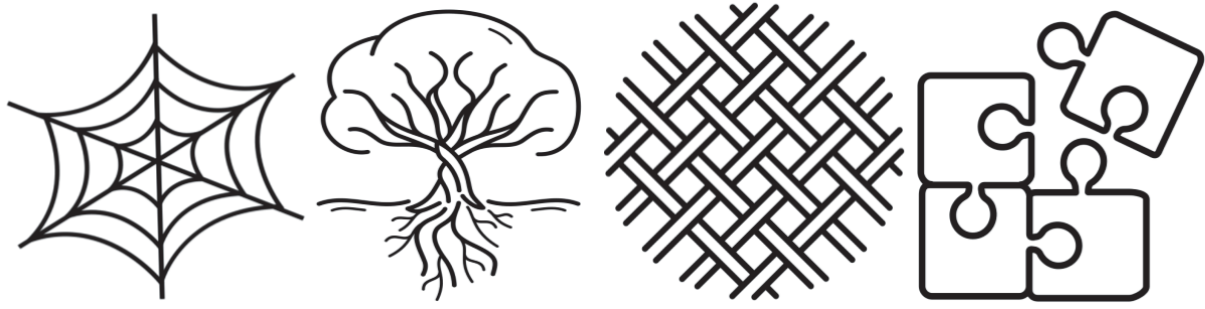


Figure 4.5. *Weaving Metaphors* (From *Visual Glow*, Olena Panasovska, Oleksandr Panasovskyi, and Akriti Bhusal).

A Working Definition for ‘Weaving’

When asked to define *Weaving*, interviewees often described it as “fluid”, “amorphous”, or “organic” (Respondent #17; Respondent #20), emphasising that the terminology of *Weaving* is constantly evolving and that there is no single definition that works for everyone (Respondent #10; Respondent #14; Respondent #17; Respondent #20; Respondent #21). Whilst they found it difficult to specifically define *Weaving*, there were some recurring themes and patterns that surfaced during the interviews. Firstly, *Weaving* is seen as a set of interrelated practices or as a “dynamic”, “iterative”, “cyclical” or “spirally”, rather than a linear process (Respondent #15; Respondent #16; Respondent #20). There is no step-by-step process that can be followed, as *Weaving* is highly context-dependent, and requires “continual pivoting and adaptation” depending on everchanging local needs (Respondent #20). Secondly, *Weaving* involves cultivating meaningful relationships for synergistic purposes (Respondent #10; Respondent #15; Respondent #16; Respondent #20). Thirdly, in accordance with a holarchy, *Weaving* happens within, between and across different scales of socio-ecological systems (Respondent #10; Respondent #15; Respondent #20). These themes led to the formation of the following working definition: “*Weaving is the practice of cultivating meaningful relationships within, between and across socio-ecological systems for synergistic purposes*”.

‘Weaving’ as used in the example of BWL

In the context of BWL, a bioregion is a holon: a whole in itself, while being part of a greater whole (most notably planet Earth). The bioregional holon consists of local holons of interconnected communities, which subsequently consist of interconnected holons of individuals. *Weaving* happens in accordance with this holarchy; complex interaction happens within, between and across the boundaries of subsystems, both vertically and horizontally. Horizontal *Weaving* is the interaction on the same level of the hierarchy, i.e. the interaction between different bioregions, communities or individuals. Vertical *Weaving* is the interaction from one hierarchy to the other, i.e. from individual to community, from community to bioregion, from bioregion to community, or from community to the individual (see Figure 4.6).

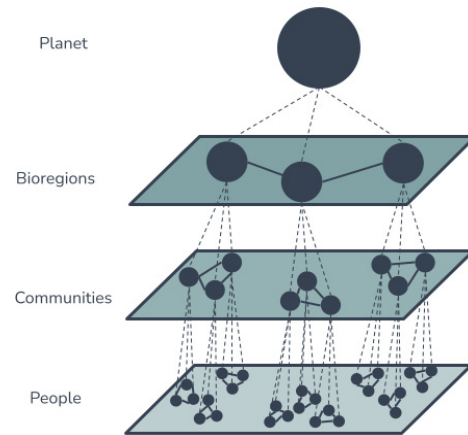


Figure 4.6. *Weaving Hierarchy in BWLs.*

According to the BWL collective, *Weaving* is an emerging leadership practice aimed at creating thriving communities, continuously aligning, learning, and collaborating toward a shared purpose (Müller et al. 2022). The Weaving Lab, the main contributor to the concept of *Weaving* within BWL, defines it as “the practice of interconnecting people, projects and places in synergistic and purposeful ways” (The Weaving Lab n.d.). The BWL collective distinguishes the concept of *Weaving* into three dimensions (see Figure 4.7).



Figure 4.7. *Nested dimensions of the concept of Weaving.*

A “weaver” holds certain leadership capacities that allow them to facilitate and “hold the space for the practice of *Weaving*” (Respondent #15). These *Weaving* capacities can be clustered into four key dimensions: (1) connecting people to each other and to a shared purpose, (2) fostering collaborations for systemic impact, (3) facilitating collective learning, iteration, and evolution, and (4) embodying universal wellbeing (Müller et al. 2022). *Weaving* is then conducted by the weaver who performs certain *Weaving* practices. Lastly the BWL are seen as a container to “hold the space” in which the weaver and the *Weaving* practices are held and can flourish (Respondent #15; Respondent #16).

4.2.3 Weaving practices

Weaving practices were a prominent theme that emerged through the interview process, prompting the researchers to further develop Conceptual Framework II with an additional literature review and expert interviews. The *Weaving* practices refer to the activities or actions that weavers do, which together have the potential of bringing about systemic change towards sustainability. Thus, they are all interrelated and interdependent and cannot be seen in isolation (Figure 4.8).

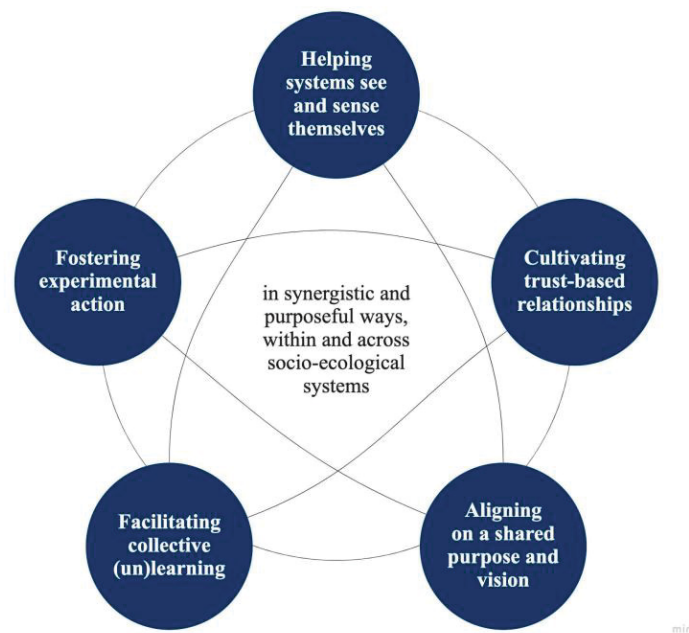


Figure 4.8. Five interrelated Weaving Practices.

1. Helping systems see and sense themselves

Weavers initiate and support systems to see and sense themselves. This implies that they help people see themselves as part of a larger system in order to better understand the dynamics of these complex socio-ecological systems (Respondent #10; Respondent #15; Respondent #16; Waddock and Waddell 2021). Through this systems perspective, weavers allow actors to better understand their own role in catalysing systems change and the identification of potential leverage points that can lead to large-scale and fundamental changes (Lee and Waddock 2021; Respondent #10; Respondent #15; Respondent #16; Respondent #20; Respondent #21). Seeing and sensing systems can be done informally, for example, through facilitating dialogues with key stakeholders (Waddock and Waddell 2021). A more structured and rigorous approach is also possible through participatory mapping processes with tools such as systems mapping, data analysis and visualizing, network mapping, and social network analysis (de Moor 2018; Waddock and Waddell 2021; Krebs and Holley 2006; Respondent #18).

2. Cultivating trust-based relationships

Weavers shed light on the potential for synergy and actively cultivate trust-based relationships. When weavers help people become more aware of the systems around them, they enable them to better see the potential of mutual benefit within those systems (Vance-Borland and Holley 2011). A weaver strategically ‘illuminates’ this potential for synergy to the wider system, so that a mutualistic relationship between key actors can organically arise or be strengthened (Respondent #10; Respondent #19; Vance-Borland and Holley 2011; Krebs and Holley 2006; Waddock and Waddell 2021; Holley 2012). Additionally, weavers actively create the conditions for fostering deep and meaningful relationships. For example, they facilitate generative dialogues and deep listening practices as well as sensing into what wants to emerge (Respondent #12; Respondent #15; Respondent #16; Respondent #19; Respondent #20; Spencer-Keyes, Luksha, and Cubista 2020). Weavers specifically focus on cultivating relationships based on trust, as trust is the foundation for creating thriving networks and sustaining socio-ecological systems (Respondent #10; Respondent #12; Respondent #20; Ehrlichman, Sawyer, and Spence 2018; Röbbke 2020; Missimer, Robèrt, and Broman 2017). Cultivating trust-based relationships is something deeply human and cannot be mechanised (Respondent #13; Respondent #15). Like Wheatley (1999, 145) said: “If we are interested in effecting change, it is crucial to remember that we are working within webs of relations, not with machines”.

3. Aligning on a shared purpose and vision

Weavers help people align and connect to a shared purpose and vision. This alignment provides the foundation for a common practice and a shared understanding (Goldstein et al. 2017; Respondent #21). Weavers help bring initiatives into alignment, for example, by co-creating or collaboratively uncovering a shared intention, aspiration, identity, purpose, vision, narrative or set of values (Meadows 1999; Goldstein et al. 2017; Waddock and Waddell 2021; Röbbke 2020; Respondent #19; Respondent #20; Respondent #21). Moreover, weavers help communicate the shared visions through crafting, articulating, and framing these visions in powerful narratives, stories, images, and other symbols (Klerkx, Aarts, and Leeuwis 2010; Waddock and Waddell 2021). Frequently mentioned purposes revolved around universal wellbeing, the regeneration of life, a story of love, the evolution of complex systems, or co-creating thriving communities and ecosystems (Respondent #10; Respondent #20; Respondent #21).

4. Fostering experimental action

Weavers foster experimental action for collective impact. Weavers create “safe” and “brave spaces” for others that encourage rapid experimentation and invite questioning, exploring, and analysing assumptions (Respondent #14; Respondent #15; Waddock and Waddell 2021; Goldstein et al. 2018). Weavers specifically foster experimental actions that could bring about large-scale and fundamental change, as opposed to incremental or fragmented approaches (Lee and Waddock 2021; Respondent #20). This requires nurturing “courage”, “action-confidence”, and a “sense of agency” (Respondent #14; Respondent #15; Respondent #17; Röbbke 2020). An example of fostering experimentation is using ‘rapid prototyping’ with a design-thinking logic to facilitate quick action-learning cycles (Waddock and Waddell 2021). Weavers also experiment with different approaches or methods for relationship building or collaboration methods,

realising every process is highly context dependent and requires continuous adaptation and iteration (Goldstein et al. 2017; Respondent #20). Besides fostering experimental action, weavers foster collaborative actions, for example through interconnecting already existing projects to create mutually reinforcing outcomes (Respondent #10; Respondent #20). Even though weavers generally catalyse innovation, they also have an openness to using what already exists (Respondent #20).

5. Facilitating collective (un)learning

Weavers facilitate collective learning and unlearning. They continually share and make sense of what has been learned from the experiments to the wider system, to support collective learning and conscious evolution (Waddock and Waddell 2021; Rübke 2020; Respondent #20). Weavers are aware of the information, knowledge, and ideas that are already present in the system, and subsequently open, aggregate, and direct these flows of information to the right places at the right time (Waddock and Waddell 2021; Goldstein, Smith, and Ryan 2021; Goldstein et al. 2018; Respondent #16; Respondent #18; Respondent #20). Weavers can have a curatorial role, enabling people to navigate complexity and information overload more effectively (Kampelmann, Kaethler, and Hill 2018). Sharing knowledge, information or ideas can be done in numerous ways, for example through storytelling, arts, events or digital community platforms (Respondent #10; Respondent #11; Respondent #14; Respondent #17). Besides opening and directing the flow of information, weavers help co-produce new knowledge (Chambers et al. 2021). Weavers, for example, help diverse knowledge systems collaboratively mobilise, translate, negotiate, synthesise, and apply multiple types of knowledge to create a shared and coherent understanding (Tengö et al. 2017; Respondent #10; Respondent #20). This does not only involve learning, but also unlearning, as weaving knowledge often requires “*a softening of the ego*” or a “*beginners mind*” of the people involved, enabling them to let go of preconceived ideas or models and being more open to the collective possibility (Respondent #10; Respondent #14; Respondent #15; Respondent #16; Respondent #20).

5 Discussion

The data collection phase resulted in rich results and findings for both sub questions as presented above. In the following chapter, these results will be discussed and placed in the wider context of society's transition towards sustainability.

5.1 Discussion on barriers and enablers to scaling NbS

If the world wants to move towards sustainable development, solutions to complex problems need to be built *with* nature and cannot rely solely on technical solutions. Especially in landscape and ecosystem regeneration, which are utterly complex, solutions are needed that match the complexity of the problem they are aiming to solve. The human intellect will likely not suffice to restore complex water cycles, food webs or soil fertility to name only a few. Beyond providing a systemic approach, nature-based solutions have the potential to change mindsets about what is defined as success for a desired future as people practically see and get involved in the design of future-fit solutions. Donella Meadows (1999) famously identified shifting mindsets as one of the most effective leverage points to intervene in a system. Particularly as used in BWLs, NbS can be used to shift current human-nature paradigms towards an understanding that “We are Nature” which is strategically critical to advancing towards planetary regeneration. Nature-based solutions, however, can only unfold sufficient potential for regeneration if they are scaled to the landscape level. In urban settings, NbS are often implemented as stand-alone and fragmented interventions that provide co-benefits locally and contribute to adaptation (e.g. cooling in busy streets and flood prevention) rather than regeneration. Increasing the scale and complexity to the landscape or bioregional level allows for more holistic co-benefits as NbS are integrated in natural ecosystems and they become more interconnected. This way, large carbon sinks and biodiversity hubs can emerge which are not possible in small-scale, fragmented urban settings.

While NbS on the landscape level have a significant potential to help mankind strategically overcome sustainability issues, human systems and constructs like legislations and power structures inhibit these high-potential solutions from being implemented widely. To name only one example, several barriers (e.g. *a lack of collaboration, supportive policies, public financing, and access to space*) on the landscape level are fostered by the man-made fragmentation of responsibilities in public administrations as depicted in Figure 5.1. Herrick et al. (2019, 126) highlight that “[c]onventional planning and policy decisions for natural resources in different parts of a landscape are siloed in different ministries and discussed with different stakeholders. Yet critical ecosystem services, such as water flow and storage, movement of pollinators and wild plant species do not respect these artificial boundaries, nor do many degradation processes, such as soil erosion, nor economic and social flows and interactions.”



Figure 5.1. Fragmentation of Responsibility on the Landscape Scale (Herrick et al. 2019).

The findings of this research confirm that, with current barriers (like the fragmentation of responsibility) so structurally rooted and deeply interwoven, the global society is realistically still far from a more sustainable trajectory, let alone reaching sustainability as defined by the eight Sustainability Principles (Broman and Robèrt 2017). The complexity of NbS as a tool is an underlying issue that has been mentioned again and again causing many of the barriers. At the same time, it has been portrayed as the beauty of NbS that inherently provides a more holistic view and forces those implementing them to think in interconnected systems.

‘Lacking alignment’ and ‘no shared vision among key stakeholders’ have emerged as an underlying theme with many ripple effects on other identified barriers. The *lack of supportive policies, financing, measurement, and access to space*, for example, can in part be attributed to this lack of shared vision and alignment. Hence, bringing relevant parties together seems to be a powerful leverage point to tackle underlying conditions for other barriers that appear more like symptoms. Similarly, power imbalances have been pointed out as an overarching barrier and fundamental structural condition that hinders the implementation of pro-NbS policies and supportive financing structures as well as holistic measurement and adequate knowledge dissemination. Building trust and safe spaces for new ideas have been emphasised as underlying enablers that can counteract several structural conditions that underpin important barriers.

Overall, the identified barriers and enablers can be clustered into those that describe *what* is lacking or needs to be created and those indicating *how* the work needs to be done (see Table 5.1).

Table 5.1. WHAT- and HOW-Barriers and Enablers to scaling NbS to the landscape level.

WHAT		HOW	
Barriers	Enablers	Barriers	Enablers
<ul style="list-style-type: none"> • Lack of supportive policies • Lack of financing • Lack of measurement • Lack of access to space • Lack of knowledge 	<ul style="list-style-type: none"> • Supportive policies • Supportive financing • Holistic and consistent measurement • Education of the public and professionals • Attractive design 	<ul style="list-style-type: none"> • Lack of collaboration • Lack of supportive mindset 	<ul style="list-style-type: none"> • Trustful co-creation with a diversity of stakeholder groups • Adequate knowledge sharing mechanisms • Experimental mindset • Combination of green and grey infrastructure

Controversially discussed by experts were the barrier, *lack of access to space* and the enablers, *attractive design* and *combination of green and grey infrastructure*. All of which were at first glance mainly attributed to urban spaces as opposed to the landscape level. Several interviewees (Respondent #1; Respondent #3; Respondent #4; Respondent #5; Respondent #6), however, presented strong arguments for why those should also be included when referring to the landscape level (see explanation of barriers and enablers in sections 4.1.2 and 4.1.3).

While the researchers acknowledge that the identification of barriers and enablers for scaling NbS is much less complicated than overcoming barriers or applying enablers in practice, they would like to emphasise the importance of illuminating problem areas as a means to grow awareness and build knowledge that is necessary to intentionally and strategically address problems. With more knowledge being built on barriers and enablers, available energy and other resources can be allocated in much more directed and effective ways. On this note, further research is recommended in several areas.

Firstly, fundamental structural differences between urban and landscape settings should be assessed again to then compare barriers and enablers based on those differences. Such differences could include but are not limited to differences in institutional structures (e.g. authorities and land ownership), social structures (e.g. relevant stakeholders and expectations), and physical settings (e.g. complexity of geography and ecology). More thorough analyses should validate the established lists of barriers and enablers for both their existence and quality in the given surrounding (urban vs. landscape). Interviewees, for example, pointed out that while ‘knowledge uncertainties’ exist in both urban and landscape settings, the quality of these uncertainties can be vastly different (Respondent #3).

Secondly, the fact that barriers and enablers are generally highly interrelated and some of them very context-dependent has been established in the literature (e.g. Sarabi et al. 2020), confirmed by all interviewed experts, and is exemplified in Figure 5.1. However, there are differences in the strength of the respective connections (Sarabi et al. 2020) and barriers like a *lack of knowledge* or a *lack of measurement* appear to be less context-dependent than others like a *lack of supportive policies* or a *lack of financing* (Respondent #2). Due to scope and time constraints, this matter was not explored further in the present research and leaves a gap for future studies to investigate the degrees of context-dependency and interrelation for each barrier and enabler.

While this research does explicitly not suggest any hierarchy of the barriers and enablers in a general context, potential priority-assessments for respective local contexts could be useful to make the generic list more actionable in a given location.

Thirdly, while lists of barriers and enablers are important, they often only highlight symptoms of problems that are rooted more deeply. The underlying structural conditions for barriers and concrete supportive actions for enablers are the real leverage points for systemic change. Hence, more research should be conducted on these layers that underlie the broad list of seven barriers and nine enablers (see Appendix B for the layers).

Additionally, action or transdisciplinary research should be conducted to scientifically support practitioners in overcoming identified barriers. Studies on cases like the BWL collective, once the labs are more established, can help to extract scientific knowledge from practical learnings and insights in a specific setting to make them accessible and applicable to a broader audience.

Finally, the relationship between the barriers and the enablers side should be the focus of further research. There seems to be an apparent overlap between barriers and enablers which, in some cases might suggest that they are two sides of the same coin. Further research is required to understand whether enablers simply solve for the barriers or if some enablers advance NbS uptake without necessarily addressing any barrier directly.

5.2 Discussion on *Weaving* and *Weaving* practices

This research tried to craft a practical working definition for *Weaving*, which remains a work in progress and requires further investments of time and energy from a diversity of stakeholders. As *Weaving* was found to be an emerging concept, practitioners seemed to favour not to box the term by a specific definition and leave it open as a living term that evolves with time and the progression of the practice (Respondent #17). However, not defining *Weaving* in clear terms might be an unrecognised obstacle that hinders practitioners from aligning on a shared vision that makes their efforts more coherent and effective. Thereby the working definition of *Weaving* as a “*practice of cultivating meaningful relationships, within, between and across socio-ecological systems for synergistic purposes*” can hopefully serve as a practical steppingstone to create more alignment around the concept and spur further evolution of the practice in different contexts. The process of defining *Weaving* and “naming” it as an important new approach to leading in complexity can help connect weavers into a nourishing community of practice that, together, can illuminate seeds of a more sustainable system (depicted by the parabola opened upwards in Figure 5.2) while gracefully hospicing the old, unsustainable system (depicted by the parabola opened downwards in Figure 5.2) (Wheatley and Frieze 2006; Respondent #20).

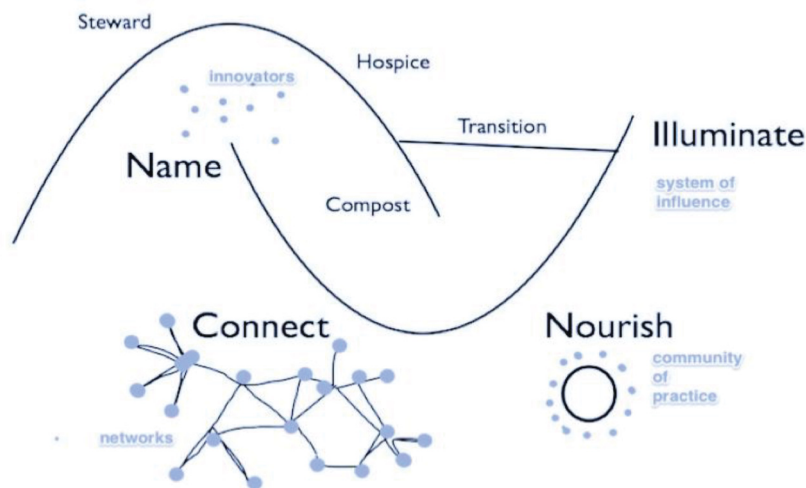


Figure 5.2. The Berkana Two Loops Model (Bond 2017, based on Wheatley and Frieze 2006).

Weaving happens in accordance with a nested holarchy, linking local systems up to the global and vice versa, through both horizontal and vertical interactions. *Weaving* can, for example, help establish vertical connections between grassroots actors and policymakers, which are often missing (Respondent #20). Holonic *Weaving* practices that link different scales can also help overcome spatial scale mismatches, e.g. through aligning governance with the local culture and ecological and biophysical patterns of a place. Furthermore, whilst *Weaving* has the potential to improve the ‘landscape’ or ‘socio-ecological connectivity’, *Weaving* practices often focus on improving social connectivity (e.g. through communication, collaboration, and knowledge exchange). Besides a social awareness, a sense of place is vital, as this fosters people’s connection to land and culture that can trigger a collective sense of responsibility, action and hope (Masterson et al. 2019; Mehmood et al. 2019; Ruggeri 2020; Ferwerda 2016; Dudley et al. 2021). To not look at connectivity with a siloed approach, more attention should be placed on integrating ecological and social connectivity, and thus focusing on the socio-ecological interactions through a place-based approach.

Weaving as an emerging leadership practice holds many similarities to a growing field of other leadership paradigms aiming to shift from mechanical and linear means of working to ones that are responsive to the changing conditions of its environment. Instead of using a command-and-control approach, these leadership practices aim to sense into the systems and respond not to a symptom, but rather the underlying structural conditions that hold the system in place. They help to move away from the siloed and fragmented approaches of the past to ones in which they cohere change-making efforts and foster the conditions for innovation and experimentation. By doing so, they strategically build resilience and cultivate an adaptive responsiveness in the system that is better equipped to address the complex challenges of the 21st century.

Whilst not yet distinguished as a unique leadership practice, one distinctive characteristic of *Weaving* is its focus on cultivating relationships between actors, within and across systems. *Weaving* can be viewed as an umbrella term for other relational leadership practices (Respondent #20; Kinder et al. 2021). Relational approaches like *Weaving* allow for more holistic and dynamic analyses of human-nature connectedness and can generate sustainability

interventions that nurture relationships in place and practice (West et al. 2020; Goodchild and Li 2021). Whereas the emergence of relational practices is relatively new to sustainability science, the *Weaving* experts indicated that it was a skill set that must be cultivated within a weaver (Respondent #15). The skills were specifically classified as capacities of a weaver that enabled them to conduct the *Weaving* practices. Such capacities were centred around weavers' abilities to practice deep listening, nurture meaningful relationships, and connect to themselves as well as others. As Respondent #14 pointed out "if you do the *Weaving* practices without the *Weaving* capacities it is merely transactional". This leads to the understanding that by building upon the *Weaving* capacities that are deeply related to relational aspects to oneself and others, a weaver is able to bridge the gap between the knowledge of a practice and the value-based embodiment of it.

Another seemingly distinct characteristic of *Weaving* is its power for sense- and meaning making. Metaphors such as *Weaving* can profoundly influence how we conceptualise and act on important societal issues (Thibodeau and Boroditsky 2011; de Moor 2015; Copeland and de Moor 2018) helping to simplify and grasp the interconnected nature of the complex evolving systems (Respondent #13). As a metaphor, *Weaving* holds a distinctive allure to evoke social imagination and mobilise change. In a time of fragmentation, *Weaving* can provide a "return on inspiration, return on hope and trust in the system" (Respondent #14). *Weaving* evokes a sense of unification and embodies a tapestry of how we see ourselves intertwined in the systems rather than apart. The *Weaving* metaphors embody the "story of interbeing" by acknowledging our relational nature and fundamental interdependence with all of life, which are often used in indigenous cultures (Nhat Hanh 1988, 3; Wahl 2016; Eisenstein 2013, 15; Respondent #20). Acting to connect people more deeply to themselves, each other, nature, and to a shared purpose. Some practitioners mentioned the need for simple language (non-academic and non-jargon) to connect with people on the ground like farmers and local entrepreneurs to engage them in co-creating visions and solutions for their communities. It should be noted that this research was mainly conducted with experts and practitioners who are actively using the term. It remains unknown whether the *Weaving* narrative or metaphor would also resonate outside of the BWL context.

In cultivating the shift towards sustainable development, five key *Weaving* practices were identified as important and synthesised into a coherent framework that portrays how they are interrelated and interdependent (e.g. *fostering experimental action* cannot be achieved without *cultivating trust-based relationships*, *making sense of the relevant system* and *alignment on a shared purpose*). The process of *Weaving* is not linear, nor is it bounded by specific frameworks like Theory U (Respondent #15; Respondent #20). Instead, different frameworks and processes are woven together into a tapestry of different methods, depending on the context and local needs. This emergent and organic approach makes *Weaving* more intuitive and flexible than rigid approaches, where *Weaving* practitioners are continually sensing into what the system needs (Respondent #16). Practitioners also stressed that these practices cannot all be put on one person, as this would be unrealistic or could lead to burnout (Respondent #10; Respondent #14). This is not only due to the magnitude and complexity of the work but also to the skills and capacities it requires.

Weaving has the potential to increase the adaptive capacity of social systems, as the *Weaving* practices align well with the essential aspects of social sustainability. As mentioned in the introduction, the essential aspects of complex adaptive social systems that need to be sustained for people to meet their needs are trust, common meaning, diversity, capacity for learning, and

capacity for self-organisation (Missimer, Robèrt, and Broman 2017). The *Weaving* practices of *cultivating trust-based relationships*, *aligning on a common purpose or vision*, *facilitating collective (un)learning*, and *fostering experimental action* directly address the essential societal needs for trust, common meaning, and the capacity for learning and self-organisation. Whilst the *Weaving* practices do not link directly to diversity as a core aspect of adaptive capacity, diversity is somewhat represented in *facilitating collective (un)learning*, through weaving together diverse knowledge systems. One could, however, suggest that diversity should be placed at the forefront of *Weaving* practices, as diverse and inclusive collaborations are key for fostering sustainability transformations (Abson et al. 2017; Baumgärtner et al. 2008; Clark and Dickson 2003; Hadorn et al. 2006; Robert W. Kates 2011; Lang et al. 2012; Martens 2007). One respondent noted that “if we do not continuously bring new perspectives and voices into our networks, we risk creating echo chambers and bubbles” (Respondent #10). Nevertheless, whilst diversity can be embedded more into the practices, the *Weaving* practices as a whole have the potential to increase the adaptive capacity and resilience of social systems through their interconnected and interwoven approach to the complex challenges.

Further research is recommended in several areas. First of all, whilst *Weaving* has the potential to link social and ecological networks and thus reduce spatial-scale mismatch, further research is required to validate this. For BWL, for example, performing a multilevel social–ecological network analysis (SENA) or analysing the social-ecological connectivity is recommended, to better understand if and how *Weaving* can reduce spatial-scale mismatch within interdependent socio-ecological systems at the landscape level. This implies to not only focus on social connectivity, but on the integration of ecological and social connectivity and the power of place.

Furthermore, the importance of *Weaving* capacities became apparent throughout the interviews as participants shared a sense of agency and need to cultivate one's inner conditions to hold the changing dynamics of the 21st century. The capacities were outside of the research scope and, thus, not investigated further. However, the researchers acknowledge the need to develop these capacities and cultivate a sense of agency, well-being, and confidence to truly foster systemic change. It is suggested that future research could investigate how to effectively develop or link these *Weaving* capacities with current actors in the field, e.g. the Inner Development Goals (Reams et al. 2021) or interpersonal skills (Ayers, Missimer, and Bryant 2022).

Thirdly, as some practitioners mentioned the need for simple language, we recommend each community of practice that uses the term *Weaving*, like BWL, to investigate what language and metaphors work and for whom. This would allow a unique and attuned perspective to the local context and culture. Staying away from academic jargon can help to connect with people on the ground like farmers and local entrepreneurs to engage them in co-creating visions and solutions for their communities.

Finally, the data for this study on *Weaving*, whether from the literature or the interviewees, is mostly based on the European context. Ideally, a diversity of cultures would have been considered so that findings were more applicable to different contexts. Future research is required to explore if leadership styles similar to *Weaving* are being practiced in other parts of the world too and what the contexts and outcomes are.

5.3 Discussion on the intersection of barriers and enablers to scaling NbS and the practice of *Weaving*

While the practice of *Weaving* is an emerging facet of leading in complexity and illustrates *how* the sustainability challenge can be tackled, nature-based solutions can be considered one part of *what* needs to be done to combat the current crises. The core question of this research was, therefore, how *Weaving* practices could foster the conditions for scaling NbS to the landscape-level. In the hope of answering this question, the initial research methodology sought to let NbS weavers map where the distilled *Weaving* practices could address identified barriers and enablers. This approach turned out to be too complex for the setting of this study. Because the process required too much prior knowledge about the two newly created frameworks to be executed externally, the researchers attempted the mapping themselves. The complete result of which can be found in Appendix L. Several points could be identified where *Weaving*, as defined by the five practices, has the potential to address barriers or create enabling conditions for scaling NbS to the landscape level. Because the mapping was done by the researchers, the following has not been validated with practical examples and case studies yet. However, first indications can be made about potential leverage points through logical reasoning in the researchers' perspective.

It is likely that *Weaving* practices will only indirectly affect the 'what barriers' but have the potential to directly influence the 'how barriers' (see Table 5.1). Among the most obvious is the potential for overcoming the *lack of collaboration* which *Weaving* can address with the practice of *cultivating trust-based relationships* to break silos within and bridging gaps between different organisations that are critical for NbS implementation on the landscape scale. Weavers can function as intermediary or trans-boundary actors that are not affiliated with any involved party but have the potential to cohere and convene different groups by speaking their different languages. Especially considering the fast pace in which the concepts and language around NbS evolve, weavers can play a critical role in linking the parts that might otherwise develop into entirely different directions and create a common language. An increase in collaboration among NbS-critical stakeholders can also be supported by the practice of *helping systems see and sense themselves*. For example, this practice helps stakeholders to understand the interconnectedness of the environmental, social, and economic crises, as well as their own agency in the crises. A lack of such awareness and understanding has been reported as a key underlying structure that fosters a *lack of collaboration* (see UNDP 2017, 9). The practice of *aligning on a shared vision and purpose* could help bridge the gap between different operating timeframes that practitioners and policymakers or financiers, for example, were found to have. Similarly, it has the potential to help the public (i.e. the local community in the case of BWL) to create a shared vision for the landscape that is to be transformed and, hence, strengthen feelings of stewardship, connection, trust, and acceptance which are critical to mediating conflicting interests and creating a common goal. Finally, the practice of *facilitating collective (un)learning* has the potential to ensure that local and indigenous knowledge systems are as much considered as other types of knowledge, which helps to tailor the NbS implementation to the given local context and, thus, increases likelihood of success. Besides establishing a shared language, facilitating the dissemination of knowledge, can also contribute to raising overall awareness about NbS which, in turn, fosters citizen engagement and secures a social license to operate.

Overall, the facilitation of connection and knowledge exchange between and across holonic structures can help stakeholders engage in collaboration where time and capacity constraints make it difficult to engage when no external facilitation is provided. In the example of BWL,

this can take the shape of connecting individual NbS social entrepreneurs among themselves to exchange best-practices on the implementation (horizontal connection) or connecting social entrepreneurs to policymakers, for example, to lobby for better regulatory conditions across governance scales (vertical connection).

By potentially addressing the *collaboration* aspect of NbS implementation on the landscape level directly, *Weaving* also has the potential to indirectly address ‘what barriers’ like *lack of supportive policies*, *lack of financing* or *lack of access to space*. These are all areas in which systems change and mindset shifts are needed to support the scaling of NbS. *Weaving* might have the potential to facilitate these systems changes and mindset shifts by directly helping to overcome a *lack of collaboration* as one example. Through the practice of *helping systems see and sense themselves*, for example, *Weaving* could help overcome the lack of perceived responsibility to collaborate with NbS practitioners that was found to be present in critical ministries or departments and continues to hinder effective NbS implementation on the landscape scale. *Trust-based relationships* between NbS practitioners and policymakers that weavers could cultivate might help create collaboration and, through that, overcome the issue of traditional solutions having powerful lobby groups that influence policy decision-making in their favour, often opposing the needs of NbS. To create supportive financing, the practice of *aligning on a shared vision and purpose* between the collaborating parties might address a misalignment of investment interests and *facilitating collective (un)learning* could increase the open flow of information needed to make good investment decisions in NbS. As established in the Results section 4.1.2, a *lack of access to space* is rather a problem of ownership and authority complexities than an actual lack of land. Since *Weaving* happens holonically and connections are built across levels (irrespective of man-made borders), it has the potential to address the challenges that come with working across municipalities, counties, and even nation-states for large-scale NbS implementation. These are some examples of barriers which *Weaving* might address indirectly, given the complexity of both barriers and enablers as well as *Weaving* as a concept, more indirect touchpoints might be possible and require further research.

While the enabler ‘*trustful co-creation with a diversity of stakeholder groups*’ corresponds to what was said above, other ‘how conditions’ that could be addressed by *Weaving* are the enabler ‘*experimental mindset*’ and the barrier ‘*lack of supportive mindset*’. By *fostering experimental action*, weavers can help communities try, test, and learn about the best strategies for locally implementing NbS in safe incubation space without risking significant losses in case of failure. Supporting people to approach NbS implementation with experimental action also allows for dealing with the uncertainty around them and can change perceptions of new interventions like NbS as outlined in section 4.1.3 on *experimental mindset*. When applying the experimental mindset not just to NbS as a product but also to resources, rules, and roles (as Respondent #9 mentioned), this *Weaving* practice could help change the fundamental structures of the system (e.g. policy-making and financing). Specifically in the example of BWL, the practice of *helping systems see and sense themselves* could contribute to a fundamental shift from the paradigm of human-nature detachment, which has been reported as a key barrier for pro-NbS policy change for example, to what the BWL collective calls a paradigm of “We Are Nature”.

Broadly speaking, the practice of *cultivating trust-based relationships* stood out in the mapping (see Appendix M) as one of the most dominant practices for helping NbS scale. This suggests that the strength of the relationships within a system, indicated by level of trust and trustworthiness, for example (Missimer, Robèrt, and Broman 2017), may be one of the most important success-factors for endeavours of implementing novel and complex solutions like

NbS. Additionally, *Weaving* practices mapped onto the barriers showed a continuous theme of three specific practices being featured on several of the barriers. The *Weaving* practices of *aligning on shared purpose and vision*, *helping systems see and sense themselves* and *facilitating collective (un)learning* could all be mapped to the barriers of *lack of supportive policies*, *lack of supportive mindset*, *lack of collaboration* and *lack of knowledge*. Suggesting that in order to shift the system from its current paradigm and ways of working, a systems perspective with an aligned vision and collective knowledge dissemination could weave together the currently fragmented approach to scaling NbS.

During the mapping process itself, however, it soon became clear that a linear one-to-one mapping of *Weaving* practices on all barriers and enablers with the guiding question “Can this barrier/enabler be addressed by any of the five *Weaving* practices?” would not do justice to the complex and interconnected nature of both sides. Initially, the mapping exercise aimed to develop a linear and practical application of how *Weaving* practices could foster the conditions for scaling NbS. In doing so, the researchers intended to develop a framework that would help organisations like BWL who are using *Weaving*, to identify and overcome the gaps in their current work of scaling NbS to landscape level. However, beyond the above-mentioned first indications of potential touchpoints, the researchers acknowledge that complex and interconnected problems require complex and interconnected solutions, and a linear one-to-one mapping would not solve a gap in the process of scaling NbS to a landscape level. Barriers will not be overcome if they are not addressed as a whole, starting from their underlying structural conditions. *Weaving* is a dynamic process and highly context dependent. Instead of moving in a mechanistic, band-aid solution mindset, which can be found in many siloed approaches to problem solving, the *Weaving* practices are based on sensing into the systems and responding not to a symptom, but rather the underlying structural conditions that hold the system in place. Thus, the emergence of *Weaving* as a new leadership practice, for example in the work of large-scale landscape restoration, is promising to help overcome identified barriers and create enabling conditions for NbS to be scaled. Future studies might find better suited methodologies to investigate and further qualify the potential of *Weaving* and *Weaving* practices to address specific barriers and enablers or the entire complexity of scaling NbS to the landscape level.

6 Conclusion

The sustainability challenge is a complex and wicked interplay of interconnected challenges that requires an integrated and systemic approach to be tackled. With increasing pressure on the Earth's socio-ecological system, being strategic is paramount to avoid further degeneration. Nature-based solutions are widely acknowledged as a key tool for addressing the complexity and interconnectedness of the challenge but are currently not implemented at a large enough scale. To give a holistic overview on the impediments, this research developed a conceptual framework that establishes a list of barriers and enablers for scaling NbS to the landscape level. Seven barriers and nine enablers were identified, ranging in topics from financing and policies to experimental mindsets and collaboration. The conceptual framework contributes to the scientific discourse around NbS uptake by newly establishing the barriers and enablers specific to the landscape level as well as qualifying each barrier and enabler further through the insights that were gained during expert interviews. The thesis also enriches the scientific discourse by raising a series of new, highly nuanced research questions to be studied in the future. As much as it contributes to the scientific field, the conceptual framework also provides the basis for a practical toolkit that is being developed for stakeholders involved in NbS implementation to help them make sense of barriers and enablers in their given context.

On the topic of *Weaving*, this thesis contributes by further coining it as an emerging and evolving leadership practice that is believed to help cohere fragmented change-making efforts and increase the adaptive capacity and resilience of socio-ecological systems. Compensating for the scarcity in academic literature on *Weaving*, the second conceptual framework that was developed during this research project comprises a working definition and a list of five core practices for *Weaving*. Similarly to the conceptual framework on barriers and enablers, the one on *Weaving* also provides the basis for a practical toolkit that will give aspiring weavers an introduction to the concept as well as helping them to assess their current capabilities in regard to the five core practices. Overall, the second conceptual framework aims to illuminate an emergent form of leadership that has developed to tackle the socio-ecological challenges of the 21st century. Due to its contribution to establishing the concept, the results of this research prepare the ground for further systematic studies on *Weaving* and assessments on how effective it is as a new practice in the complex field of sustainability work. The process of defining *Weaving* and “naming” weavers, can also help connect them into a nourishing community of practice that, together, can illuminate seeds of a more sustainable system while gracefully hospicing the old, unsustainable system.

Based on the two conceptual frameworks, this research investigated how *Weaving* practices could foster the conditions for scaling NbS to the landscape level, i.e. help overcome barriers or create enablers. First indications have highlighted where *Weaving* practices have the potential to address several of the barriers and enablers and, thereby, strengthen the adaptive capacity of a system. A key finding from this study, however, is that a mechanistic, direct mapping would not do justice to the complex, interconnected ways in which both barriers and enablers and *Weaving* practices work. On the premise that interconnected problems, like barriers and enablers to scaling NbS, need interwoven solutions that respect their complexity, *Weaving* has the potential accelerate large-scale and fundamental change towards strategic sustainable development, rather than the incremental and fragmented change that is currently undertaken.

References

Cited References

- Abson, David J., Joern Fischer, Julia Leventon, Jens Newig, Thomas Schomerus, Ulli Vilsmaier, Henrik von Wehrden, et al. 2017. "Leverage Points for Sustainability Transformation." *Ambio* 46, no. 1 (February): 30–39. <https://doi.org/10.1007/S13280-016-0800-Y/TABLES/2>.
- Alexander, Steven M., Jennifer F. Provencher, Dominique A. Henri, Jessica J. Taylor, and Steven J. Cooke. 2019. "Bridging Indigenous and Science-Based Knowledge in Coastal-Marine Research, Monitoring, and Management in Canada: A Systematic Map Protocol." *Environmental Evidence* 8, no. 1 (March): 1–7. <https://doi.org/10.1186/S13750-019-0159-1/TABLES/1>.
- Allen, Craig R., David G. Angeler, Ahjond S. Garmestani, Lance H. Gunderson, and C. S. Holling. 2014. "Panarchy: Theory and Application." *Ecosystems* 17, no. 4 (January): 578–89. <https://doi.org/10.1007/S10021-013-9744-2/TABLES/1>.
- American Heritage Dictionary. 2011. "Objectivism." In *American Heritage® Dictionary of the English Language*, 5th ed. <https://www.thefreedictionary.com/objectivism>.
- Ashoka. 2022. "Whitepaper - Bioregional Weaving Labs Collective." 2022. <https://www.ashoka.org/en-nl/Program/Bioregional-Weaving-Labs-Collective>.
- . n.d. "Social Entrepreneurship."
- Ayers, James, Merlina Missimer, and Jayne Bryant. 2022. "The Dark Matter of Sustainability Leadership: Presenting an Intrapersonal Competence Understanding for Sustainability."
- Barnes, Michele L., Örjan Bodin, Angela M. Guerrero, Ryan R.J. McAllister, Steven M. Alexander, and Garry Robins. 2017. "The Social Structural Foundations of Adaptation and Transformation in Social–Ecological Systems." *Ecology and Society, Published Online: Nov 07, 2017* | *Doi:10.5751/ES-09769-220416* 22, no. 4 (November). <https://doi.org/10.5751/ES-09769-220416>.
- Baumgärtner, Stefan, Christian Becker, Karin Frank, Birgit Müller, and Martin Quaas. 2008. "Relating the Philosophy and Practice of Ecological Economics: The Role of Concepts, Models, and Case Studies in Inter- and Transdisciplinary Sustainability Research." *Ecological Economics* 67, no. 3 (October): 384–93. <https://doi.org/10.1016/J.ECOLECON.2008.07.018>.
- Benne, Beatrice, and Pamela Mang. 2015. "Working Regeneratively across Scales—Insights from Nature Applied to the Built Environment." *Journal of Cleaner Production* 109, no. December (December): 42–52. <https://doi.org/10.1016/J.JCLEPRO.2015.02.037>.
- Bergsten, Arvid, Diego Galafassi, and Örjan Bodin. 2014. "The Problem of Spatial Fit in Social-Ecological Systems: Detecting Mismatches between Ecological Connectivity and Land Management in an Urban Region." *Ecology and Society, Published Online: Oct 14, 2014* | *Doi:10.5751/ES-06931-190406* 19, no. 4 (October). <https://doi.org/10.5751/ES-06931-190406>.

- Bodin, Örjan, and Maria Tengö. 2012. "Disentangling Intangible Social-Ecological Systems." *Global Environmental Change* 22, no. 2 (May): 430–39. <https://doi.org/10.1016/J.GLOENVCHA.2012.01.005>.
- Bond, Brittnee. 2017. "Two Loops Model." Medium.Com. September 11, 2017. <https://brittneebond.medium.com/two-loops-model-9a3d52c7da4e>.
- Borgström, Sara. 2019. "Balancing Diversity and Connectivity in Multi-Level Governance Settings for Urban Transformative Capacity." *Ambio* 48, no. 5 (May): 463–77. <https://doi.org/10.1007/S13280-018-01142-1/TABLES/2>.
- Brancalion, Pedro H.S., and Robin L. Chazdon. 2017. "Beyond Hectares: Four Principles to Guide Reforestation in the Context of Tropical Forest and Landscape Restoration." *Restoration Ecology* 25, no. 4. <https://doi.org/10.1111/rec.12519>.
- Broman, Göran Ingvar, and Karl Henrik Robèrt. 2017. "A Framework for Strategic Sustainable Development." *Journal of Cleaner Production* 140. <https://doi.org/10.1016/j.jclepro.2015.10.121>.
- Bryman, Alan. 2012. "Social Research Methods." Oxford: Oxford University Press.
- Buchanan, Richard. 1992. "Wicked Problems in Design Thinking." *Design Issues* 8, no. 2 (Spring): 5. <https://doi.org/10.2307/1511637>.
- Cambridge Dictionary. n.d. "Greenwashing." Cambridge University Press. Accessed May 22, 2022. <https://dictionary.cambridge.org/dictionary/english/greenwashing>.
- Carmenta, Rachel, David A. Coomes, Fabrice A.J. DeClerck, Abigail K. Hart, Celia A. Harvey, Jeff Milder, James Reed, Bhaskar Vira, and Natalia Estrada-Carmona. 2020. "Characterizing and Evaluating Integrated Landscape Initiatives." *One Earth* 2, no. 2 (February): 174–87. <https://doi.org/10.1016/J.ONEEAR.2020.01.009>.
- Cavanaugh, Nancy, Kaats Saa, and Waa della Cheney. 2002. "Community Collaboration-A Weaving." *Public Health Management and Practice* 8, no. 1: 13–20.
- Chambers, Josephine M., Carina Wyborn, Nicole L. Klenk, Melanie Ryan, Anca Serban, Nathan J. Bennett, Ruth Brennan, et al. 2022. "Co-Productive Agility and Four Collaborative Pathways to Sustainability Transformations." *Global Environmental Change* 72, no. January (January): 102422. <https://doi.org/10.1016/J.GLOENVCHA.2021.102422>.
- Chambers, Josephine M., Carina Wyborn, Melanie E. Ryan, Robin S. Reid, Maraja Riechers, Anca Serban, Nathan J. Bennett, et al. 2021. "Six Modes of Co-Production for Sustainability." *Nature Sustainability* 4:11 4, no. 11 (August): 983–96. <https://doi.org/10.1038/s41893-021-00755-x>.
- Clark, William C., and Nancy M. Dickson. 2003. "Sustainability Science: The Emerging Research Program." *Proceedings of the National Academy of Sciences of the United States of America* 100, no. 14 (July): 8059–61. <https://doi.org/10.1073/PNAS.1231333100>.
- ClientEarth. 2021. "What Is a Carbon Sink?" ClientEarth.Org. December 22, 2021. <https://www.clientearth.org/latest/latest-updates/stories/what-is-a-carbon-sink/>.
- Cohen-Shacham, Emmanuelle, G Walters, C Janzen, and S Maginnis. 2016. *Nature-Based Solutions to Address Global Societal Challenges. Nature-Based Solutions to Address Global Societal Challenges*. Gland, Switzerland: IUCN.

- Collins English Dictionary. 2012. "Subjectivism." In *Collins English Dictionary - Complete & Unabridged*, digital. <https://www.dictionary.com/browse/subjectivism>.
- Copeland, Sarah, and Aldo de Moor. 2018. "Community Digital Storytelling for Collective Intelligence: Towards a Storytelling Cycle of Trust." *Ai & Society* 33, no. 1: 101–11. <http://storytelling.research.southwales.ac.uk/StoriesofChange/>.
- Cortinovis, Chiara, Peter Olsson, Niklas Boke-Olén, and Katarina Hedlund. 2021. "Scaling up Nature-Based Solutions for Climate-Change Adaptation: Potential and Benefits in Three European Cities." *Urban Forestry & Urban Greening*, 127450.
- Cumming, Graeme S., David H.M. Cumming, and Charles L. Redman. 2006. "Scale Mismatches in Social-Ecological Systems: Causes, Consequences, and Solutions." *Ecology and Society* 11, no. 1. <https://www.jstor.org/stable/26267802?seq=1>.
- Dentoni, Domenico, Verena Bitzer, and Greetje Schouten. 2018. "Harnessing Wicked Problems in Multi-Stakeholder Partnerships." *Journal of Business Ethics* 150, no. 2. <https://doi.org/10.1007/s10551-018-3858-6>.
- Dorst, Hade, Alexander van der Jagt, Helen Toxopeus, Laura Tozer, Rob Raven, and Hens Runhaar. 2022. "What's behind the Barriers? Uncovering Structural Conditions Working against Urban Nature-Based Solutions." *Landscape and Urban Planning* 220: 104335.
- Dreise, Tony, and Evalynn Mazursk. 2018. "WEAVING KNOWLEDGES." http://www.nma.gov.au/encounters_education/community/richmond_river.
- Droste, Nils, Christoph Schröter-Schlaack, Bernd Hansjürgens, and Horst Zimmermann. 2017. "Implementing Nature-Based Solutions in Urban Areas: Financing and Governance Aspects." In . https://doi.org/10.1007/978-3-319-56091-5_18.
- Dudley, Nigel, Chris Baker, Paul Chatterton, Willem Ferwerda, Victoria Gutierrez, and Jane Madgwick. 2021. "The 4 Returns Framework For Landscape Restoration."
- EC. 2013. *Green Infrastructure (GI) — Enhancing Europe's Natural Capital*. Brussels: European Commission. <https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX:52013DC0249>.
- . 2015. *Towards an EU Research and Innovation Policy Agenda for Nature-Based Solutions & Re-Naturing Cities: Final Report of the Horizon 2020 Expert Group on 'Nature-Based Solutions and Re-Naturing Cities': (Full Version)*. Publications Office. <https://doi.org/doi/10.2777/479582>.
- EC, Directorate-General for Research, and Innovation. 2015. *Towards an EU Research and Innovation Policy Agenda for Nature-Based Solutions & Re-Naturing Cities: Final Report of the Horizon 2020 Expert Group on 'Nature-Based Solutions and Re-Naturing Cities': (Full Version)*. Publications Office. <https://doi.org/doi/10.2777/479582>.
- Egerer, Monika, and Elsa Anderson. 2020. "Social-Ecological Connectivity to Understand Ecosystem Service Provision across Networks in Urban Landscapes." *Land* 2020, Vol. 9, Page 530 9, no. 12 (December): 530. <https://doi.org/10.3390/LAND9120530>.
- Ehrlichman, David, David Sawyer, and Matthew Spence. 2018. "Cutting Through the Complexity: A Roadmap for Effective Collaboration." *Stanford Social Innovation Review*. https://ssir.org/articles/entry/cutting_through_the_complexity_a_roadmap_for_effective_collaboration.

- Eisenstein, Charles. 2013. *The More Beautiful World Our Hearts Know Is Possible*. Vol. 2. North atlantic books. https://books.google.se/books?hl=en&lr=&id=nW0HYDJlt4cC&oi=fnd&pg=PR9&dq=The+More+Beautiful+World+Our+Hearts+Know+is+Possible&ots=HVvWjU0fTp&sig=EYEvH9ypSTVA8Pjben8QjJEGNWM&redir_esc=y#v=onepage&q=The+More+Beautiful+World+Our+Hearts+Know+is+Possible&f=fal.
- Farrell, Justin, Paul Berne Burow, Kathryn McConnell, Jude Bayham, Kyle Whyte, and Gal Koss. 2021. "Effects of Land Dispossession and Forced Migration on Indigenous Peoples in North America." *Science* 374, no. 6567. <https://doi.org/10.1126/science.abe4943>.
- Fastenrath, Sebastian, Judy Bush, and Lars Coenen. 2020. "Scaling-up Nature-Based Solutions. Lessons from the Living Melbourne Strategy." *Geoforum* 116. <https://doi.org/10.1016/j.geoforum.2020.07.011>.
- Ferwerda, Willem H. 2016. "Four Returns, Three Zones, 20 Years: A Systemic Approach to Scale up Landscape Restoration by Businesses and Investors to Create a Restoration Industry." *Land Restoration: Reclaiming Landscapes for a Sustainable Future*, January (January), 319–47. <https://doi.org/10.1016/B978-0-12-801231-4.00025-2>.
- Fischer, Joern, Toby A. Gardner, Elena M. Bennett, Patricia Balvanera, Reinette Biggs, Stephen Carpenter, Tim Daw, et al. 2015. "Advancing Sustainability through Mainstreaming a Social–Ecological Systems Perspective." *Current Opinion in Environmental Sustainability* 14, no. June (June): 144–49. <https://doi.org/10.1016/J.COSUST.2015.06.002>.
- Folke, Carl. 2006. "Resilience: The Emergence of a Perspective for Social-Ecological Systems Analyses." *Global Environmental Change* 16: 253–67. <https://doi.org/10.1016/j.gloenvcha.2006.04.002>.
- Frantzeskaki, Niki. 2019. "Seven Lessons for Planning Nature-Based Solutions in Cities." *Environmental Science and Policy* 93. <https://doi.org/10.1016/j.envsci.2018.12.033>.
- Frazier, Amy E., Brett A. Bryan, Alexander Buyantuev, Liding Chen, Cristian Echeverria, Peng Jia, Lumeng Liu, et al. 2019. "Ecological Civilization: Perspectives from Landscape Ecology and Landscape Sustainability Science." *Landscape Ecology* 34, no. 1: 1–8. <https://doi.org/10.1007/s10980-019-00772-4>.
- Future Terrains. n.d. "What Is Landscape Restoration." Accessed May 20, 2022. <https://futureterrains.org/what-is-landscape-restoration/>.
- Global Commission on Adaptation. 2019. "Adapt Now: A Global Call for Leadership on Climate Resilience." Washington, DC. <https://openknowledge.worldbank.org/handle/10986/32362>.
- Goldstein, Bruce Evan, Claire Chase, Lee Frankel-Goldwater, Jeremiah Osborne-Gowey, Julie Risien, and Sarah Schweizer. 2017. "Transforming with a Soft Touch: Comparing Four Learning Networks." *Systems Research and Behavioral Science* 34, no. 5 (September): 537–43. <https://doi.org/10.1002/SRES.2479>.
- . 2018. "Transformative Learning Networks."
- Goldstein, Bruce Evan, Lisa Smith, and Melanie Ryan. 2021. "STEM Netweaver Dialogues: Creating, Designing, and Managing Transformative Networks." *Network of STEM Education Centers*.

- Goodchild, Michael F., and Wenwen Li. 2021. "Replication across Space and Time Must Be Weak in the Social and Environmental Sciences." *Proceedings of the National Academy of Sciences of the United States of America* 118, no. 35 (August). <https://doi.org/10.1073/PNAS.2015759118/ASSET/9AFAE61C-E626-4060-B5D1-551D7E7D889C/ASSETS/IMAGES/LARGE/PNAS.2015759118FIG02.JPG>.
- Gotts, Nicholas M. 2007. "Resilience, Panarchy, and World-Systems Analysis" 12, no. 1. <http://www.ecologyandsociety.org/vol12/iss1/art24/>.
- Grant, Maria J., and Andrew Booth. 2009. "A Typology of Reviews: An Analysis of 14 Review Types and Associated Methodologies." *Health Information and Libraries Journal* 26, no. 2 (June): 91–108. <https://doi.org/10.1111/J.1471-1842.2009.00848.X>.
- Hadorn, Gertrude Hirsch, David Bradley, Christian Pohl, Stephan Rist, and Urs Wiesmann. 2006. "Implications of Transdisciplinarity for Sustainability Research." <https://doi.org/10.1016/j.ecolecon.2005>.
- Håkanson, Louise. 2021. "Strategies for Overcoming Barriers to Implementation of Nature-Based Solutions." Master Thesis, Uppsala: Uppsala University.
- Hathaway, Mark D. 2016. "Agroecology and Permaculture: Addressing Key Ecological Problems by Rethinking and Redesigning Agricultural Systems." *Journal of Environmental Studies and Sciences* 6, no. 2. <https://doi.org/10.1007/s13412-015-0254-8>.
- Hawken, Paul. 2021. *Regeneration: Ending the Climate Crisis in One Generation*. Penguin UK. https://books.google.se/books?hl=en&lr=&id=D1gpEAAQBAJ&oi=fnd&pg=PT11&dq=paul+hawken+regeneration&ots=Vr0_fc35G&sig=TF4atzWB0kvwyfG7FK20G_vmPlw&redir_esc=y#v=onepage&q=paul+hawken+regeneration&f=false.
- Henri, Dominique A., Jennifer F. Provencher, Ella Bowles, Jessica J. Taylor, Jade Steel, Carmen Chelick, Jesse N. Popp, et al. 2021. "Weaving Indigenous Knowledge Systems and Western Sciences in Terrestrial Research, Monitoring and Management in Canada: A Protocol for a Systematic Map." *Ecological Solutions and Evidence* 2, no. 2 (April). <https://doi.org/10.1002/2688-8319.12057>.
- Herrick, Jeffrey, T Abrahamse, P Abhilash, S Ali, P Alvarez-Torres, and A Barau. 2019. "Land Restoration for Achieving the Sustainable Development Goals." *An International Resource Panel Think Piece. United Nations Environment Programme*. Nairobi, Kenya.
- Höhl, Markus, Vianny Ahimbisibwe, John A. Stanturf, Peter Elsasser, Michael Kleine, and Andreas Bolte. 2020. "Forest Landscape Restoration-What Generates Failure and Success?" *Forests* 11, no. 9. <https://doi.org/10.3390/F11090938>.
- Holley, June. 2012. "Network Weaver Handbook," 376.
- Holling, Crawford S. 2004. "From Complex Regions to Complex Worlds." *Ecology and Society* 9, no. 1. <https://www.jstor.org/stable/26267656>.
- Hopkins, Debra, Tara L. Joly, Harvey Sykes, Almer Waniandy, John Grant, Lorrie Gallagher, Leonard Hansen, Kaitlyn Wall, Peter Fortna, and Michelle Bailey. 2019. "'learning Together': Braiding Indigenous and Western Knowledge Systems to Understand Freshwater Mussel Health in the Lower Athabasca Region of Alberta, Canada." *Journal of Ethnobiology* 39, no. 2 (June): 315–36. <https://doi.org/10.2993/0278-0771-39.2.315>.

- Howells, Jeremy. 2006. "Intermediation and the Role of Intermediaries in Innovation." *Research Policy* 35: 715–28. <https://doi.org/10.1016/j.respol.2006.03.005>.
- Hsieh, Hsiu Fang, and Sarah E. Shannon. 2005. "Three Approaches to Qualitative Content Analysis." *Qualitative Health Research* 15, no. 9. <https://doi.org/10.1177/1049732305276687>.
- Hussein, Taz, Matt Plummer, and Bill Breen. 2018. "How Field Catalysts Galvanize Social Change." *Stanford Social Innovation Review* 16, no. 1: 48–54. https://ssir.org/articles/entry/field_catalysts#.
- IPBES. 2019. "Summary for Policymakers of the Global Assessment Report on Biodiversity and Ecosystem Services of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services." *Population and Development Review* 45, no. 3. <https://doi.org/10.1111/padr.12283>.
- IPCC. 2022. *Climate Change 2022: Impacts, Adaptation, and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change*. Edited by H.-O. Pörtner, D.C. Roberts, M. Tignor, E.S. Poloczanska, K. Mintenbeck, A. Alegria, M. Craig, et al. Cambridge University Press. In Press.
- Johnson, Jay T, · Richard Howitt, · Gregory Cajete, · Fikret Berkes, · Renee, Pualani Louis, and Andrew Kliskey. 2015. "Weaving Indigenous and Sustainability Sciences to Diversify Our Methods." *Sustainability Science* 11. <https://doi.org/10.1007/s11625-015-0349-x>.
- Kabisch, Nadja, Niki Frantzeskaki, Stephan Pauleit, Sandra Naumann, McKenna Davis, Martina Artmann, Dagmar Haase, et al. 2016. "Nature-Based Solutions to Climate Change Mitigation and Adaptation in Urban Areas: Perspectives on Indicators, Knowledge Gaps, Barriers, and Opportunities for Action." *Ecology and Society* 21, no. 2. <https://doi.org/10.5751/ES-08373-210239>.
- Kampelmann, Stephan, Michael Kaethler, and Adrian Vickery Hill. 2018. "Curating Complexity: An Artful Approach for Real-World System Transitions." *Environmental Innovation and Societal Transitions* 27, no. June (June): 59–71. <https://doi.org/10.1016/J.EIST.2017.10.005>.
- Kapos, Valerie, S Wicander, T Salvaterra, K Dawkins, and C Hicks. 2019. "The Role of the Natural Environment in Adaptation." Background Paper for the Global Commission on Adaptation. Rotterdam and Washington, D.C.
- Kates, Robert W., W. C. Clark, R. Corell, J. M. Hall, C. C. Jaeger, I. Lowe, J. J. McCarthy, et al. 2001. "Environment and Development: Sustainability Science." *Science* 292, no. 5517. <https://doi.org/10.1126/science.1059386>.
- Kates, Robert W. 2011. "What Kind of a Science Is Sustainability Science?" *Proceedings of the National Academy of Sciences of the United States of America* 108, no. 49 (December): 19449–50. <https://doi.org/10.1073/PNAS.1116097108/ASSET/8CEB4D39-067F-4094-80DD-CF05CD8015D1/ASSETS/GRAPHIC/PNAS.1116097108FIG01.JPEG>.
- Kibiswa, Naupess K. 2019. "Directed Qualitative Content Analysis (DQICA): A Tool for Conflict Analysis." *Qualitative Report* 24, no. 8. <https://doi.org/10.46743/2160-3715/2019.3778>.
- Kimmerer, Robin. 2013. *Braiding Sweetgrass: Indigenous Wisdom, Scientific Knowledge and the Teachings of Plants*. Milkweed editions. <https://books.google.se/books?hl=en&lr=&id=vmM9BAAQBAJ&oi=fnd&pg=PR7&d>

q=kimmerer+braiding+sweetgrass&ots=niicvF7cgO&sig=HNNjYCakpe6JCxSyproB3ne
uKAk&redir_esc=y#v=onepage&q=kimmerer braiding sweetgrass&f=false.

- Kinder, Tony, Jari Stenvall, Frédérique Six, and Ally Memon. 2021. "Relational Leadership in Collaborative Governance Ecosystems." *Public Management Review* 23, no. 11: 1612–39. <https://doi.org/10.1080/14719037.2021.1879913>.
- Klerkx, Laurens, Noelle Aarts, and Cees Leeuwis. 2010. "Adaptive Management in Agricultural Innovation Systems: The Interactions between Innovation Networks and Their Environment." *Agricultural Systems* 103, no. 6 (July): 390–400. <https://doi.org/10.1016/J.AGSY.2010.03.012>.
- Klerkx, Laurens, Andy Hall, and Cees Leeuwis. 2009. "Strengthening Agricultural Innovation Capacity: Are Innovation Brokers the Answer?" *International Journal of Agricultural Resources, Governance and Ecology* 8, no. 5–6: 409–38. <https://doi.org/10.1504/IJARGE.2009.032643>.
- Koestler, Arthur. 1967. *The Ghost in the Machine*. 1990 reprint. Penguin Group.
- Krebs, Valdis, and June Holley. 2006. "Building Smart Communities through Network Weaving." *Appalachian Center for Economic Networks*.
- Lafortezza, Raffaele, Jiquan Chen, Cecil Konijnendijk van den Bosch, and Thomas B. Randrup. 2018. "Nature-Based Solutions for Resilient Landscapes and Cities." *Environmental Research* 165. <https://doi.org/10.1016/j.envres.2017.11.038>.
- Lang, Daniel J., Arnim Wiek, Matthias Bergmann, Michael Stauffacher, Pim Martens, Peter Moll, Mark Swilling, and Christopher J. Thomas. 2012. "Transdisciplinary Research in Sustainability Science: Practice, Principles, and Challenges." *Sustainability Science* 7, no. SUPPL. 1 (February): 25–43. <https://doi.org/10.1007/S11625-011-0149-X/TABLES/3>.
- Lee, Ju Young, and Sandra Waddock. 2021. "How Transformation Catalysts Take Catalytic Action." *Sustainability 2021, Vol. 13, Page 9813* 13, no. 17 (September): 9813. <https://doi.org/10.3390/SU13179813>.
- Maier, Mark W. 1998. "Architecting Principles for Systems-of-systems." *Systems Engineering: The Journal of the International Council on Systems Engineering* 1, no. 4: 267–84.
- Malmer, Pernilla, Masterson Vanessa, Beau Austin, and Maria Tengö. 2020. "Mobilisation of Indigenous and Local Knowledge as a Source of Useable Evidence for Conservation Partnerships." In *Conservation Research, Policy and Practice*, 82–113. Cambridge University Press. <https://doi.org/10.1017/9781108638210.006>.
- Mansourian, Stephanie, and John Parrotta. 2018. *Forest Landscape Restoration: Integrated Approaches to Support Effective Implementation*. Routledge.
- Martens, Pim. 2007. "Sustainability: Science or Fiction?" *IEEE Engineering Management Review* 35, no. 3: 70. <https://doi.org/10.1109/EMR.2007.4296430>.
- Martin, Juliette G.C., Anna Scolobig, Joanne Linnerooth-Bayer, Wei Liu, and Jörg Balsiger. 2021. "Catalyzing Innovation: Governance Enablers of Nature-Based Solutions." *Sustainability (Switzerland)* 13, no. 4 (February): 1–28. <https://doi.org/10.3390/SU13041971>.
- Masterson, Vanessa A., Johan P. Enqvist, Richard C. Stedman, and Maria Tengö. 2019. "Sense of Place in Social–Ecological Systems: From Theory to Empirics." *Sustainability Science* 14, no. 3 (May): 555–64. <https://doi.org/10.1007/S11625-019-00695-8>.

- Maxwell, Joseph A. 2012. *Qualitative Research Design: An Interactive Approach*. Sage publications.
- Mayring, Philipp. 2014. “Qualitative Content Analysis: Theoretical Foundation, Basic Procedures and Software Solution (Free Download via Social Science Open Access Repository SSOAR).” *Forum Qualitative Sozialforschung/Forum: Qualitative Social Research*.
- McQuaid, Siobhan, Esmee D Kooijman, Mary-Lee Rhodes, and Sheila M Cannon. 2021. “Innovating with Nature: Factors Influencing the Success of Nature-Based Enterprises.” <https://doi.org/10.3390/su132212488>.
- Meadows, Donella. 1982. “HISTORY OF THE IDEAS UNDERLYING THE BALATON GROUP.”
- . 1999. “Leverage Points: Places to Intervene in a System” Donellameadows.Org/Archives/Leverage-Points-Places-to-Intervene-in-a-System.” *Sustainability Institute*.
- Mehmood, Abid, Terry Marsden, Alice Taherzadeh, Lorena F. Axinte, and Cátia Rebelo. 2019. “Transformative Roles of People and Places: Learning, Experiencing, and Regenerative Action through Social Innovation.” *Sustainability Science* 15, no. 2 (March): 455–66. <https://doi.org/10.1007/S11625-019-00740-6/FIGURES/1>.
- Ministry of Education. 2004. *Swedish Ethical Review Act*. Ministry of Education, Sweden. <https://rkrattsbaser.gov.se/sfst?bet=2003:460>.
- Missimer, Merlina, Karl Henrik Robèrt, and Göran Broman. 2017. “A Strategic Approach to Social Sustainability – Part 1: Exploring the Social System.” *Journal of Cleaner Production* 140, no. January (January): 32–41. <https://doi.org/10.1016/J.JCLEPRO.2016.03.170>.
- Mitchell, Matthew G.E., Elena M. Bennett, and Andrew Gonzalez. 2013. “Linking Landscape Connectivity and Ecosystem Service Provision: Current Knowledge and Research Gaps.” *Ecosystems* 16, no. 5 (August): 894–908. <https://doi.org/10.1007/S10021-013-9647-2/TABLES/1>.
- Mitsch, William J., and James G. Gosselink. 2015. *Wetlands*. 5th ed. Wiley.
- Mittermeier, Russell A, Michael Totten, Laura Ledwith Pennypacker, Frederick Boltz, Guy Midgley, Carlos Manuel Rodríguez, Glenn Prickett, Claude Gascon, Peter A Seligmann, and Olivier M Langrand. 2008. *A Climate For Life: Meeting the Global Challenge*. Edited by Cristina Goettsch Mittermeier. Vol. 16. Conservation International.
- Moor, Aldo de. 2015. “Knowledge Weaving for Social Innovation: Laying the First Strand.”
- . 2018. “A Community Network Ontology for Participatory Collaboration Mapping: Towards Collective Impact.” *Information (Switzerland)* 9, no. 7 (June). <https://doi.org/10.3390/INFO9070151>.
- Müller, Karin, Veronika Mackû, Ellie Percey, and João Alves. 2022. “Insights Report: Bioregional Weaving Labs – A Collective Strategy for Unlocking Nature’s Potential to Reverse Climate Change and Biodiversity Loss.”
- Nesshöver, Carsten, Timo Assmuth, Katherine N. Irvine, Graciela M. Rusch, Kerry A. Waylen, Ben Delbaere, Dagmar Haase, et al. 2017. “The Science, Policy and Practice of Nature-

- Based Solutions: An Interdisciplinary Perspective.” *Science of the Total Environment*. <https://doi.org/10.1016/j.scitotenv.2016.11.106>.
- Nhat Hanh, Thich. 1988. *The Heart of Understanding: Commentaries on the Prajnaparamita Heart Sutra*.
- Osaka, Shannon, Rob Bellamy, and Noel Castree. 2021. “Framing ‘Nature-Based’ Solutions to Climate Change.” *Wiley Interdisciplinary Reviews: Climate Change*. <https://doi.org/10.1002/wcc.729>.
- Pelosi, Céline, Michel Goulard, and Gérard Balent. 2010. “The Spatial Scale Mismatch between Ecological Processes and Agricultural Management: Do Difficulties Come from Underlying Theoretical Frameworks?” *Agriculture, Ecosystems & Environment* 139, no. 4 (December): 455–62. <https://doi.org/10.1016/J.AGEE.2010.09.004>.
- Petit, Nicolas, and Andrew Bovarnick. 2020. “Multi-Stakeholder Collaboration for Systemic Change: A New Approach to Strengthening Farmer Support Systems.” New York.
- Price, Roz A. 2021. “Nature-Based Solutions (NbS) – What Are They and What Are the Barriers and Enablers to Their Use?” <https://opendocs.ids.ac.uk/opendocs/handle/20.500.12413/16737>.
- Raymond, Christopher M., Niki Frantzeskaki, Nadja Kabisch, Pam Berry, Margaretha Breil, Mihai Razvan Nita, Davide Geneletti, and Carlo Calfapietra. 2017. “A Framework for Assessing and Implementing the Co-Benefits of Nature-Based Solutions in Urban Areas.” *Environmental Science and Policy* 77. <https://doi.org/10.1016/j.envsci.2017.07.008>.
- Reams, Jonathan, Kristian Stålné, Stefanie Greca, Jan Artem Henriksson, Tomas Björkman, and Theo Dawson. 2021. “Background 1: The General Framing.”
- Rittel, Horst W.J., and Melvin M. Webber. 1973. “Dilemmas in a General Theory of Planning.” *Policy Sciences* 1973 4:2 4, no. 2 (June): 155–69. <https://doi.org/10.1007/BF01405730>.
- Robèrt, Karl-Henrik, Goran Broman, David Waldron, Henrik Ny, Sophie Hallstedt, David Crook, Lena Johansson, et al. 2019. *Sustainability Handbook*. Second ed. Lund: Studentlitteratur AB.
- Robinson, Jake M., Nick Gellie, Danielle MacCarthy, Jacob G. Mills, Kim O’Donnell, and Nicole Redvers. 2021. “Traditional Ecological Knowledge in Restoration Ecology: A Call to Listen Deeply, to Engage with, and Respect Indigenous Voices.” *Restoration Ecology* 29, no. 4 (May). <https://doi.org/10.1111/REC.13381>.
- Röbke, Adrian. 2020. “The Art and Science of Building System Shifting Networks.”
- Ruggeri, Deni. 2020. “The Agency of Place Attachment in the Contemporary Co-Production of Community Landscapes.” *Place Attachment*, November (November), 243–60. <https://doi.org/10.4324/9780429274442-15>.
- Ryder, Courtney, Tamara Mackean, Julieann Coombs, Hayley Williams, Kate Hunter, Andrew J.A. Holland, and Rebecca Q. Ivers. 2019. “Indigenous Research Methodology—Weaving a Research Interface.” *International Journal of Social Research Methodology* 23, no. 3 (May): 255–67. <https://doi.org/10.1080/13645579.2019.1669923>.
- Sarabi, Shahryar, Qi Han, A. Georges L. Romme, Bauke de Vries, Rianne Valkenburg, and Elke den Ouden. 2020. “Uptake and Implementation of Nature-Based Solutions: An Analysis of Barriers Using Interpretive Structural Modeling.” *Journal of Environmental Management* 270. <https://doi.org/10.1016/j.jenvman.2020.110749>.

- Sarabi, Shahryar, Qi Han, A. Georges L. Romme, Bauke de Vries, and Laura Wendling. 2019. “Key Enablers of and Barriers to the Uptake and Implementation of Nature-Based Solutions in Urban Settings: A Review.” *Resources* 8, no. 3. <https://doi.org/10.3390/resources8030121>.
- Savin-Baden, Maggi, and Claire Howell Major. 2013. “Qualitative Research: An Essential Guide to Theory and Practice.” *Routledge*.
- Sayles, Jesse S., and Jacopo A. Baggio. 2017. “Social-Ecological Network Analysis of Scale Mismatches in Estuary Watershed Restoration.” *Proceedings of the National Academy of Sciences of the United States of America* 114, no. 10 (March): E1776–85. https://doi.org/10.1073/PNAS.1604405114/SUPPL_FILE/PNAS.1604405114.SAPP.PDF.
- Schad, Jonathan, and Pratima Bansal. 2018. “Seeing the Forest and the Trees: How a Systems Perspective Informs Paradox Research.” *Journal of Management Studies* 55, no. 8 (December): 1490–1506. <https://doi.org/10.1111/JOMS.12398>.
- Scharmer, Otto. 2016. *Theory U: Leading from the Future as It Emerges*. 2nd ed. Oakland, CA: Berrett-Koehler Publishers.
- Schmalzbauer, Andreas. 2018. “Barriers and Success Factors for Effectively Co-Creating Nature-Based Solutions for Urban Regeneration.” H2020 grant no. 776604. https://clevercities.eu/fileadmin/user_upload/Resources/D1.1_Theme_1_Barriers_success_factors_co-creation_HWWI_12.2018.pdf.
- Schops, Ignace, Geert van der Veer, Noa Lodeizen, and Karin Müller. 2021. “Weaving for a Thriving Planet.”
- Seddon, Nathalie, Alexandre Chausson, Pam Berry, Cécile A.J. Girardin, Alison Smith, and Beth Turner. 2020. “Understanding the Value and Limits of Nature-Based Solutions to Climate Change and Other Global Challenges.” *Philosophical Transactions of the Royal Society B: Biological Sciences* 375, no. 1794. <https://doi.org/10.1098/rstb.2019.0120>.
- Selsky, John W., and Barbara Parker. 2005. “Cross-Sector Partnerships to Address Social Issues: Challenges to Theory and Practice.” *Journal of Management* 31, no. 6: 849–73. <https://doi.org/10.1177/0149206305279601>.
- Sievers-Glotzbach, Stefanie, and Julia Tschersich. 2019. “Overcoming the Process-Structure Divide in Conceptions of Social-Ecological Transformation: Assessing the Transformative Character and Impact of Change Processes.” *Ecological Economics* 164, no. October (October). <https://doi.org/10.1016/J.ECOLECON.2019.106361>.
- Sloan, Pamela, and David Oliver. 2013. “Building Trust in Multi-Stakeholder Partnerships: Critical Emotional Incidents and Practices of Engagement.” *Organization Studies* 34, no. 12. <https://doi.org/10.1177/0170840613495018>.
- Smitsman, Anneloes, Bill Baue, and Ralph Thurm. 2021. “Blueprint 9. Educational Transformation – 7 Transformative Learning Perspectives for Regeneration and Thrivability.”
- Solheim, Anders, Vittoria Capobianco, Amy Oen, Bjørn Kalsnes, Turid Wulff-Knutsen, Mari Olsen, Nicola del Seppia, Idoia Arauzo, Eva Garcia Balaguer, and James Michael Strout. 2021. “Implementing Nature-Based Solutions in Rural Landscapes: Barriers Experienced in the PHUSICOS Project.” <https://doi.org/10.3390/su13031461>.

- Somarakis, Giorgos, Stavros Stagakis, Nektarios Chrysoulakis, Marja Mesimäki, and Susanna Lehvävirta. 2019. "ThinkNature Nature-Based Solutions Handbook."
- Spencer-Keyes, Jessica, Pavel Luksha, and Joshua Cubista. 2020. "Learning Ecosystems An Emerging Praxis For The Future Of Education."
- Starik, Mark, and Gordon P. Rands. 1995. "Weaving An Integrated Web: Multilevel and Multisystem Perspectives of Ecologically Sustainable Organizations." *Https://Doi.Org/10.5465/Amr.1995.9512280025* 20, no. 4 (October): 908–35. <https://doi.org/10.5465/AMR.1995.9512280025>.
- Steffen, Will, Wendy Broadgate, Lisa Deutsch, Owen Gaffney, and Cornelia Ludwig. 2015. "The Trajectory of the Anthropocene: The Great Acceleration." *Anthropocene Review*. <https://doi.org/10.1177/2053019614564785>.
- Steffen, Will, Katherine Richardson, Johan Rockström, Sarah E. Cornell, Ingo Fetzer, Elena M. Bennett, Reinette Biggs, et al. 2015. "Planetary Boundaries: Guiding Human Development on a Changing Planet." *Science* 347, no. 6223. <https://doi.org/10.1126/science.1259855>.
- Strauss, A. 1987. *Qualitative Analysis for Social Scientists*. Cambridge: University Press.
- Strauss, A., and J. Corbin. 1990. *Basics of Qualitative Research. Grounded Theory Procedures and Techniques*. Newbury Park: Sage.
- Tengö, Maria, Eduardo S Brondizio, Thomas Elmqvist, Pernilla Malmer, and Marja Spierenburg. 2014. "Connecting Diverse Knowledge Systems for Enhanced Ecosystem Governance: The Multiple Evidence Base Approach." <https://doi.org/10.1007/s13280-014-0501-3>.
- Tengö, Maria, Rosemary Hill, Pernilla Malmer, Christopher M. Raymond, Marja Spierenburg, Finn Danielsen, Thomas Elmqvist, and Carl Folke. 2017. "Weaving Knowledge Systems in IPBES, CBD and beyond—Lessons Learned for Sustainability." *Current Opinion in Environmental Sustainability* 26–27, no. June (June): 17–25. <https://doi.org/10.1016/J.COSUST.2016.12.005>.
- The Weaving Lab. n.d. "What Is Weaving." Weavinglab.Org. Accessed May 25, 2022. <https://weavinglab.org/what-is-weaving/>.
- Thibodeau, Paul H., and Lera Boroditsky. 2011. "Metaphors We Think With: The Role of Metaphor in Reasoning." *PLOS ONE* 6, no. 2: e16782. <https://doi.org/10.1371/JOURNAL.PONE.0016782>.
- Thorn, Jessica P.R., R. Biancardi Aleu, A. Wijesinghe, M. Mdongwe, R. A. Marchant, and S. Shackleton. 2021. "Mainstreaming Nature-Based Solutions for Climate Resilient Infrastructure in Peri-Urban Sub-Saharan Africa." *Landscape and Urban Planning* 216. <https://doi.org/10.1016/j.landurbplan.2021.104235>.
- Todd, Nancy Jack, and John Todd. 1993. *From Eco-Cities to Living Machines: Principles of Ecological Design*. North Atlantic Books.
- UNDP. 2017. "Institutional and Coordination Mechanisms. Guidance Note on Facilitating Integration and Coherence for SDG Implementation." Published by United Nations Development Programme. https://sustainabledevelopment.un.org/content/documents/2478Institutional_Coordination_Mechanisms_GuidanceNote.pdf.

- UNEP. 2019. "Scaling-up Nature-Based Solutions for Mitigation, Resilience and Adaptation." <https://www.unep.org/news-and-stories/speech/scaling-nature-based-solutions-mitigation-resilience-and-adaptation>. September 22, 2019.
- Vance-Borland, Ken, and June Holley. 2011. "Conservation Stakeholder Network Mapping, Analysis, and Weaving." *Conservation Letters* 4, no. 4: 278–88. <https://doi.org/10.1111/J.1755-263X.2011.00176.X>.
- Vilhena, Daril A, and Alexandre Antonelli. 2015. "A Network Approach for Identifying and Delimiting Biogeographical Regions." *Nature Communications*. <https://doi.org/10.1038/ncomms7848>.
- Vygotsky, Lev Semenovich, and Michael Cole. 1978. *Mind in Society: Development of Higher Psychological Processes*. Harvard university press.
- Waddell, Steve. 2003. "Global Action Networks: A Global Invention Helping Business Make Globalisation Work for All." *The Journal of Corporate Citizenship* 12, no. 12: 27–42.
- Waddell, Steve. 2005. *Societal Learning and Change: How Governments, Business and Civil Society Are Creating Solutions to Complex Multi-Stakeholder Problems*. Greenleaf Pub. <https://www.routledge.com/Societal-Learning-and-Change-How-Governments-Business-and-Civil-Society/Waddell/p/book/9781874719939>.
- Waddock, Sandra, and James E. Post. 1991. "Social Entrepreneurs and Catalytic Change." *Public Administration Review* 51, no. 5 (September): 393. <https://doi.org/10.2307/976408>.
- . 1995. "Catalytic Alliances for Social Problem Solving." *Human Relations* 48, no. 8 (April): 951–73. <https://doi.org/10.1177/001872679504800807>.
- Waddock, Sandra, and Steve Waddell. 2021. "Transformation Catalysts: Weaving Transformational Change for a Flourishing World for All" 4, no. 4: 165–82. <https://ecagriculture.org/blog/introducing-1000-landscapes-for-1-billion-people/>.
- Wahl, Daniel Christian. 2016. *Designing Regenerative Cultures*. Axminster: Axminster, England: Triarchy Press, [2016] ©2016.
- . 2017. "Panarchy: A Scale-Linking Perspective of Systemic Transformation." Medium.Com. September 9, 2017. <https://medium.com/age-of-awareness/panarchy-a-scale-linking-perspective-of-systemic-transformation-a836c8b3e2e6>.
- Wamsler, C., B. Wickenberg, H. Hanson, J. Alkan Olsson, S. Stålhammar, H. Björn, H. Falck, et al. 2020. "Environmental and Climate Policy Integration: Targeted Strategies for Overcoming Barriers to Nature-Based Solutions and Climate Change Adaptation." *Journal of Cleaner Production* 247. <https://doi.org/10.1016/j.jclepro.2019.119154>.
- Weber, Edward, and Anne M. Khademian. 2008. "Managing Collaborative Processes: Common Practices, Uncommon Circumstances." *Http://Dx.Doi.Org/10.1177/0095399708320181* 40, no. 5 (June): 431–64. <https://doi.org/10.1177/0095399708320181>.
- Wenger-Trayner, Etienne, and Beverly Wenger-Trayner. 2015. *Learning in Landscapes of Practice: Boundaries, Identity, and Knowledgeability in Practice-Based Learning*. New York: Routledge.
- West, Simon, L. Jamila Haider, Sanna Stålhammar, and Stephen Woroniecki. 2020. "A Relational Turn for Sustainability Science? Relational Thinking, Leverage Points and

- Transformations.” *Ecosystems and People* 16, no. 1 (January): 304–25. <https://doi.org/10.1080/26395916.2020.1814417/FORMAT/EPUB>.
- Wheatley, Margaret. 1999. “Bringing Schools Back to Life: Schools as Living Systems in Creating Successful School Systems: Voices from the University, the Field, and the Community.” <https://www.margaretwheatley.com/articles/lifetoschools.html>.
- Wheatley, Margaret, and Deborah Frieze. 2006. “Using Emergence to Take Social Innovation to Scale.” *The Berkana Institute* 9, no. 3: 147–97.
- Wilkinson, Clare, Daniel C.H. Hikuroa, Angus H. MacFarlane, and Matthew W. Hughes. 2020. “Ma Tauranga Ma Ori in Geomorphology: Existing Frameworks, Case Studies, and Recommendations for Incorporating Indigenous Knowledge in Earth Science.” *Earth Surface Dynamics* 8, no. 3 (July): 595–618. <https://doi.org/10.5194/ESURF-8-595-2020>.
- Williams, Portia Adade, Likho Sikutshwa, and Sheona Shackleton. 2020. “Acknowledging Indigenous and Local Knowledge to Facilitate Collaboration in Landscape Approaches—Lessons from a Systematic Review.” *Land*. <https://doi.org/10.3390/LAND9090331>.
- Wulf, Andrea. 2015. *The Invention of Nature: The Adventures of Alexander von Humboldt, the Lost Hero of Science*. John Murray. John Murray.
- WWAP (United Nations World Water Assessment Programme)/UN-Water. 2018. “The United Nations World Water Development Report 2018: Nature-Based Solutions for Water.” Paris. <https://unesdoc.unesco.org/ark:/48223/pf0000261424/PDF/261424eng.pdf.multi>.

Additional References

- Arlati, Alessandro, Anne Rödl, Sopho Kanjaria-Christian, and Jörg Knieling. 2021. “Stakeholder Participation in the Planning and Design of Nature-Based Solutions. Insights from Clever Cities Project in Hamburg.” *Sustainability (Switzerland)* 13, no. 5 (March): 1–18. <https://doi.org/10.3390/SU13052572>.
- Cohen-Shacham, Emmanuelle, Angela Andrade, James Dalton, Nigel Dudley, Mike Jones, Chetan Kumar, Stewart Maginnis, et al. 2019. “Core Principles for Successfully Implementing and Upscaling Nature-Based Solutions.” *Environmental Science and Policy* 98. <https://doi.org/10.1016/j.envsci.2019.04.014>.
- Croeser, Thami, Georgia E. Garrard, Freya M. Thomas, Trinh Duc Tran, Ian Mell, Sarah Clement, Raúl Sánchez, and Sarah Bekessy. 2021. “Diagnosing Delivery Capabilities on a Large International Nature-Based Solutions Project.” *Npj Urban Sustainability* 1, no. 1. <https://doi.org/10.1038/s42949-021-00036-8>.
- Davies, Clive, and Raffaele Laforteza. 2019. “Transitional Path to the Adoption of Nature-Based Solutions.” *Land Use Policy* 80, no. January (January): 406–9. <https://doi.org/10.1016/J.LANDUSEPOL.2018.09.020>.
- Dorst, Hade, Alexander van der Jagt, Rob Raven, and Hens Runhaar. 2019. “Urban Greening through Nature-Based Solutions – Key Characteristics of an Emerging Concept.” *Sustainable Cities and Society*. <https://doi.org/10.1016/j.scs.2019.101620>.
- Erbaugh, James T., and Johan A. Oldekop. 2018. “Forest Landscape Restoration for Livelihoods and Well-Being.” *Current Opinion in Environmental Sustainability* 32, no. June (June): 76–83. <https://doi.org/10.1016/J.COSUST.2018.05.007>.
- Ferreira, Vera, Ana Paula Barreira, Luís Loures, Dulce Antunes, and Thomas Panagopoulos. 2020. “Stakeholders’ Engagement on Nature-Based Solutions: A Systematic Literature Review.” *Sustainability* 2020, Vol. 12, Page 640 12, no. 2 (January): 640. <https://doi.org/10.3390/SU12020640>.
- Frantzeskaki, Niki, Sara Borgström, Leen Gorissen, Markus Egermann, and Franziska Ehnert. 2017. “Nature-Based Solutions Accelerating Urban Sustainability Transitions in Cities: Lessons from Dresden, Genk and Stockholm Cities.”. https://doi.org/10.1007/978-3-319-56091-5_5.
- Frantzeskaki, Niki, Timon McPhearson, Marcus J. Collier, Dave Kendal, Harriet Bulkeley, Adina Dumitru, Claire Walsh, et al. 2019. “Nature-Based Solutions for Urban Climate Change Adaptation: Linking Science, Policy, and Practice Communities for Evidence-Based Decision-Making.” *BioScience* 69, no. 6 (June): 455–66. <https://doi.org/10.1093/BIOSCI/BIZ042>.
- Habibipour, Abdolrasoul, Anna Ståhlbröst, Spela Zalokar, Ines Vaittinen, Joëlle Mastelic, Agnieszka Włodarczyk-Gębik, Wojciech Przybylski, et al. n.d. “LIVING LAB HANDBOOK FOR URBAN LIVING LABS DEVELOPING NATURE-BASED SOLUTIONS TABLE OF CONTENT TABLE OF CONTENT AUTHORS.” Accessed January 27, 2022. <https://unalab.eu/>.

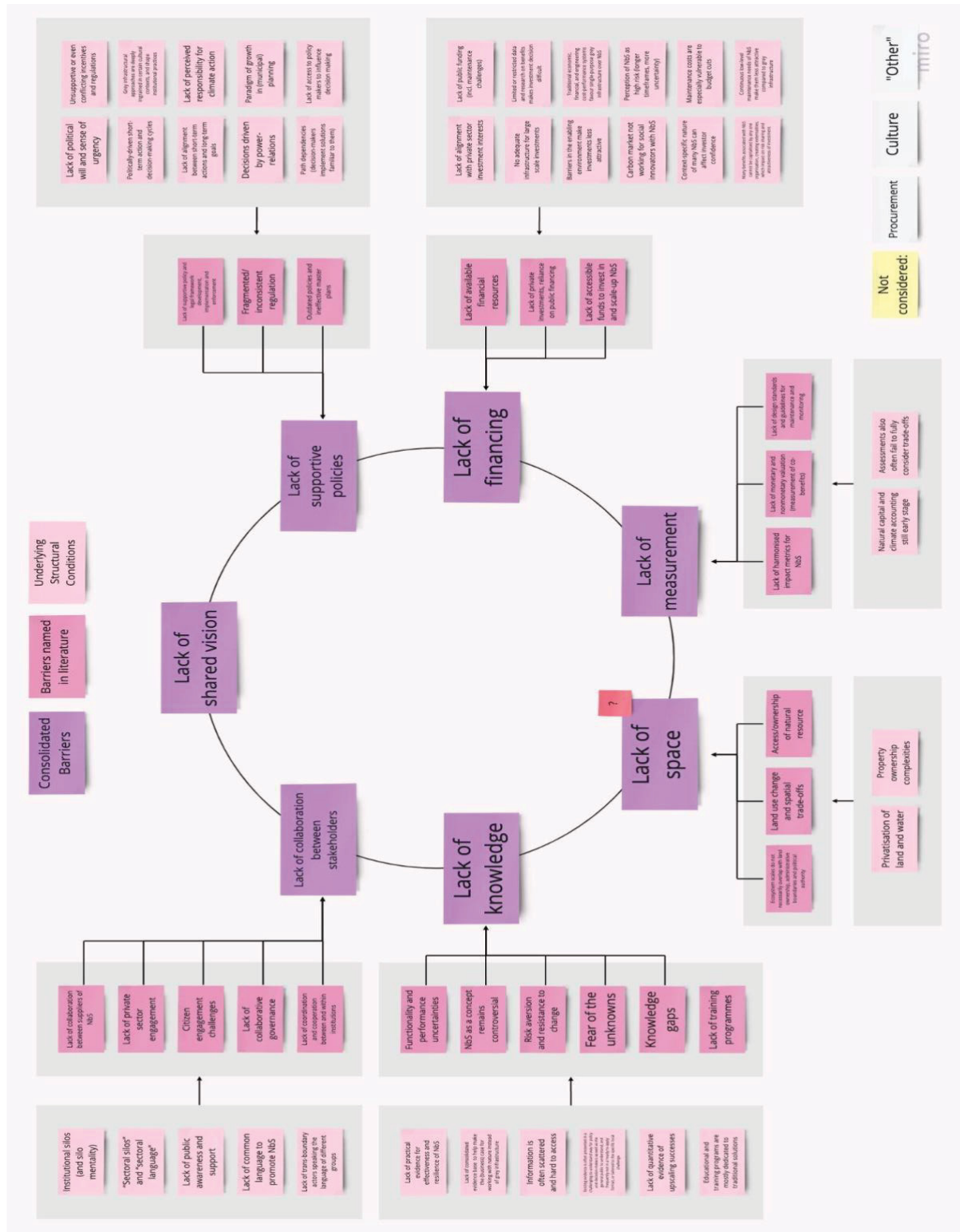
- Kati, Vierikko, and Niemelä Jari. 2016. "Bottom-up Thinking-Identifying Socio-Cultural Values of Ecosystem Services in Local Blue-Green Infrastructure Planning in Helsinki, Finland." *Land Use Policy* 50. <https://doi.org/10.1016/j.landusepol.2015.09.031>.
- Kooijman, Esmee D, Siobhan Mcquaid, Mary-Lee Rhodes, Marcus J Collier, and Francesco Pilla. 2021. "Innovating with Nature: From Nature-Based Solutions to Nature-Based Enterprises" 13: 1263. <https://doi.org/10.3390/su13031263>.
- Mahmoud, Israa H., Eugenio Morello, Chiara Vona, Maria Benciolini, Iliriana Sejdullahu, Marina Trentin, and Karnele Herranz Pascual. 2021. "Setting the Social Monitoring Framework for Nature-Based Solutions Impact: Methodological Approach and Pre-Greening Measurements in the Case Study from Clever Cities Milan." *Sustainability (Switzerland)* 13, no. 17 (September). <https://doi.org/10.3390/SU13179672/S1>.
- Mahmoud, Israa, and Eugenio Morello. 2019. "Co-Creation Pathway for Urban Nature-Based Solutions: Testing a Shared-Governance Approach in Three Cities and Nine Action Labs." *Green Energy and Technology*, December (December), 259–76. https://doi.org/10.1007/978-3-030-57764-3_17.
- Mendonça, Rita, Peter Roebeling, Teresa Fidélis, and Miguel Saraiva. 2021. "Policy Instruments to Encourage the Adoption of Nature-Based Solutions in Urban Landscapes." <https://doi.org/10.3390/resources10080081>.
- Randrup, Thomas B., Arjen Buijs, Cecil C. Konijnendijk, and Tom Wild. 2020. "Moving beyond the Nature-Based Solutions Discourse: Introducing Nature-Based Thinking." *Urban Ecosystems* 23, no. 4. <https://doi.org/10.1007/s11252-020-00964-w>.
- Sarabi, Shahryar, Qi Han, A. Georges L. Romme, Bauke de Vries, Rianne Valkenburg, Elke den Ouden, Spela Zalokar, and Laura Wendling. 2021. "Barriers to the Adoption of Urban Living Labs for NBS Implementation: A Systemic Perspective." *Sustainability* 13, no. 23 (November): 13276. <https://doi.org/10.3390/SU132313276/S1>.
- Seddon, Nathalie, Alison Smith, Pete Smith, Isabel Key, Alexandre Chausson, Cécile Girardin, Jo House, Shilpi Srivastava, and Beth Turner. 2021. "Getting the Message Right on Nature-Based Solutions to Climate Change." *Global Change Biology* 27, no. 8. <https://doi.org/10.1111/gcb.15513>.
- Toxopeus, Helen, and Friedemann Polzin. 2021. "Reviewing Financing Barriers and Strategies for Urban Nature-Based Solutions." *Journal of Environmental Management* 289. <https://doi.org/10.1016/j.jenvman.2021.112371>.
- Wamsler, C., J. Alkan-Olsson, H. Björn, H. Falck, H. Hanson, T. Oskarsson, E. Simonsson, and F. Zelmerlow. 2020. "Beyond Participation: When Citizen Engagement Leads to Undesirable Outcomes for Nature-Based Solutions and Climate Change Adaptation." *Climatic Change* 158, no. 2 (January): 235–54. <https://doi.org/10.1007/S10584-019-02557-9/TABLES/2>.
- Wang, Jingxia, and Ellen Banzhaf. 2018. "Towards a Better Understanding of Green Infrastructure: A Critical Review." *Ecological Indicators*. <https://doi.org/10.1016/j.ecolind.2017.09.018>.

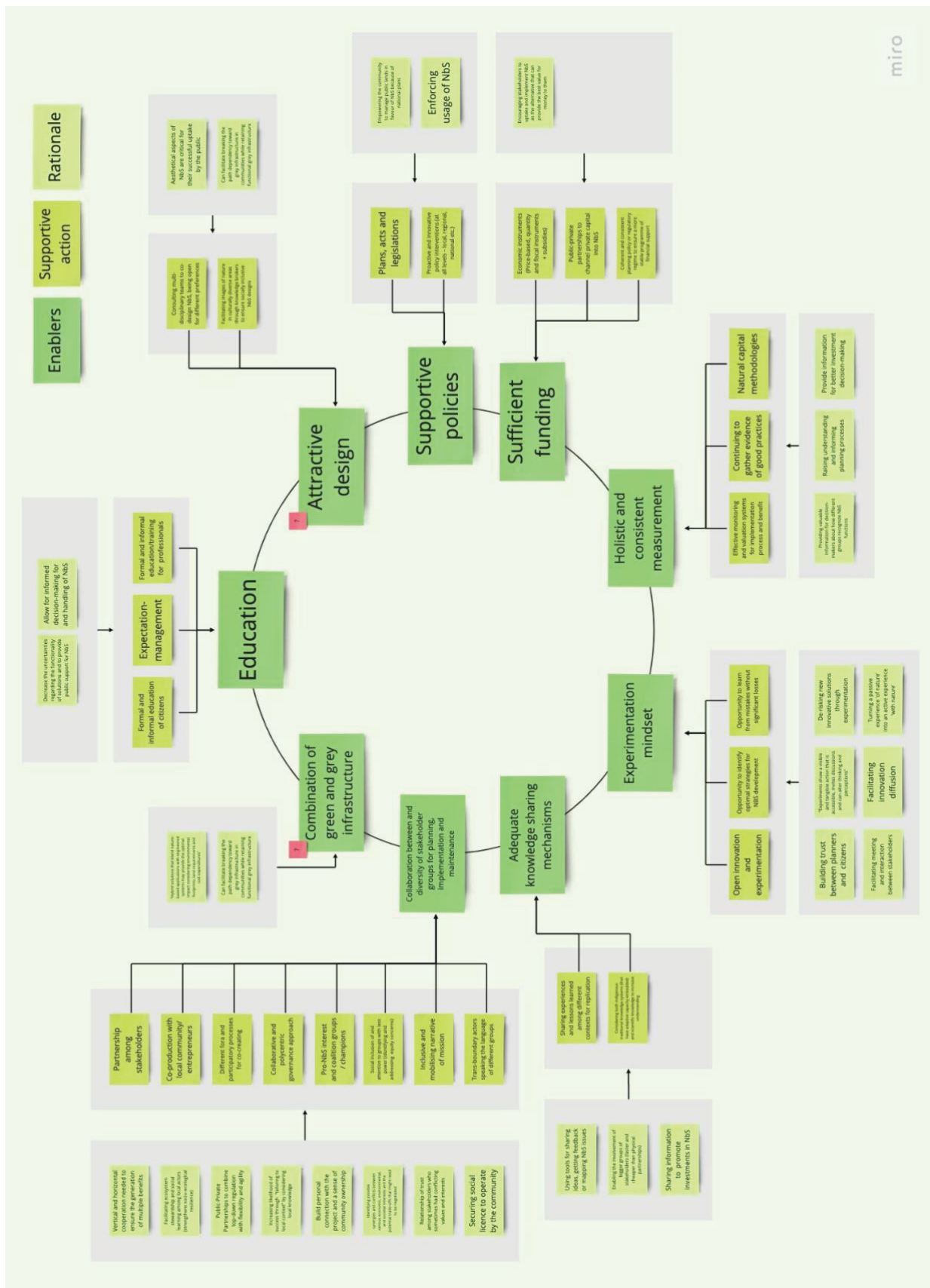
Welden, E. A., Alexandre Chausson, and Marina S. Melanidis. 2021. “Leveraging Nature-Based Solutions for Transformation: Reconnecting People and Nature.” *People and Nature* 3, no. 5 (October): 966–77. <https://doi.org/10.1002/PAN3.10212/SUPPINFO>.

Appendices

Appendix A – Conceptual Frameworks 1.0

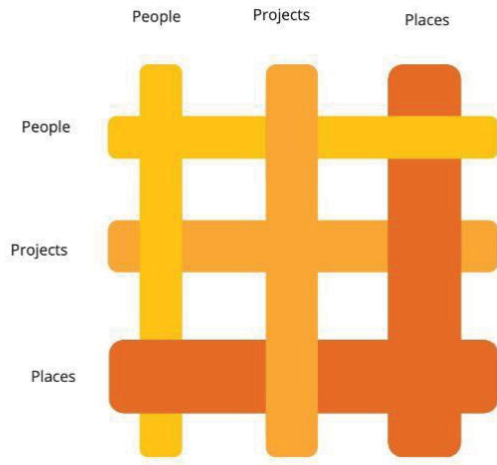
CF I 1.0 – Barriers & Enablers to scaling NbS to the landscape level



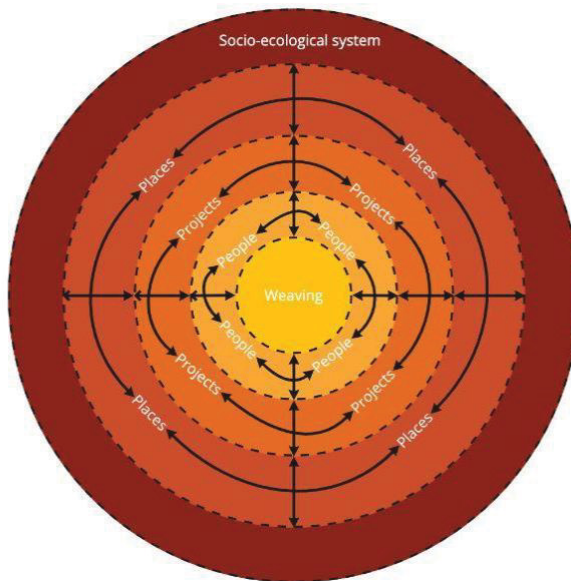


CF II 1.0 – Weaving

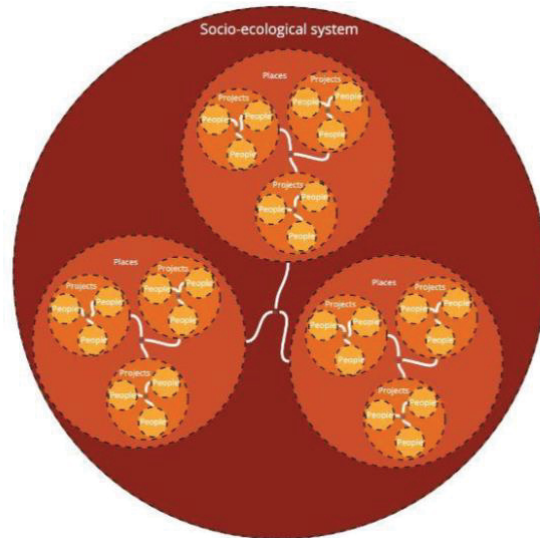
The practice of interconnecting **people**, **projects** and **places** in synergistic and purposeful ways



Vertical vs horizontal weaving

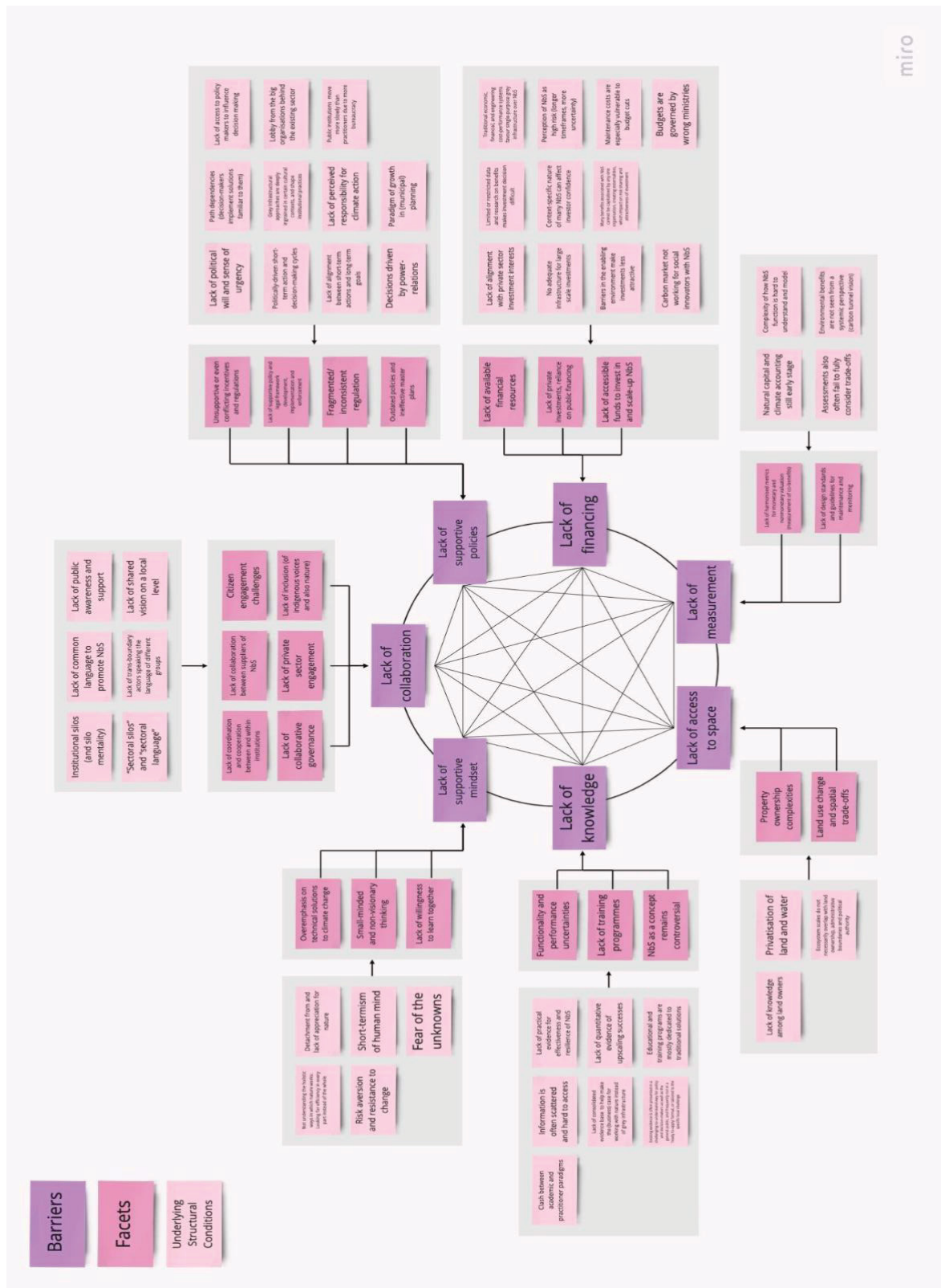


Holonic weaving

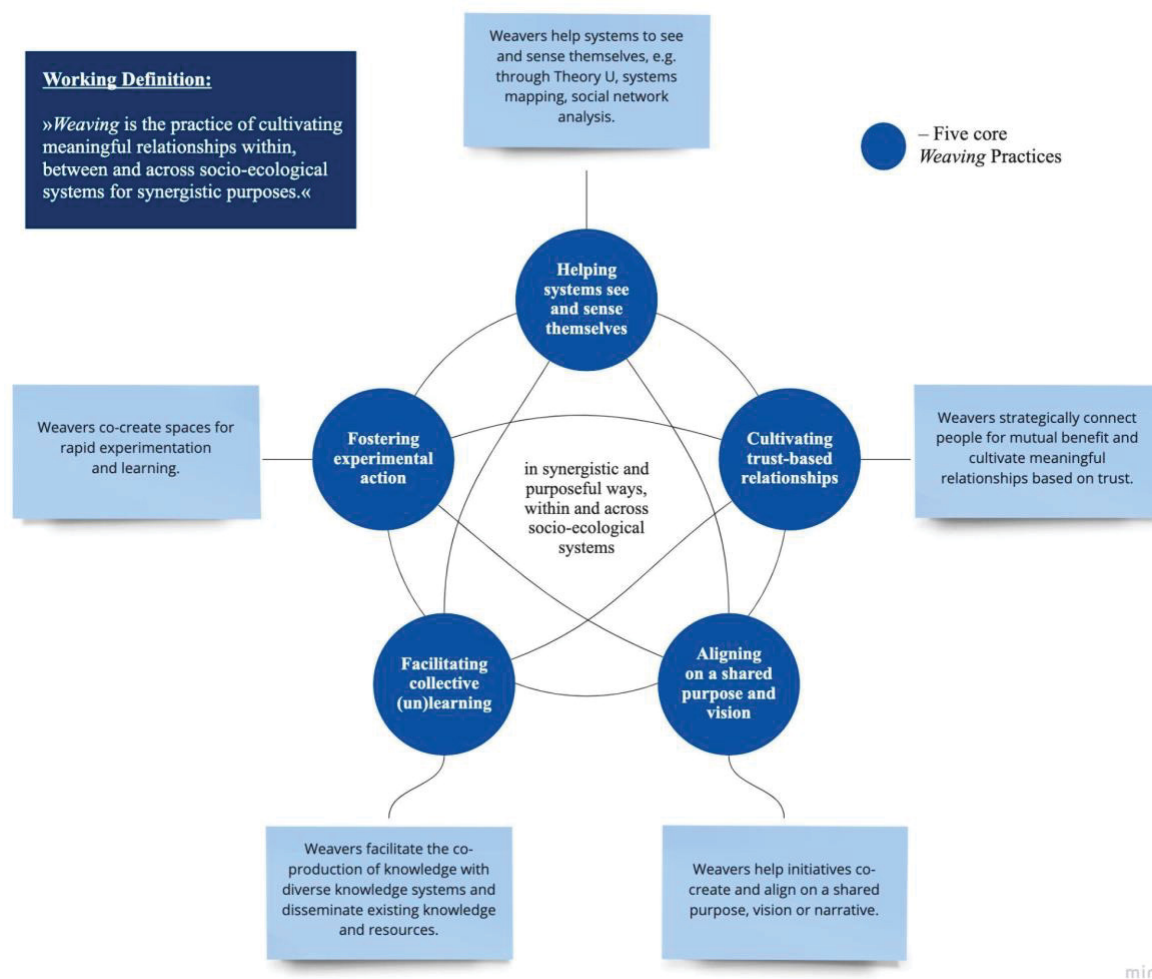


Appendix B – Conceptual Frameworks 2.0

CF I 2.0 – Barriers & Enablers to scaling NbS to the landscape level



CF II 2.0 – Weaving and Weaving Practices



Appendix C – List of Interviewees

INTERVIEWS CONDUCTED BY STUDENT RESEARCH TEAM					
Reference	Name	SQ	Description	# of academic papers	# of years in the field
Respondent #1	Karin Müller	1	Co-founder and executive director at Ashoka (Netherlands) with a history of working in social and cultural entrepreneurship, Lead author of the BWL Insights Report 2022		3+
Respondent #2	Matthieu Grosjean	1	Project Manager at Steinbeis Europa Zentrum (innovation consultancy for a sustainable society and responsible industrial change, IUCN expert on SmartCity and Nature-based Solutions)		5+
Respondent #3	Niki	1	Professor of Regional and Metropolitan Governance	5+	

	Frantzeskaki		and Planning (expert on urban NbS, published several influential papers on NbS)		
Respondent #4	Piet Haerens	1	Founder of Haedes (consultancy for marine and river NbS)		10+
Respondent #5	Shahryar Sarabi	1	Doctoral Candidate at the Department of Built Environment at Eindhoven University of Technology	5+	
Respondent #6		1	(wishes to stay anonymous)		4+
Respondent #7	Sven Jense	1	Founder at Climate Cleanup (support organisation for social entrepreneurs working with NbS)		5+
Respondent #8	Ties van der Hoeven	1	Founder of The Weather Makers (engineering firm aiming to regreen the Sinai desert through NbS)		5+
Respondent #9	Sarah Prosser	1, 2	Weaver in BWL (Ireland) experienced in community-based projects		8+
Respondent #10	Adrian Röbbke	2	Network Weaver, Lead of Business Development and Backbone Coordinator at the Weaving Lab		6+
Respondent #11	Aldo de Moor	2	PhD, owner CommunitySense - for working communities, process weaver, collaboration catalyst, systems convener	10+	
Respondent #12	Astrid Vargas	2	Weaver in large-scale landscape restoration initiative in Spain (AlVelAl)		28+
Respondent #13	Bruce Goldstein	2	Associate Professor in Environmental Design and the Environmental Studies Program at the University of Colorado Boulder, and a faculty research associate in the Institute for Behavioral Science (focus on Netweaving)	5+	
Respondent #14	Dieter Van den Broeck	2	Design Strategist and Facilitator Head of 4 Returns Labs at Commonland (Weaver)		15
Respondent #15	Florentina Bajraktari	2	Program Manager of the Societal Transformation Lab at Presencing Institute, Facilitator and designer of engagement for more equitable social systems worldwide (Weaver)		5+
Respondent #16	Jenny Anderson	2	Regenerative practitioner, creative strategist, evolutionary catalyst, future storyteller, and agent for change to a regenerative economy (Weaver)		10+
Respondent #17	Katie Stubley	2	Director at MacroScope Solutions (Australia), specialized in social design & systems change (Weaver)		14+
Respondent #18	Michael Sillion	2	Weaver, Future Navigator & Captain Future at Future Navigators Crew (Sweden), exploring, prototyping, and navigating a new path into an unknown complex future		5+
Respondent #19	Roos van der Deijl	2	Tools & Platform Developer at Commonland (working with the 4 Return platform for landscape restoration, weaver)		4+

Respondent #20	Ross Hall	2	Founder and leader of The Weaving Lab (Weaver)		15+
Respondent #21	Sandra Waddock	2	Galligan Chair of Strategy at Carroll School Scholar of Corporate Responsibility, and Professor of Management at Boston College's Carroll School of Management. Researcher on system transformation, stewardship of the future and others	10+	
INTERVIEWS CONDUCTED BY ASHOKA					
Reference	Name	SQ	Description	# of academic papers	# of years in the field
Respondent #22	Antonio Stasi	1	From social enterprise 'Vazapp' (providing farmers opportunity to exchange experiences, encourage cooperation, and disseminate knowledge through organising cultural events)		5+
Respondent #23	Bach Kim Nguyen	1	From social enterprise 'BeeOdiversity' (redefining the role of bees in our ecosystems through offering and innovative scientific monitoring tool using bees as drones to capture valuable data about the environment)		5+
Respondent #24	Brendan Dunford	1	From social enterprise 'Farming for Nature' (recognising, supporting, and rewarding farmers for working on the improvement of their farms' environmental health)		10+
Respondent #25	Daniela Ibarra-Howell	1	From social enterprise 'Savory Institute' (equipping land managers with innovative tools and curricula for holistic management of land via the establishment of regional hubs)		10+
Respondent #26	Geert van der Veer	1	From of social enterprise 'Herenboeren' (supporting families in developing self-owned nature-driven cooperative farms)		5+
Respondent #27	Giuseppe Savio	1	From social enterprise 'Vazapp' (providing farmers opportunity to exchange experiences, encourage cooperation, and disseminate knowledge through organising cultural events)		5+
Respondent #28	Jacek Bożek	1	From social enterprise 'Klub Gaja' (engaging citizens in taking practical actions for the natural environment and animal rights, like planting trees with the community or schools)		10+
Respondent #29	Pam Warhurst	1	From social enterprise 'Incredible Edible' (inspiring citizens to grow food in public spaces and share it across their communities to enhance active citizenship)		5+
Respondent #30	Wietse van der Werf	1	From social enterprise 'Sea Ranger Service' (training unemployed youth to become Sea Rangers to protect the ocean and restore ocean biodiversity at scale)		5+

Appendix D – Interview Questions (Student Team)

Because the interviews were conducted in a semi-structured approach, the question list varied slightly between the interviews. The list of questions also evolved over time due to the iterative and interactive research approach that was taken to account for newly gained insights in the following interviews. The general skeleton of questions, however, remained widely the same.

Interview Questions for Sub Question 1

(SQ 1: What are Barriers and Enablers to scaling NbS to the landscape scale?)

MODULE 1:	CONCEPT OF NBS
Question 1:	Can you share with us your definition of NbS?
Question 2:	What do NbS look like on the landscape level? Can you give us 1-2 examples?
Question 3:	How, in your eyes, are NbS connected to sustainable development?
MODULE 2:	FACTORS INFLUENCING SCALING SUCCESS
Question 4:	So you have received our attempt of consolidating Barriers and Enablers from the literature. Do you have any general comments on this?
Question 5:	How do the Barriers and Enablers to scaling NbS differ between urban and landscape settings?
Question 6:	<p>Beyond the ones from urban settings, some literature suggests that additional key barriers on the landscape level are:</p> <ul style="list-style-type: none"> - A lack of quantitative evidence of upscaling successes - Increased pressure on governance structures as (more) different actors and departments have to collaborate (ecosystem scales do not necessarily overlap with land ownership, administrative boundaries and political authority) - Land can be overwhelmingly owned by actors who put their financial interests over environmental goals - Knowledge, practices and technologies have to be transformed to and made applicable at larger scale - Even more site-specific knowledge is required due to great variability and variation in how ecosystems behave <p>What do you think about these? Are there any landscape-level-specific barriers that you can think of?</p>
MODULE 3:	PROPERTIES OF BARRIERS AND ENABLERS
Question 7:	Would you support the insight that barriers and enablers are highly context dependent? If so, can you give us an example?
Question 8:	Would you support the insight that barriers and enablers are highly interconnected? If so, can you give us an example?
MODULE 4:	BEST PRACTICES
Question 9:	How do you think can Enablers best be scaled?
MODULE 5:	WRAP UP
Question 10:	<p>Any other questions / remarks from the team?</p> <p>Any other questions / remarks from you?</p>

Interview Questions for Sub Question 2

(SQ 2: What are *Weaving* and *Weaving Practices*?)

MODULE 1:	<i>WEAVING AND WEAVING PRACTICES</i>
Question 1:	What does <i>Weaving</i> mean to you? How would you define <i>Weaving</i> and why?
Question 2:	<p>In the scientific literature, <i>Weaving</i> is described as knowledge weaving or network weaving</p> <ul style="list-style-type: none"> - Knowledge weaving is “a process through which multiple types of knowledge are equitably brought together to enable the reciprocal exchange of understanding for mutual learning and application” (Henri et al. 2021, 2) - “Netweavers support the health of a network by enabling the flow of ideas, building strong ties that facilitate information flow, and forging a common voice to promote systems change. Netweavers knit their networks together to develop collective capacity to overcome resistance to systems change” (Goldstein, Smith, and Ryan 2021) - According to the Weaving Lab, “Weaving is the practice of interconnecting people, projects and places in synergistic and purposeful ways.” <p>How do you feel about these definitions? Can it be improved? Is something missing?</p>
Question 3:	Could you name specific practices that particularly weavers do?
Question 4:	Can you share an example of how the BWL Collective ‘weaves’ and at what levels?
Question 5:	Are there any related practices or concepts that are similar to <i>Weaving</i> ? Do you feel <i>Weaving</i> is something unique?
MODULE 3:	SUSTAINABILITY
Question 6:	How does <i>Weaving</i> connect to the sustainability challenge and sustainable development?
Question 7:	How does <i>Weaving</i> relate to landscape restoration?
MODULE 3:	COMMUNICATION
Question 8:	How have people responded to the concept of <i>Weaving</i> ?
Question 9:	How do you see the role of narrative and metaphors when communicating the concept of <i>Weaving</i> ?
Question 10:	How would you visualise <i>Weaving</i> ?
MODULE 3:	BEST PRACTICES
Question 11:	Do you have best practices in <i>Weaving</i> ?
Question 12:	What difficulties did you face during the <i>Weaving</i> process and how did you overcome them?
MODULE 3:	WRAP-UP
Question 13:	<p>Any other questions / remarks from the team?</p> <p>Any other questions / remarks from you?</p>

Appendix E – Interview Questions (Ashoka)

Similarly to the research conducted by the student research team, the question list for the interviews conducted by Ashoka also varied slightly between interviews. The general outline of the questions, however, was as follows.

Question 1:	What was the initial root problem you identified, what was the context and what was the personal trigger to address it?
Question 2:	How do you define a thriving ecosystem and what about your innovation contributes to its creation?
Question 3:	What are your innovation's specific capacities, as a social innovation, that put you in a good position to address the root causes of the problem that you are focused on?
Question 4:	To what extent do you identify your innovation as a 'nature-based solution' and why or why not?
Question 5:	How is the community providing input in the design, planning and implementation of interventions?
Question 6:	How is the innovation currently influential at local, national or global governance scales? Who do you need to influence and why?
Question 7:	What institutional barriers do you/your innovation face, and how do you address them?

Appendix F – Codes for SQ 1

For sub question 1, mainly the barriers and enablers identified in the literature were used to code the interviews. Inductive category building was applied where interviewees mentioned relevant points that were not yet covered in the literature.

BARRIERS			
	Themes	Codes (Barriers)	Codes (Underlying structural conditions)
Deductive (from literature)	Lack of collaboration	<ul style="list-style-type: none"> • Lack of cooperation between and within institutions • Citizen engagement challenges • Lack of collaborative governance • Lack of private sector engagement 	<ul style="list-style-type: none"> • Silos • Lack of common language • Lack of public awareness • Lack of trans-boundary actors • Lack of shared vision
	Lack of supportive policies	<ul style="list-style-type: none"> • Unsupportive/ conflicting regulations • Lack of supportive policy development, implementation and enforcement • Fragmented/ inconsistent regulation • Outdated policies 	<ul style="list-style-type: none"> • Lack of political will and sense of urgency • Short-termism • Power-relations • Path dependencies • Lack of perceived responsibility • Lack of access to policy makers
	Lack of financing	<ul style="list-style-type: none"> • Lack of available financial resources • Lack of private investments, reliance on public financing 	<ul style="list-style-type: none"> • Lack of alignment with private sector investment interests • No adequate infrastructure for large scale investments

			<ul style="list-style-type: none"> Carbon market not working for social innovators with NbS Investment risk Investment decision-making based on old measurement
	Lack of measurement	<ul style="list-style-type: none"> Lack of harmonised metrics for monetary and nonmonetary valuation Lack of design standards 	<ul style="list-style-type: none"> Natural capital and climate accounting still early stage
	Lack of space	<ul style="list-style-type: none"> Property ownership complexities Spatial trade-offs 	<ul style="list-style-type: none"> Privatisation of land and water Ecosystem scales \neq land ownership \neq administrative boundaries
	Lack of knowledge	<ul style="list-style-type: none"> Functionality and performance uncertainties Lack of training programmes 	<ul style="list-style-type: none"> Lack of quantitative evidence of upscaling successes Educational and training programs dedicated to traditional solutions Information is scattered Lack of consolidated evidence base for (business) case
Inductive code	Lack of supportive mindset	<ul style="list-style-type: none"> Small-minded, non-visionary thinking Overemphasis on technical solutions to climate change Lack of willingness to learn together 	<ul style="list-style-type: none"> Detachment from and lack of appreciation for nature Short-termism of human mind Fear of the unknowns Risk aversion and resistance to change
ENABLERS			
	Themes	Codes (Enablers/Supportive action)	Codes (Rationale)
Deductive (from literature)	Collaboration	<ul style="list-style-type: none"> Foster partnerships Fora and participatory processes Inclusive and mobilising narrative Trans-boundary actors 	<ul style="list-style-type: none"> Secures social licence to operate by the community Tailored to local context Identify possible synergies and conflicts between interests Sense of community ownership and ecosystem stewardship
	Supportive policies and plans	<ul style="list-style-type: none"> Supportive plans, acts and legislations on all levels Debureaucratise on all governmental levels 	<ul style="list-style-type: none"> Enforces implementation and usage of NbS Empowers community to manage public lands in favour of NbS
	Supportive financing	<ul style="list-style-type: none"> Economic instruments Public-private partnerships Stable programme of financial support through coherent and consistent regulatory regime 	<ul style="list-style-type: none"> Encourages uptake of NbS with best value for money
	Measurement	<ul style="list-style-type: none"> Monitoring and valuation systems for implementation process and benefits Develop natural capital methodologies Harmonise different measurement systems 	<ul style="list-style-type: none"> Provides information for better policy and spatial planning decision-making Provides information for better investment decision-making

	Knowledge sharing	<ul style="list-style-type: none"> • Share experiences and lessons learned for replication • Tools for sharing ideas, getting feedback or mapping NbS issues • Consider both indigenous traditional knowledge systems 	<ul style="list-style-type: none"> • Speeds up uptake and increases likelihood of success
	Education	<ul style="list-style-type: none"> • Educate citizens formally and informally • Educate and train professionals formally and informally 	<ul style="list-style-type: none"> • Decreases the uncertainties regarding • Allows informed decision-making
	Experimental mindset	<ul style="list-style-type: none"> • Open innovation and experimentation • Opportunity to learn from mistakes without significant losses • Opportunity to identify optimal strategies for NbS development 	<ul style="list-style-type: none"> • De-risks new innovative solutions through iterative testing • Facilitates innovation diffusion • Facilitates encounters and interaction between stakeholders, building trust
	Attractive design	<ul style="list-style-type: none"> • Multi-disciplinary teams to co-design NbS • Open for different preferences 	<ul style="list-style-type: none"> • Increases likelihood of successful uptake by the public • Can help breaking the path dependency
	Combination of green and grey	<ul style="list-style-type: none"> • Combination of green and grey 	<ul style="list-style-type: none"> • Can help breaking the path dependencies

Appendix G – Codes for SQ 2

WEAVING (DEDUCTIVE CODING)	
Themes	Codes
Knowledge weaving	<ul style="list-style-type: none"> • Sense-making process • Sharing knowledge, practices, initiatives, resources • Reciprocal exchange of understanding • Mutual learning and application • Co-production of knowledge • Weaving knowledge systems
Network weaving	<ul style="list-style-type: none"> • Making sense of the system • System mapping • Enhancing communication • Facilitating connections • Connecting synergistically
Leadership practices	<ul style="list-style-type: none"> • Sustainability leadership • Ecosystem leadership • Regenerative leadership • Relational leadership
Sustainability	<ul style="list-style-type: none"> • Wicked problems need interconnected solutions • Holistic approach • Systemic approach • System transformation
Connecting	<ul style="list-style-type: none"> • Enhance strategic connection among elements of the system

	<ul style="list-style-type: none"> ● Enhance connection between change-makers ● Build networks connecting individuals ● Creating purposeful and synergistic relationships between projects, places and people
Shared vision	<ul style="list-style-type: none"> ● Cohere shared vision ● Mediate different interests ● Establish a coherent and aligned vision or purpose. ● Bring initiatives into alignment around shared aspirations.
Experimentation	<ul style="list-style-type: none"> ● Creating spaces for radical action-learning cycles ● Creating spaces for experimentation ● Creating a space for questioning, exploring and analysing assumptions
Collaboration	<ul style="list-style-type: none"> ● Fostering collaborations for systemic impact ● Enhance collaboration for network learning and development
Learning	<ul style="list-style-type: none"> ● Facilitate knowledge dissemination ● Create synergies between knowledge systems
Scales	<ul style="list-style-type: none"> ● Holonic weaving ● Socio-ecological system holarchy ● Interconnecting individuals, communities, bioregions
Narrative	<ul style="list-style-type: none"> ● Powerful narratives for future visions ● Role of storytelling in making change ● Images, and other symbols as visual representations
WEAVING (INDUCTIVE CATEGORY DEVELOPMENT)	
Themes	Codes
Weaving	<ul style="list-style-type: none"> ● Connecting community ● Collaborating for systemic change ● Learning together ● Embodying universal wellbeing
Knowledge weaving	<ul style="list-style-type: none"> ● Sharing knowledge ● Knowledge dissemination ● Co-learning ● Sharing practices
Network weaving	<ul style="list-style-type: none"> ● Building relationships ● Connecting people ● Connecting synergistically and purposefully
Leadership practices	<ul style="list-style-type: none"> ● Embodying universal wellbeing ● Cultivating ecosystems ● Collaborating for systemic change ● Learning collectively
Sustainability	<ul style="list-style-type: none"> ● Weaving as systemic approach to sustainability challenges ● Addressing socio-ecological issues ● Interconnected solutions and innovations ● Mindset shift
Weaving practices	<ul style="list-style-type: none"> ● Cultivating trust-based relationships ● Co-creating shared visions ● Alignment on a shared vision and purpose ● Facilitating collaboration ● Facilitating experimentation, prototyping, implementation ● Knowledge sharing

Scales	<ul style="list-style-type: none"> • Horizontal weaving • Vertical weaving
Narrative	<ul style="list-style-type: none"> • Power of metaphors • Telling new stories of connection and hope • Inspiration from natural patterns • Social fabric • Embodiment • Tapestry • Web of life

Appendix H – List of Barriers & Underlying Structural Conditions

BARRIER	UNDERLYING STRUCTURAL CONDITIONS	REFERENCES
Lack of collaboration	<ul style="list-style-type: none"> • Institutional silos, silo mentality and sectoral language • Lack of public awareness and support • Lack of common language to promote NbS and lack of trans-boundary actors speaking the language of different groups 	<p>(Dorst et al. 2022; Müller et al. 2022; McQuaid et al. 2021; Price 2021; Thorn et al. 2021; Sarabi et al. 2020; Schmalzbauer 2018; Kabisch et al. 2016)</p> <p>Respondents #1, 7, 8, and 9</p>
Lack of supportive policies	<ul style="list-style-type: none"> • Lack of political will and sense of urgency • Politically driven short-term action and decision-making cycles • Lack of alignment between short-term actions and long-term goals • Decisions driven by power-relations • Path dependencies: Decision-makers implement solutions familiar to them • Lack of perceived responsibility for climate action • Paradigm of growth in (municipal) planning • Lack of access to policy makers to influence decision making • Strong lobby from the big organisations behind the existing sector 	<p>(Dorst et al. 2022; Müller et al. 2022; McQuaid et al. 2021; Price 2021; Thorn et al. 2021; Sarabi et al. 2020; Schmalzbauer 2018; Kabisch et al. 2016; Seddon et al. 2020)</p> <p>Respondents #5, 7, 9, 22, 24, 25, 26, 28, and 30</p>
Lack of financing	<p>Private</p> <ul style="list-style-type: none"> • Lack of alignment with private sector investment interests • No adequate infrastructure for large scale investments and lack of accessible funds to invest in and scale up NbS • Barriers in the enabling environment make investments less attractive • Carbon market not working for social innovators with NbS • Context-specific nature of many NbS can affect investor confidence • Limited or restricted data and research on benefits makes investment decision difficult • Many benefits associated with NbS cannot be capitalised by any one organisation, creating externalities, which impact on risk sharing and attractiveness of investment • Perception of NbS as high risk (longer timeframes, more uncertainty) <p>Public</p> <ul style="list-style-type: none"> • Lack of public funding (incl. maintenance challenges) 	<p>(Dorst et al. 2022; Müller et al. 2022; McQuaid et al. 2021; Price 2021; Thorn et al. 2021; Sarabi et al. 2020; Schmalzbauer 2018; Seddon et al. 2020)</p> <p>Respondents #1, 2, 4, 5, 6, 7, 8, 9, 24, 27, and 29</p>

	<ul style="list-style-type: none"> Traditional economic, financial, and engineering cost-performance systems favour single-purpose grey infrastructure over NbS Maintenance costs are especially vulnerable to budget cuts 	
Lack of measurement	<ul style="list-style-type: none"> Multi-functionality and cross-sectoral governance of NbS increases complexity in impact measurement and modelling Natural capital and climate accounting still early stage Lack of harmonisation between measurement approaches Assessments often fail to fully consider trade-offs 	(Müller et al. 2022; McQuaid et al. 2021; Price 2021; Thorn et al. 2021; Sarabi et al. 2020; Schmalzbauer 2018; Seddon et al. 2020) Respondents #1, 2, 5, 8, 9, 23, and 29
Lack of access to space	<ul style="list-style-type: none"> Property ownership complexities – Ecosystem scales do not necessarily overlap with land ownership, administrative boundaries, and political authority Privatisation of land and water Spatial planning trade-offs Lack of knowledge and awareness among landowners 	(Dorst et al. 2022; McQuaid et al. 2021; Price 2021; Thorn et al. 2021; Sarabi et al. 2020) Respondents #3, 4, 6, and 8
Lack of knowledge	<ul style="list-style-type: none"> Lack of practical and quantitative evidence for effectiveness and resilience of NbS as well as upscaling successes Lack of consolidated evidence base to help make the (business) case for NbS over grey infrastructure Information often scattered and hard to access Existing evidence is often presented in a challenging-to-understand way for policy and decision-makers as well as the general public, and frequently not in a ‘ready-to-apply’ format, or tailored to the specific local challenge Lack of coordination and communication between academic research and practitioners Educational and training programs are mostly dedicated to traditional solutions 	(Dorst et al. 2022; Müller et al. 2022; McQuaid et al. 2021; Price 2021; Sarabi et al. 2020; Schmalzbauer 2018) Respondents #3, 5, 8, and 9
Lack of supportive mindset	<ul style="list-style-type: none"> Fear of the unknowns Risk aversion and resistance to change Paradigm of human separation from and dominance over nature 	(Solheim et al. 2021; Sarabi et al. 2020; Kabisch et al. 2016) Respondents #1, 4, 8, 9, and 24

Appendix I – List of Enablers & respective Rationale

ENABLER	RATIONALE	REFERENCES
Trustful co-creation with a diversity of stakeholder groups	<ul style="list-style-type: none"> Secures social licence to operate by the community Vertical and horizontal cooperation needed to ensure the generation of multi-functional benefits Builds personal connection with the project and a sense of community ownership Enables greater ecosystem stewardship and social learning among local actors (strengthens socio-ecological resilience) Public-Private Partnerships combine top-down regulation with flexibility and agility Increases likelihood of success by considering local knowledge to “tailor to local context” Helps to identify possible synergies and conflicts between various economic, environmental, and societal interests and the potential trade-offs that 	(Martin et al. 2021; McQuaid et al. 2021; Price 2021; Frantzeskaki 2019; Sarabi et al. 2019; Schmalzbauer 2018) Respondent #1, 5, and 9

	might need to be negotiated	
Supportive policies and plans	<ul style="list-style-type: none"> • Empowers the community to manage public lands in favour of NbS because of national/regional/local plans • Enforces usage of NbS 	<p>(McQuaid et al. 2021; Price 2021; Sarabi et al. 2019)</p> <p>Respondent, #5, 9, and 25</p>
Supportive financing	<ul style="list-style-type: none"> • Encourages stakeholders to uptake and implement NbS as the alternative that can provide the best value for money 	<p>(Martin et al. 2021; McQuaid et al. 2021; Price 2021; Frantzeskaki 2019; Sarabi et al. 2019; Schmalzbauer 2018)</p> <p>Respondent #1, 2, 4, 6, 7, and 9</p>
Holistic and consistent measurement	<ul style="list-style-type: none"> • Provides valuable information for political decision-makers about how different groups recognize NbS functions • Provides information for better investment decision-making 	<p>(McQuaid et al. 2021; Price 2021; Sarabi et al. 2019)</p> <p>Respondent #1, 3, 5, 7, 8, and 9</p>
Adequate knowledge sharing mechanisms	<ul style="list-style-type: none"> • Speeds up uptake and increases likelihood of success for other projects 	<p>(McQuaid et al. 2021; Price 2021; Sarabi et al. 2019; Frantzeskaki 2019)</p> <p>Respondent #1 and 9</p>
Education of the public and professionals	<ul style="list-style-type: none"> • Decrease the uncertainties regarding the functionality of solutions and to provide public support for NbS • Allows for informed decision-making for and handling of NbS • Promotes investments in NbS • Helps to manage expectations 	<p>(Price 2021; Sarabi et al. 2019; Schmalzbauer 2018)</p> <p>Respondent #1, 2, 4, 8, and 9</p>
Experimental mindset	<ul style="list-style-type: none"> • Helps to identify optimal strategies for NbS development • Helps to learn from mistakes without significant losses • Reduces risks of innovative solutions through iterative testing • Visible and tangible action that is accessible, invites discussions and can alter thinking and perceptions – turns a passive experience ‘of nature’ into an active experience ‘with nature’ • Facilitates encounters and interaction between stakeholders • Facilitates innovation diffusion 	<p>(Frantzeskaki 2019; Sarabi et al. 2019)</p> <p>Respondent #4, 5, 7, 8, and 9</p>
Attractive design	<ul style="list-style-type: none"> • Aesthetical aspects of NbS are critical for their successful uptake by the public • Can help breaking the path dependency toward grey infrastructure in communities 	<p>(Frantzeskaki 2019; Sarabi et al. 2019)</p> <p>Respondent #1, 4, 5, 8, and 9</p>
Combination of green and grey infrastructure	<ul style="list-style-type: none"> • Can help breaking the path dependency toward grey infrastructure in communities while retaining functional grey infrastructure 	<p>(Martin et al. 2021; Sarabi et al. 2019)</p> <p>Respondent #3, 4, and 6</p>

Appendix J – Weaving-Related multi-level Collaborations Terms

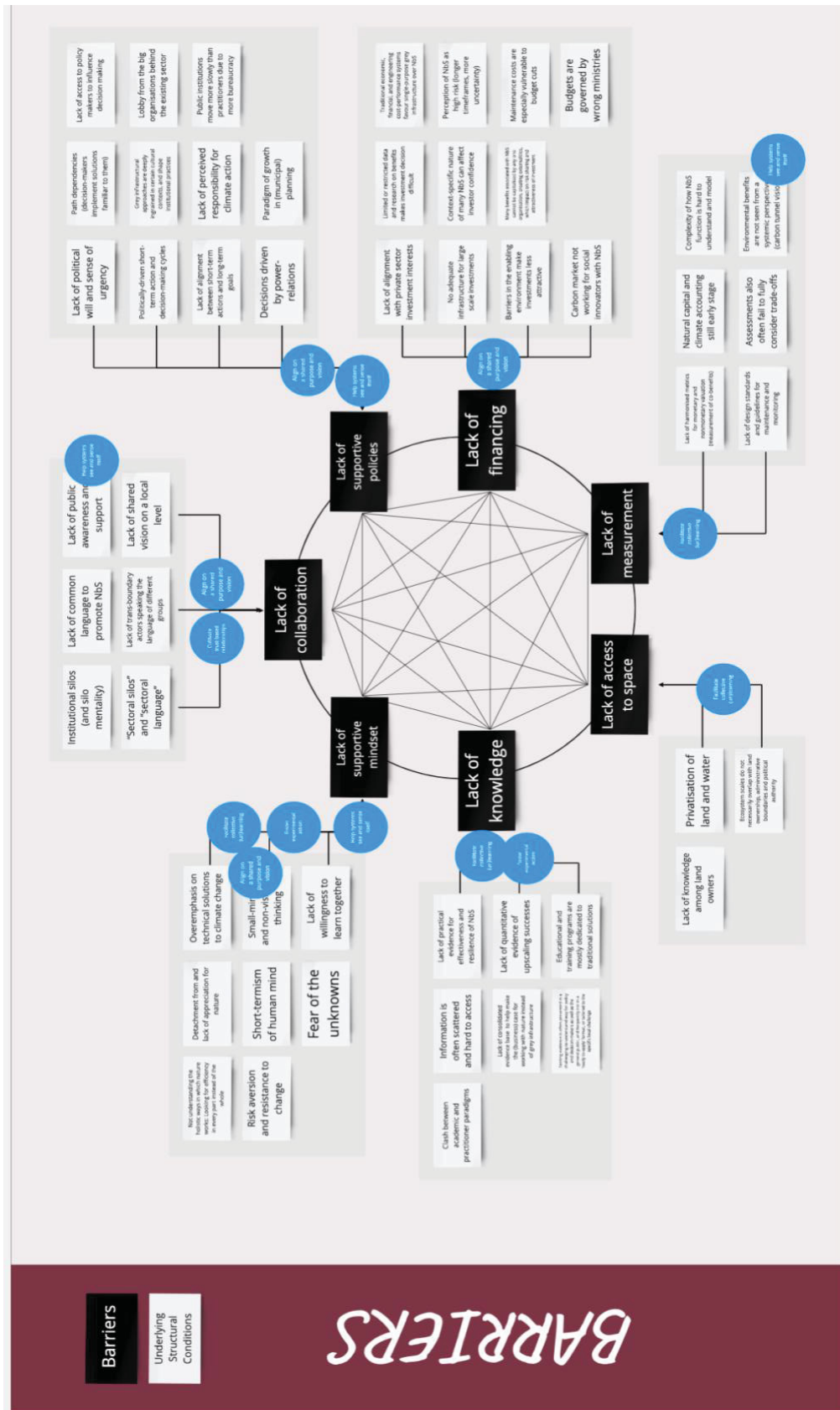
Related term	Definition	Focus	Systemic	Metaphor
Innovation brokers / intermediaries	“an organization or body that acts an agent or broker in any aspect of the innovation process between two or more parties” (Howells 2006, 720)	Innovation systems		
Cross-sector social partnerships	“cross-sector projects formed explicitly to address social issues and causes that actively engage the partners on an ongoing basis”. (Selsky and Parker 2005, 850)	Sectors		
Global Action Networks	“bringing together diverse groups and resources around the world to create the vision of how we can prosper as a common humanity and to actually create the depth and breadth of change that the vision demands. GANs are organisations and networks that join together under a common name to address a particular issue of public concern through a worldwide change strategy.” (Waddell 2003, 2)	Global networks		
Multi-stakeholder partnerships	“A process of interactive learning, empowerment and participatory governance that enables stakeholders with interconnected problems and ambitions, but often differing interests, to be collectively innovative and resilient when faced with the emerging risks, crises and opportunities of a complex and changing environment.” (Petit and Bovarnick 2020)	Stakeholders / Partnerships	•	
Knowledge weaving	“a process through which multiple types of knowledge are equitably brought together to enable the reciprocal exchange of understanding for mutual learning and application” (Henri et al. 2021, 2).	Knowledge systems		•
Network weaving	“Netweavers support the health of a network by enabling the flow of ideas, building strong ties that facilitate information flow, and forging a common voice to promote systems change. Netweavers knit their networks together to develop collective capacity to overcome resistance to systems change” (Goldstein, Smith, and Ryan 2021, 7)	Networks	•	•
Transformation catalyst	“Transformations catalysts (TCs) are promising organizing innovations specifically designed to address complexly wicked societal problems and opportunities and bring about purposeful system transformation. . . . Specifically, they connect, cohere, and amplify efforts of other initiatives in an attempt to overcome the fragmentation and lack of impact They help coalitions of actors emerge shared visions, goals, aspirations, or other narratives that enable them to align their efforts, even while they pursue their individual agendas”. (Waddock and Waddell 2021, 168)	Transformation systems	•	
Bioregional Weaving Labs	“Weaving is the practice of interconnecting people, projects and places to each other and to a shared purpose, fostering collaborations for systemic impact, facilitating collective learning and embodying the change we wish to see.” (Müller et al. 2022, 6)	Bioregions	•	•
Working definition	Weaving is the practice of cultivating meaningful relationships within, between and across socio-ecological systems for synergistic purposes.	Socio-ecological systems	•	•

Appendix K – Various Paradigms indicating the emerging Model of Leadership

(Adapted from Spencer-Keyes, Luksha, and Cubista 2020)

Leadership type	What is it?	Principal: Researchers, Practitioners, or Communities
Liminal	Mutually alert care and attention to the wellbeing of all people and ecological systems. Emphasis on relational characteristics, which cannot be bound to an individual, organization, nations, religions, or institutions rather the liminal between actors.	Nora Bateson, Stephen Tierney, Robert Tomes, George Por
Hosting	Hosting is a participatory and process-oriented way of engaging in meaningful conversations that lead to impactful work that matters.	Art of Hosting Global Community, Toke Møller, Margaret Wheatly, Mark McKergow
Servant	A servant-leader focuses primarily on the growth and well-being of people and the communities to which they belong, shares power, puts the needs of others first and helps people develop and perform as highly as possible.	Robert K. Greenleaf, Ken Blanchard, Stephen Covey, M. Scott Peck, Ann McGee- Cooper & Duane Trammell, Larry Spears, and Kent Keith. Frederic Laloux, Samantha Slade, Sociocracy 3.0
Horizontal, Teal, Agile	Networked, collaborative, and shared leadership approaches to organizing and co-creating projects, organizations, and initiatives that support continuous evolution, learning, and the prototyping of solutions, products, or services.	Frederic Laloux, Samantha Slade, Sociocracy 3.0, Global Agile Community, Teal 4 Teal Community, SCRUM community
Systems and Systemic	Understanding and addressing complex adaptive opportunities and challenges within systems, influencing leverage points toward desired outcomes, and working toward the long-term evolutionary viability of systems.	Peter Senge, The Academy For Systems Change, Bela Banathy, Alexander Laszlo, School For Systems Change, Emergent Strategy Ideation Institute, Systems Sanctuary
Chaordic	Chaordic Leadership is both a management style, and a system of organization characterized by the harmonious blending of both order and chaos principles where neither is dominant (e.g. competition and cooperation).	Dee Hock, Art of Hosting Community
Transformational	Where a leader works with teams to identify needed change, creating a vision to guide the change through inspiration, and executing the change in tandem with committed members of a group.	James V. Downton James MacGregor Burns
Regenerative	Working together to co-create a world where purpose, people, planet and profit collectively thrive. A world built on regenerative principles, interconnection, and co-design.	Giles Hutchins & Laura Storm, John Hardman, Daniel Christian Wahl, Gaia Education, Gaia University, UCI (Costa Rica), Universidad del Medio Ambiente, Global Ecovillage Network, Regenerative Communities Network, Global Permaculture Movement
Integral	Theory and practice that can be employed to unify and evolve worldviews, cultures, organizations, and systems through holistic development.	Ken Wilber, Peter Merry, Ubiquity University, Integral Coaching community, Integral Life, Integral Cities, Integral Without Borders, Meta Integral
Social Justice	Social justice and deep equity (i.e.: BIPOC, queer, feminist), intersectional, addressing systemic violence, multicultural leadership, transformative justice	Rachel Cargle, Mia Mingus, Naomi Ortiz, Charlene Carruthers, Gloria E. Anzaldúa, Vandana Shiva, Eli Clare, No White Saviors, Generative Somatics, Eve Tuck

Appendix M – Mapping of Weaving Practices and Barriers & Enablers



Supportive
action



Master's Programme in Strategic Leadership towards Sustainability
Blekinge Institute of Technology, Campus Gräsvik
SE-371 79 Karlskrona, Sweden

Telephone:
Fax:
E-mail:

+46 455-38 50 00
+46 455-38 55 07
sustainabilitymasters@bth.se