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**Landscape stewardship in under-use contexts –
a transdisciplinary social-ecological analysis of common
pastures in the Black Forest Biosphere Reserve**

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by

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Summary

The common pastures of the UNESCO Black Forest Biosphere Reserve are the ecological hotspot, identification element and key feature of the cultural landscape in the southern Black Forest, Germany. In the second half of the 20th century, the Black Forest has witnessed an ongoing decline in grazing activity and pastureland, so that diverse actors of civil society, politics and science are concerned with how the social-ecological importance of the Black Forest common pastures can be sustained. Declining land use and the abandonment of traditional land-use practices constitute an important threat to cultural landscapes not only in the Black Forest, but also in many places all across the world. However, sustainability sciences have been mostly concerned with questions of overexploitation so far. Research addressing the social and ecological drivers of under use, and their interplay, is still lacking. Recent studies on under-used cultural landscapes offer insights into governance arrangements. Still, the consideration of relationships between people and their environment, a key approach to analyse and lever sustainability, are yet missing in the context of under use.

Against this background, this cumulative dissertation draws on common pastures in the Black Forest Biosphere Reserve as a case study to develop social-ecological perspectives for cultural landscapes threatened by under use. The three research articles that form the basis for this dissertation explore the diverse interactions between humans and their environment to ask the question what changes in terms of adaptations and transformations are required to sustain the common pastures. The dissertation asks how conceptual insights on organizational design of common pastures, adaptive governance and social-ecological resilience help to grasp and to advance farmers' perspectives on future pathways for grassland which is endangered by under use. Furthermore, the dissertation poses the question on how resonance theory, a qualitative analysis of relationships between self and world, contributes to a better understanding of the different types of relationships that characterise action in pursuit of landscape sustainability, referred to by the term landscape stewardship.

This dissertation follows a transdisciplinary research approach, in the sense that practitioners motivated this research, provided data and validated the findings. The author's practical experience as staff of the Black Forest Biosphere Reserve links research, practice and landscape stewardship. The dissertation is rooted in social-ecological systems thinking. The notion of social-ecological systems understands common pastures in terms of interlinked social and ecological elements and processes. The research articles make use of the concepts of Ostrom Design Principles, Social-Ecological Systems Framework, social-ecological Resilience Principles, relational approaches in social-ecological thinking and Resonance Theory. Resonance characterizes the occurrence of meaningful relational encounters that potentially transform self-world relationships. The notion of landscape stewardship refers to the

diversity of meanings that motivate action in pursuit of landscape sustainability. Landscape stewardship thus serves as a frame to connect the different concepts and research articles of the present work. Rooted in empirical social research, this dissertation adopts a qualitative methodology but includes quantitative data to illustrate and support qualitative findings.

Given the rich conceptual foundation and transdisciplinary approach, the results of this dissertation allow for both conceptual advancements and practical recommendations. The results of the research articles show that place-based practical perspectives and social-ecological concepts reinforce one another. Practitioners' central assertion that diverse small-scale farming initiatives are required to sustain common pastures illustrate and substantiate the conceptual groundings of adaptive governance, resilience, and Resonance Theory.

Concerning adaptive governance, this research finds that a central element of organizational design in the under-use context of the Black Forest common pastures is to include all actors that take advantage of the cultural landscape. This implies to motivate and incentivize diverse actor groups, such as tourism and local population, to contribute to landscape stewardship in a way that corresponds to their benefits. Relational and resilience arguments emphasize the importance of multiple and diverse structures in grassland farming. This implies that specific support to match the needs and challenges of initiatives such as landcare groups, common pasture organizations or small-scale farming is required. The resilience perspective adds to this in highlighting that polycentric governance should find stronger application to encourage reciprocal learning and maintain the social-ecological diversity connected to common pastures.

The introduction of Resonance Theory into social-ecological research provides important contributions to the debate on sustainability transformations. By emphasizing the uncontrollable and unpredictable character of meaningful relationships, Resonance Theory shifts the practical and conceptual focus on agency towards the quality of relationships. The axes of resonance provide a framework to analyse different types of relationships between self and world that are present in initiatives of landscape stewardship. From the perspective of Resonance Theory, adaptive governance should be directed towards enabling or favouring the emergence of meaningful relationships between people, livestock and the landscape.

The practical and conceptual recommendations to sustain common pastures call for changes in terms of adaptations and transformations. The importance and consequences of these key changes, such as improved commercialization of pasture products, the integration of local people into landscape stewardship, or to fit the administrative frameworks and support schemes to the social-ecological reality of common pastures, depend on the social-ecological perspective of analysis. As grassland farmers or public administration have their specific view on common pastures, the anticipated effects

of and the required commitment to these changes differ, so that they may appear as adaptations to one group, while constituting transformations to another.

To conclude, this dissertation shows that the application of different social-ecological concepts to rich contextual data advances both conceptual and practical understandings of under use and the interconnectedness of humans and their environment. In bringing together science and practice, biosphere reserves are particularly suited for transdisciplinary approaches. For supporting landscape stewardship, the Black Forest Biosphere Reserve will need to include more actors benefiting from common pastures to contribute to their sustenance. Moreover, it is important to create conditions that enable meaningful relationships and resonance in landscape stewardship. There is a need for further place-based research in under-use contexts to provide more knowledge of the organizational and relational aspects that characterize under use. To benefit from the full potential of the resonance perspective, it is necessary to show how contextual, institutional and cultural conditions that foster or inhibit resonance can be accounted for in social-ecological research.

Zusammenfassung

Die Allmendweiden des UNESCO Biosphärengebiets Schwarzwald sind ökologischer Hotspot, Identifikationspunkt und Kernelement der Kulturlandschaft des Südschwarzwalds in Deutschland. Seit der zweiten Hälfte des 20. Jahrhunderts ist im Schwarzwald ein kontinuierlicher Rückgang der Weidewirtschaft und damit der Weideflächen zu verzeichnen. Daher drängt sich von Seiten verschiedener Akteure aus Zivilgesellschaft, Politik und Wissenschaft die Frage auf, wie die sozial-ökologische Bedeutung der Allmendweiden erhalten bleiben kann. Nicht nur im Schwarzwald, sondern auf der ganzen Welt sind viele Kulturlandschaften von der Abnahme oder Aufgabe von traditionellen Landnutzungspraktiken bedroht. Die Nachhaltigkeitswissenschaften haben sich jedoch bisher vor allem mit Fragen der Übernutzung auseinandergesetzt. Es fehlt an wissenschaftlichen Arbeiten, die sich mit den sozialen und ökologischen Triebkräften von Unternutzung, sowie deren Wechselwirkung, befassen. Aktuelle Arbeiten gewähren Erkenntnisse zu Governance-Arrangements untergenutzter Kulturlandschaften. Die Berücksichtigung von Mensch-Umwelt-Beziehungen fehlt jedoch im Zusammenhang mit Unternutzungsproblemen, obwohl diese Beziehungen für die Analyse sowie das Angehen von Nachhaltigkeitsaspekten eine zentrale Rolle einnehmen.

Auf dieser Ausgangssituation aufbauend, entwickelt diese kumulative Dissertation sozial-ökologische Perspektiven für durch Unternutzung bedrohte Kulturlandschaften anhand des Fallbeispiels der Allmendweiden des Biosphärengebiets Schwarzwald. Die drei wissenschaftlichen Artikel, die dieser Dissertation zugrunde liegen, untersuchen die vielfältigen Interaktionen zwischen Mensch und Umwelt und fragen, welche Veränderungen im Sinne von Adaptationen und Transformationen notwendig sind, um die Allmendweiden zu erhalten. Die Dissertation geht der Frage nach, inwiefern konzeptionelle Erkenntnisse über die Organisationsprinzipien für Allmenden, adaptive Governance und sozial-ökologische Resilienz dazu beitragen, die Zukunftsperspektiven des durch Unternutzung gefährdeten Grünlands einzuordnen und zu fördern. Zusätzlich setzt sich die Dissertation mit der Frage auseinander, wie die Resonanztheorie, als ein qualitativer Analyserahmen für Selbst-Welt-Beziehungen, zu einem besseren Verständnis der verschiedenen Arten von Beziehungen beiträgt, die mit dem konkreten Einsatz für nachhaltige Kulturlandschaften zusammenhängen. Der Begriff Landscape Stewardship bezeichnet diesen Einsatz.

Der transdisziplinäre Forschungsansatz der Dissertation beinhaltet, dass Praktikerinnen und Praktiker diese Forschung motiviert haben. Darüber hinaus haben diese Daten geliefert und dazu beigetragen, die Ergebnisse zu validieren. Die praktische Erfahrung des Autors als Mitarbeiter des Biosphärengebiets Schwarzwald stellt eine Verbindung zwischen Forschung, Praxis und Landscape Stewardship dar. Die Dissertation ist in der sozial-ökologischen Forschung verankert. Der Begriff der

sozial-ökologischen Systeme betrachtet die Allmendweiden im Sinne der miteinander verknüpften sozialen und ökologischen Elemente und Prozesse. Die Forschungsartikel der Dissertation wenden die Konzepte der Ostrom Design Principles, des Social-Ecological Systems Framework, der sozial-ökologischen Resilienzprinzipien, der relationalen Ansätze in der sozial-ökologischen Literatur sowie der Resonanztheorie an. Resonanz charakterisiert das Auftreten bedeutungsvoller Begegnungen, durch die Beziehungen zwischen Selbst und Welt transformiert werden können. Der Begriff der Landscape Stewardship bezieht sich auf die Vielfalt der Bedeutungen, die das Handeln im Streben nach Nachhaltigkeit von Kulturlandschaften begründen. Landscape Stewardship dient somit als Rahmen, um die Konzepte und Forschungsartikel der vorliegenden Arbeit zu verbinden. Die Dissertation ist in der qualitativen empirischen Sozialforschung angesiedelt, quantitative Methoden werden eingebunden, um die qualitativen Ergebnisse zu illustrieren und zu untermauern.

Durch die vielgliedrige konzeptionelle Grundlage und den transdisziplinären Ansatz ermöglichen die Ergebnisse dieser Dissertation sowohl konzeptionelle Weiterentwicklungen als auch praktische Empfehlungen. Die Ergebnisse der Forschungsartikel zeigen, dass die Perspektive der Praxis vor Ort und sozial-ökologische Konzepte sich gegenseitig verstärken. Die zentrale Aussage von Praktikerinnen und Praktikern, dass es vielfältiger und kleiner Beweidungsmodelle bedarf, um die Allmendweiden zu erhalten, verdeutlicht und substantiiert die konzeptionellen Grundlagen der adaptiven Governance, der Resilienz und der Resonanztheorie.

Was die adaptive Governance betrifft, so gilt für die Allmendweiden des Schwarzwalds, dass alle Akteurinnen und Akteure Berücksichtigung finden sollten, die von den Weiden profitieren. Dies bedeutet, dass verschiedene Akteursgruppen, wie z.B. der Tourismus und die lokale Bevölkerung, dazu gebracht werden sollten, einen Beitrag zur Erhaltung der Kulturlandschaft in dem Maße zu leisten, der ihrem Nutzen entspricht. Aus der Perspektive der relationalen Ansätze und der Resilienz wird die Bedeutung vielfältiger und unterschiedlicher Strukturen in der Grünlandbewirtschaftung hervorgehoben. Landschaftspflegevereine, Weidgemeinschaften oder Einzelbetriebe im Nebenerwerb benötigen spezifische Unterstützung, um die bestehenden Herausforderungen anzugehen. Daran anknüpfend lenkt die Resilienzperspektive den Blick darauf, dass polyzentrische Governance-Ansätze stärker zur Anwendung kommen sollten, um das gegenseitige Lernen zu fördern und die sozial-ökologische Vielfalt der Allmendweiden zu erhalten.

Die Einführung der Resonanztheorie in die sozial-ökologische Forschung leistet einen wichtigen Beitrag zur Debatte über Nachhaltigkeitstransformationen. Indem Resonanz den unkontrollierbaren und unvorhersehbaren Charakter gelingender Beziehungen in den Mittelpunkt rückt, fokussiert die Resonanztheorie den praktischen und konzeptionellen Schwerpunkt auf die Qualität von Beziehungen. Die Achsen der Resonanz bieten einen Rahmen für die Analyse unterschiedlicher Beziehungsarten von Selbst und Welt. Diese finden sich in unterschiedlichen Initiativen im Bereich der Landscape

Stewardship wieder. Aus der Perspektive der Resonanztheorie heraus sollte die adaptive Governance das Entstehen gelingender Beziehungen zwischen Menschen, Weidetieren und der Landschaft ermöglichen oder fördern.

Die praktischen und konzeptionellen Empfehlungen zur Erhaltung von Gemeinschaftsweiden erfordern Veränderungen im Sinne von Anpassungen und Transformationen. Einige der wichtigsten Änderungen sind die Verbesserung der Vermarktung von Weideerzeugnissen, die Einbindung der lokalen Bevölkerung in die Erhaltung der Kulturlandschaft oder die Anpassung der administrativen Rahmenbedingungen und Förderprogramme an die sozial-ökologische Realität der Allmendweiden. Die Bedeutung und die Folgen dieser Änderungen hängen von der sozial-ökologischen Perspektive der Analyse ab. Da Weidebetriebe und die Verwaltung ihre eigenen Sichtweisen auf die Allmendweiden haben, unterscheiden sich die erwarteten Auswirkungen und das erforderliche Engagement für diese Veränderungen, so dass sie einer Gruppe als Adaptationen erscheinen können, während sie für eine andere Gruppe Transformationen darstellen.

Zusammenfassend zeigt diese Dissertation, dass die Anwendung verschiedener sozial-ökologischer Konzepte auf reichhaltige Kontextdaten sowohl das konzeptionelle als auch das praktische Verständnis von Unternutzung sowie der wechselseitigen Verbundenheit von Menschen und ihrer Umwelt fördert. Biosphärenreservate eignen sich besonders für transdisziplinäre Ansätze, da in diesen Wissenschaft und Praxis zusammengeführt werden. Um die Landscape Stewardship zu unterstützen, gilt es im Biosphärengebiet Schwarzwald, mehr Akteure einzubeziehen, die von den Allmendweiden profitieren, um zu deren Erhaltung beizutragen. Darüber hinaus ist es wichtig, den Rahmen zu schaffen, dass gelingende Beziehungen und Resonanz im Landscape Stewardship entstehen können. Es besteht Bedarf an weiterer Forschung in Kontexten mit Unternutzung, um mehr Wissen über die Organisationsprinzipien und Beziehungen zu erarbeiten, die für Unternutzung kennzeichnend sind. Um das volle Potenzial der Resonanz-Perspektive zu nutzen, gilt es zu zeigen, wie kontextuelle, institutionelle und kulturelle Bedingungen, die Resonanz fördern oder hemmen, in der sozial-ökologischen Forschung bessere Berücksichtigung finden können.

Fadensonnen
über der grauschwarzen Ödnis.
Ein baum-
hoher Gedanke
greift sich den Lichtton: es sind
noch Lieder zu singen jenseits
der Menschen

Paul Celan, 1968

This seems to me to be the root of modernity's fundamental anxiety with respect to the environment: not that we might lose nature as a resource, but that nature might fall mute as a sphere of resonance, an independent counterpart capable of responding to us and thus giving us some orientation. From the perspective of resonance theory, the muting of nature (both within us and outside of us), its reduction to something that is or can be placed at our disposal, is the actual cultural 'environmental problem' for late modern societies.

Hartmut Rosa, 2019, p. 274

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List of Acronyms

Acronym	Description
CPR	Common pool resources
DP	Design Principle, i.e. Ostrom Design Principle
RP	Resilience principle
SES	Social-ecological systems
SESF	Social-Ecological Systems Framework
UNESCO	United Nations Education, Scientific and Cultural Organization

Cumulative dissertation

In accordance with the University of Hohenheim Doctoral Regulations from 15 January 2019, the present document forms the cumulative dissertation in the sense that it shows the internal coherence between the scientific publications that constitute my doctoral work. Correspondingly, I herein seek to depict the overall motivations, objectives and contributions of my work. I neither seek to reproduce exhaustively the conceptual and methodological proceedings I adopted in the respective articles, nor do I mirror the practical and theoretical insights that are given in the publications. Instead, this dissertation explores the connectedness of my work in developing overall research objectives, depicting social-ecological concepts and the way I employed them, my transdisciplinary research approach and to reflect critically upon my work. I refer to the articles using Roman numerals. The articles are:

- Article I. Brossette, F., Bieling, C., & Penker, M. (2022). Adapting Common Resource Management to Under-Use Contexts: The Case of Common Pasture Organizations in the Black Forest Biosphere Reserve. *International Journal of the Commons*, 16(1), pp. 29–46. DOI: 10.5334/ijc.1138.
- Article II. Brossette F., Bieling C., Kiefer L., Kemkes W., Röske H. (2022). Sozial-ökologische Perspektiven zur Erhaltung der Land(wirt)schaft – Erkenntnisse zu den Allmendweiden im Biosphärengebiet Schwarzwald [*English translation: Social-ecological perspectives on the preservation of agricultural landscapes – findings on common pastures in the Black Forest biosphere region*]. *Naturschutz und Landschaftsplanung* 54 (06), pp. 12-21. DOI: 10.1399/NuL.2022.06.01.
- Article III. Brossette F., Bieling C. Connecting resonance theory with social-ecological thinking: conceptualizing self-world relationships in the context of sustainability transformations. Submitted to: *People and Nature* (July 2023). Under review.

This document is structured in the following. Part I presents the dissertation. Pars II-IV present the scientific **Articles I-III**.

I hope that readers of the present document find the information helpful to understand scope, contributions and limitations my doctoral research, that it answers some questions while inspiring further research.

PART I - Dissertation

1 Introduction

1.1 Context and motivation

In the light of multiple sustainability challenges and interwoven social-ecological crises, the debate on comprehensive change at individual, systems and global level has gained momentum in science (Charli-Joseph et al., 2018; Steffen et al., 2018), politics (IPBES, 2019; United Nations, 2015) and society. In the field of sustainability science, social-ecological systems (SES) approaches consider sustainability issues as the interplay of social, economic, technological and ecologic elements and seek inter- and transdisciplinary understandings (Horcea-Milcu et al., 2020; Preiser et al., 2018; Westley et al., 2013). Social-ecological approaches are flourishing, as illustrated by extensive literature fields that apply social-ecological thinking to various contexts and under distinct conceptual underpinnings (Biggs et al., 2021).

The inherent tie of human and non-human processes in cultural landscapes illustrates the notion of SES. Cultural landscapes originate from interactions of abiotic, biotic and cultural processes. Consequently, they bear testimony of the past and their present context codetermines future perspectives of development (Antrop, 2005). Multiple interlinked social-ecological factors, such as climate change, changes in land use intensity, economic necessity or the diverse relations between people and their environment challenge the resilience of cultural landscapes (Bieling & Plieninger, 2017; García-Martín et al., 2018; Selman, 2012). At the same time, cultural landscapes hold important meanings and values for people that are connected to them (Bieling et al., 2020; Plieninger et al., 2014; West, 2016).

With respect to landscapes, scholars have argued that dominant socioeconomic pressures are disrupting connections between people and their environment, resulting in defective relationships, threats to resilience and, consequently, material effects in cultural landscapes and beyond (Beery et al., 2023; Bieling & Plieninger, 2017; Krebs, 2014; Selman, 2012). Recent discussions in SES-literature are proposing that establishing novel relationships within landscapes (and SES in general) has substantial potential to address sustainability challenges (Abson et al., 2017; Cockburn, Rosenberg, et al., 2020; Folke et al., 2011). This is because relational characteristics are decisive for the goals and paradigms of SES. Different components such as landscape aesthetics (Krebs, 2014), sense of place (Cooke et al., 2016; Eaton et al., 2019) or ecological diversity promote the capacity to relate to cultural landscapes. Embodied and mental experiences of and within cultural landscapes are found to be essential for reconnecting people and their environment (Raymond et al., 2018; Tilley, 2004). The concept of landscape stewardship, which I apply for this dissertation, encompasses the above-

mentioned considerations that lead to action in pursuit of landscape sustainability (Bieling & Plieninger, 2017; Garcia-Martin, 2018).

In Europe, but also in other parts of the world, centuries-old land use practices have changed in past decades, resulting in changes of social-ecological characteristics of cultural landscapes and drawing attention from science and civil society to uphold cultural practices that provide meaning to SES (Buck et al., 2017; Schulp et al., 2019; Tieskens et al., 2017). Socioeconomic factors such as farm profitability, demographics or agricultural policies favour the abandonment of small-scale agriculture, leading to intensification and streamlined, monotonous landscapes on the one hand (Schirpke et al., 2017), and deserted landscapes on the other hand (MacDonald et al., 2000; Munroe et al., 2013).

Despite the prominence of challenges to sustainability brought about by over use (Neyret et al., 2023; Sterner et al., 2019), there is a growing body of literature that deals with the opposite: changes that threaten the social-ecological functions of landscapes due to under use (Fayet et al., 2022; Mauerhofer et al., 2018; Subedi et al., 2022). However, this literature body is heterogeneous with respect to theoretical and practical access to under use. In addition, common issues of under use are discussed using different terminology and framings (Baur & Nax, 2018, 2021; Erős et al., 2020; Hirahara, 2020; van der Zanden et al., 2018; Weissgerber et al., 2023). Underlying causes and challenges of under use are much more present in social-ecological research than they are highlighted under this label (Prager et al., 2012; Rescia et al., 2008; Risvoll et al., 2016; Sayer et al., 2013). Under use, in terms of insufficient intensity of land use, has ecological consequences, for instance in the sense that functional diversity decreases and consequently biodiversity erodes (MacDonald et al., 2000). In the context of SES research, under use also pertains issues such as the ability to relate to cultural landscapes, the mechanisms of land use governance that address under use or the forward-looking capacity of the SES to react to disturbances.

From a practical perspectives in Europe, pastures in mountain ranges are particularly affected by under use, i.e. insufficient grazing activity to hold off scrub encroachment and forests (Jiménez-Olivencia et al., 2021). In temperate climates, mountain pastures are generally dominated by herbaceous plants and depend on regular grazing activities to sustain their ecologic features and open landscape character. Spacious reforestations of mountain ranges often compromise ecological diversity (MacDonald et al., 2000) and landscapes' relational capacity (Frei et al., 2020).

The common pastures of the Black Forest Biosphere Reserve in south-west Germany, the object of this dissertation, illustrate the above-mentioned debate on under-used landscapes and social-ecological sustainability. Originating from a century old co-evolution of ecological features, livestock and humans, the Black Forest common pastures are an ecological hotspot and identification element in the southern Black Forest (Bieling & Konold, 2014; Reif & Katzmaier, 1997). Common pastures are the emblematic element of the mountain landscape (cf. Figure 1). The recognition of the Black Forest as an UNESCO

(United Nations Education, Scientific and Cultural Organization) biosphere reserve is connected to the social-ecological meaning of common pastures. Due to better off-farm opportunities, changes in property rights and farming-related policies, the number of grassland reduced considerably since the second half of the 20th century (Black Forest Biosphere Reserve Office, 2021; Geiger, 1990; Kiefer et al., 2020). Simultaneously, the extent of pastureland decreased, giving way to natural succession and reforestation. Yet, common pastures are still the emblematic element of landscape patterns, grassland farmers remain predominantly small-scale and grazing permeates many aspects of rural life (Black Forest Biosphere Reserve, 2021; Brockamp et al., 2016). In short, common pastures hold diverse but important meanings.



Figure 1: Picture of common pastures in the Black Forest Biosphere Reserve in the municipality of Kleines Wiesental.

In this context, under use in terms of insufficient grazing activity and people that contribute to maintaining pastures is threatening the persistence of the common pastures and their social-ecological meaning. An important array of local actors such as common pasture organizations, farmers, municipalities and administrative units at different levels are concerned with future perspectives for grassland farming, and consequently to sustain common pastures. The biosphere reserve hosts different initiatives that seek to support landscape stewardship in the context of common pastures.

Up to starting the research presented herewith, practical research in the Black Forest Biosphere Reserve has focussed on ecological or economic aspects of grassland farming (Barbisch et al., 2021; Fumy et al., 2020; Kiefer et al., 2020; Vögtlin & Weiss, 2012), leaving out social aspects and interdisciplinary perspectives. However, practitioners and the biosphere reserve call for more integrated approaches to address global sustainability issues at a local scale (Black Forest Biosphere Reserve, 2021; Brockamp et al., 2016; Ishwaran et al., 2008).

The here presented dissertation has evolved out of a recent initiative of the biosphere reserve to develop strategic pathways for future farming. By looking at the case of common pastures of the Black Forest, I seek to contribute with this dissertation towards better understanding under use in the context of social-ecological sustainability. By applying a transdisciplinary approach, my goal is that the findings of this research will contribute to identifying opportunities for change and sustainable landscapes in the Black Forest Biosphere Reserve and beyond.

1.2 Research gaps

With respect to research gaps, I aim with this dissertation to address the notion of under use, and more specifically, to question what change – in terms of adaptations or transformations – is required and possible to foster landscape stewardship in the under-use context. As mentioned before, there is a growing body of literature dealing with under use, but the social-ecological under-use literature lacks coherence and visibility considering the scope and challenges connected with under use and sustainability.

In the field of common pool resource literature, I adress a gap concerning governance mechanisms that allow for the sustenance of landscapes in an under-use context (Baur & Nax, 2021; Hirahara, 2020; Miyanaga & Shimada, 2018). A central research gap that I seek to contribute to, by looking at the Black Forest Biosphere Reserve, is how actors redefine rules in use when incentives and external governance changes in respect to under use. Connected to this is the need to understand how landscape stewardship matches social-ecological dynamics that characterise under use (Darnhofer et al., 2016; Raymond et al., 2016).

Under-use research, thus far, has employed concepts in a self-contained way, leaving aside the capacity of social-ecological research to combine different types of knowledge and concepts to derive an integrated understanding of under use (Biggs et al., 2021). Strategies and measures to cope with disturbances, such as under use, are context specific (Biggs et al., 2015; Cockburn, Cundill, et al., 2018). One shared ambition of SES research is to facilitate the transferability of insights to cases with varying SES characteristics (Biggs et al., 2015; Partelow, 2018). This knowledge base with respect to under use is currently missing, which constrains the resilience of under-used SES.

Under use not only characterizes governance mechanisms or interactions between components of the SES, but also the relationships that emerge within an SES and that constitute under use. Emergent discussions within SES literature stress the importance of relationships to bring about or to react to change (Fischer & Riechers, 2019; Raymond et al., 2018). However, these approaches have not yet been connected to under use, despite the recognition that relational perspectives contribute to leveraging transformative change (West et al., 2020).

1.3 Transdisciplinary social-ecological approach

In addressing the above-mentioned research gaps, this dissertation seeks to contribute to the understanding of under use in the context of social-ecological sustainability in cultural landscapes. A central characteristic of social-ecological research is that it integrates a plurality of scientific fields and approaches – and is thus open to bring in new perspectives in an almost eclectic manner (Schlüter et al., 2019; Zanotti et al., 2020). An inherent property of all concepts is that while allowing for analytical depth and practical inference for certain focal points, they necessarily marginalise others. This is particularly important with regards to the kind of transformational and adaptive change that is suggested by distinct concepts (Olsson, Folke, & Hahn, 2004; Zanotti et al., 2020). For this reason, this dissertation shifts the conceptual lens to capture related but distinct perspectives of under use. I seek to address the research gaps by scrutinizing Ostrom Design Principles and their pertinence to common pasture organizations (**Article I**), investigating the implications of grassland farmers' demands of support and social-ecological resilience (**Article II**) and illustrating how meaningful relationships contribute to landscape stewardship (**Article III**).

In addition, I use a transdisciplinary case study approach. Case studies correspond to the context-specific character of social-ecological research. They are ideal for mediating theoretical and practical demands (Ebneyamini & Sadeghi Moghadam, 2018; Partelow, 2018). Although social-ecological and landscape research call for transdisciplinary approaches to build alliances between practice and science, comprehensive transdisciplinary approaches remain infrequent in doctoral dissertations (Balvanera et al., 2017; Horcea-Milcu et al., 2020; Sellberg, Cockburn, et al., 2021; Thapa et al., 2022). The present dissertation connects to a practical project of the Black Forest Biosphere Reserve. It is transdisciplinarity in the sense that practitioners became partakers in this dissertation. To different degrees, practitioners identified knowledge gaps and objectives of this research, provided the empirical foundations for this work and took part in analysing and validating its findings. In doing so, I seek to live up to a shared aspiration of collaborative work in SES research (Björkvik, 2020; Sellberg, Cockburn, et al., 2021; Thapa et al., 2022).

1.4 Research objectives and scope

Building on the connectivity of practical and conceptual goals, my research aims to bring together theory-informed practical recommendations for landscape stewardship in the Black Forest Biosphere Reserve with empery-informed conceptual considerations of adaptive and transformational change in under-use contexts. For this purpose, I set the following research objectives:

- Explore adaptive governance and resilience of under-used common pastures
- Explore conceptualizations of relationships at the interface of human-nature and self-world in the context of transformations
- Infer social-ecologically informed recommendations for landscape stewardship at the interplay of adaptations and transformations

Articles I-III reflect these research objectives in the sense that the questions each article tries to respond to constitute my research objectives (cf. Figure2). Consequently, the synthesis of results focusses on my research objectives, leaving aside the more specific research questions that structure the respective articles.

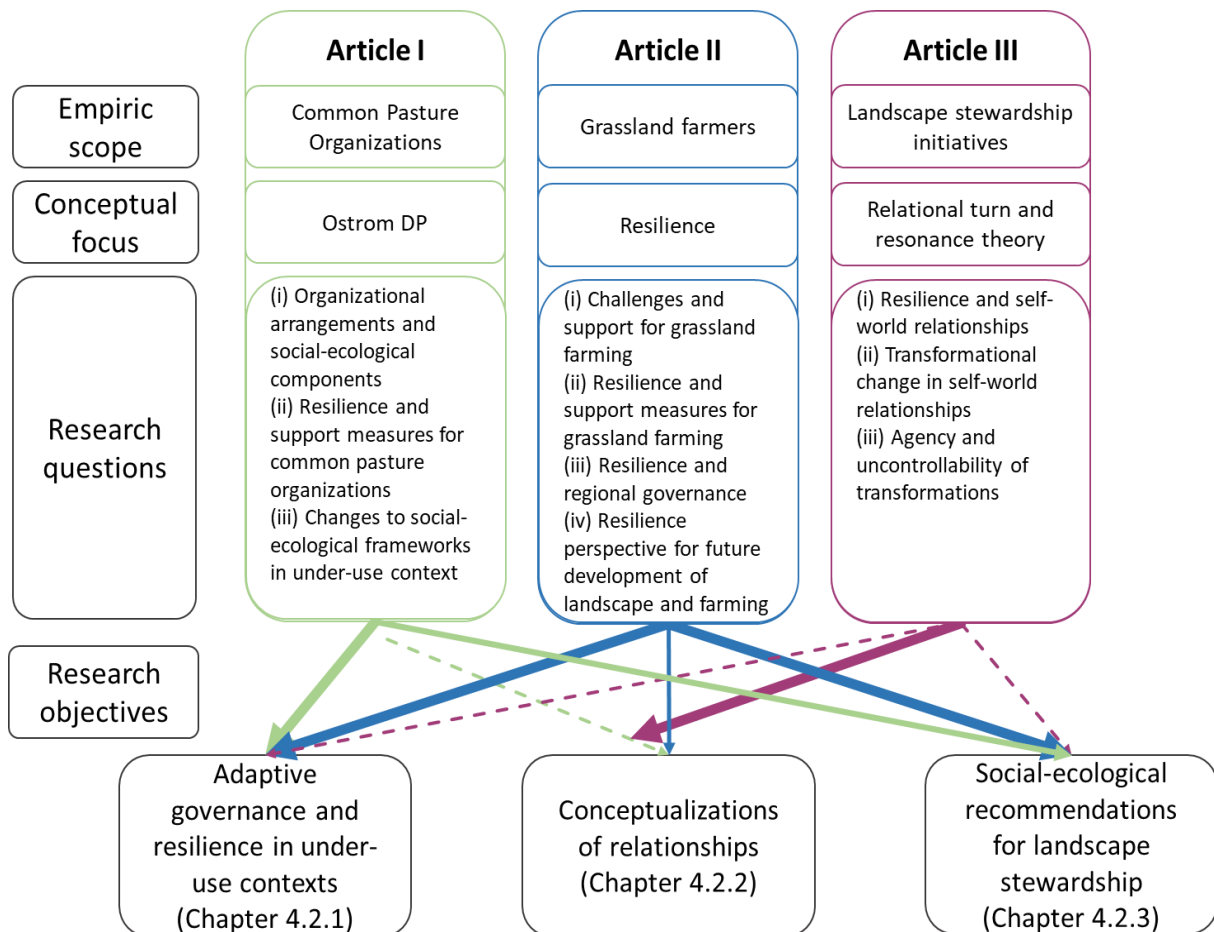


Figure 2: Research objectives and how they correspond to Articles I-III. Research questions and research objectives are presented in a shortened form (cf. PARTS II-IV for an unabridged presentation of the Articles' research questions). Arrows indicate how the Articles contributed to meeting the research objectives. Line width and style indicate the qualitative importance of the insights provided in the respective Articles.

1.5 Outline of the dissertation

Following the cumulative format of this dissertation, the present document is structured as follows. Section 1 provides an overview of the topic, the motivation, research gaps and objectives in this dissertation. Section 2 describes the social-ecological foundations and paradigms and how I make use of them to fulfil my research objectives. In turn, section 3 lays out the approach I follow, providing insights into transdisciplinarity and the context of the Black Forest Biosphere Reserve. Section 4 synthesises the findings of the underlying articles, focussing on my research objectives. The synopsis of this dissertation is given in section 5, where I will discuss the conceptual and practical implications of my findings. In this, I will go beyond the original research objectives and reflect upon the conceptual and practical coherence of this dissertation in sustainability literature. To conclude, section 6 will highlight the main scientific contributions of this dissertation and close with insights for practitioners.

2 Social-ecological foundations and paradigms

This section explores the concepts, frameworks and theories employed in this dissertation. Comprising distinct ontological and epistemological foundations, the theoretical foundations selected for this dissertation integrate different types of knowledge to provide specific understandings of social-ecological processes (Biggs et al., 2021; Epstein et al., 2020). As a central goal of this dissertation is to explore adaptive and transformational change in an under-use context, I find it important to give a summary of the conceptual underpinnings that will inform my findings. I refer to them as “social-ecological concepts” throughout this dissertation, as they make sense of the connectedness and relatedness of humans and their environment through different ontological perspectives. I recognize that the corresponding ideas may be labelled or classified differently in literature. Given the extensive fields of literature that constitute my conceptual underpinnings, I do not aim at an extensive summary in terms of “what they are”. Instead, I will focus on how I employ them to support my research objectives and approach (cf. Table 1).

Concerning the latter aspect, I find it important to notice here that the concepts and paradigms in which this dissertation operates hold a normative understanding, inherent to the applied character, and that goes beyond a descriptive and analytical framing (Milkoreit et al., 2015; West et al., 2020). Exhibiting certain social and ecological characteristics encouraged by SES thinking or resilience (Colding & Barthel, 2019; Folke et al., 2010), institutional arrangements that allow for sustainable governance (Ostrom, 1990) or arenas to promote resonant relationships (Rosa, 2019) are considered, albeit differing degrees and context-specificity, good and desirable. They open up to the call for adaptive or transformational change towards sustainability.

Table 1: Overview of the social-ecological concepts employed in this dissertation.

	Background	Ontology	Adaptations and transformations	Application as/ for	Application in
Social-ecological-systems thinking	Diverse, inter- (and trans-)disciplinary sustainability sciences (Berkes et al., 2003; Holling et al., 1998; Milkoreit et al., 2015)	Interconnectedness and inextricability of human and nature (ecological and social) but operating in distinct spheres (Anderies et al., 2013; Berkes et al., 2003)	Change is dynamic, non-linear and emerges in social-ecological interactions (Anderies et al., 2013; Levin et al., 2013; Liu et al., 2007)	Guiding conceptual frame	Articles I-III
Social-Ecological Systems Framework	Interdisciplinary sustainability sciences (Hinkel et al., 2014; Ostrom, 2007)		Cf. SES thinking; aims at depicting SES-components leading to adaptations/ transformations	Capture social-ecological components	Article I

	Background	Ontology	Adaptations and transformations	Application as/ for	Application in
Resilience Principles	Social-ecological resilience thinking, (Biggs et al., 2015; Walker et al., 2004). Different meaning outside SES thinking		Cf. SES thinking. Adaptations and transformations are an outcome of change in resilient SES (Wilson et al., 2013)	Evaluate and enhance social-ecological resilience	Articles I-II
Ostrom Design Principles	Heterodox economics (Lawson, 2006), political economy, rational choice (Forsyth & Johnson, 2014)	Complex and open social structures governing humans and nature (Lewis, 2021)	Promoted by changes within and outside of the SES. Actors redefine set of rules in use through self-governance (Ostrom, 1990)	Evaluate and enhance governance in under use	Article I
Relational turn	SES thinking, leverage points (Abson et al., 2017; Meadows, 1999)	Reciprocal constitution and holistic assemblage of human and nature (Hertz et al., 2020; West et al., 2020)	Change is inherent to holistic assemblage, occurring in continually unfolding processes. (Raymond et al., 2018; West et al., 2020)	Investigate and characterize relationships between self-world / human-nature	Article III
Resonance	Critical theory (Habermas, 1984; Taylor, 2021)	Self and world as distinct but mutually constituted entities through diverse relationships (Rosa, 2019)	Quality of relationships to the world constitute the emergence of resonance. Resonance inherently connects to self-world transformations (Rosa, 2019, p. 20)		
Landscape Stewardship	Diverse, for instance sense of place (West et al., 2018), religion (Kerber, 2015), management (Bieling & Plieninger, 2017), ethics (Cockburn et al., 2019); strong links to SES thinking	Humans as wise and responsible stewards of nature (Cockburn et al., 2019; Kerber, 2015)	Change and preservation are seen in the context of what is desirable. Human initiatives are central in stewardship initiatives. (Bieling et al., 2020; Chapin et al., 2011)	Interpret all the other social-ecological concepts with respect to cultural landscapes	Articles I-III

Social-ecological perspectives form a sweeping field of sustainability science that seek to bring together insights from natural and social science to address real-world problems, thus corresponding to my research agenda. Social-ecological approaches reject the separation between human and natural systems but view them as intertwined (Holling et al., 1998). At the interplay of distinct theoretical groundings and practical requirements, social-ecological perspectives navigate a diversity of approaches, such as inductive and deductive methodologies (Meyfroidt et al., 2018; Pacheco-Romero et al., 2021), the extent of inter- or transdisciplinarity (Beichler et al., 2014), the connectedness of

human and non-human elements (Binder et al., 2013) or the purpose and type of proposals for change (West et al., 2020).

Eminent in building social-ecological literature are conceptualizations of systems that are complex (Berkes et al., 2003; Levin et al., 2013). The concept of SES informs on the connectedness of social-ecological components through a diversity of interactions and relations while remaining self-contained entities (Biggs et al., 2021; Schlüter et al., 2019). The notion of complex adaptive systems, in turn, contributes to the SES perspective by suggesting the dynamic and non-linear character of processes within SES (Liu et al., 2007). In consequence, SES approaches not only consider the constituent properties of a system, but also the emergent phenomena that arise out of interactions and relationships (Folke, 2006). Following the notions of complex adaptive systems and SES is the recognition that research is never objective and knowledge context-specific (Preiser et al., 2021). In absence of a clear definition and self-contained theory of SES and complex adaptive systems, I will use the term SES thinking, also widespread in literature, to refer to this systemic and complexity-acknowledging social-ecological approach. SES thinking is widely used in case-study analyses and in the quest for solving real-world problems (Colding & Barthel, 2019; Partelow, 2018). Consequently, SES thinking, as I take it, is open to diverse kinds of knowledge and to cross-infusion from related fields of research.

2.1 Systems' analysis - the Social-Ecological Systems Framework

The Social-Ecological Systems Framework (SESF) (McGinnis & Ostrom, 2014; Ostrom, 2009) is the most prominent analytical framework in the context of SES thinking (Binder et al., 2013). The SESF suggests a unified terminology to describe system components and processes, unfolding in a two level classification of social-ecological entities. I make use of McGinnis and Ostrom's (2014, p. 3) understanding of the SES as an "ontological framework" that supports cross-disciplinary and cross-theoretical interactions by analysing the same units of reality.

The SESF's first-tier variables distinguish four types of variables, two of them ecological (Resource Systems, Resource Units) and two social (Governance Systems and Actors) (cf. Figure 3). The second tier consist of a list of variables that are considered as being relevant for analysing SES dynamics (Vogt et al., 2015). The SESF uses the framing of an "Action Situation" for describing interactions and relations (Hinkel et al., 2015), a notion that initially considered social interactions only (Vogt et al., 2015) but has been extended to include all kinds of human and non-human interactions and relations (Schlüter et al., 2019). The SESF translates SES thinking into a framework that allows for eclectic applications to a variety of cases. **Article I** employs the SESF as a checklist to capture emergent characteristics of common pasture organizations.

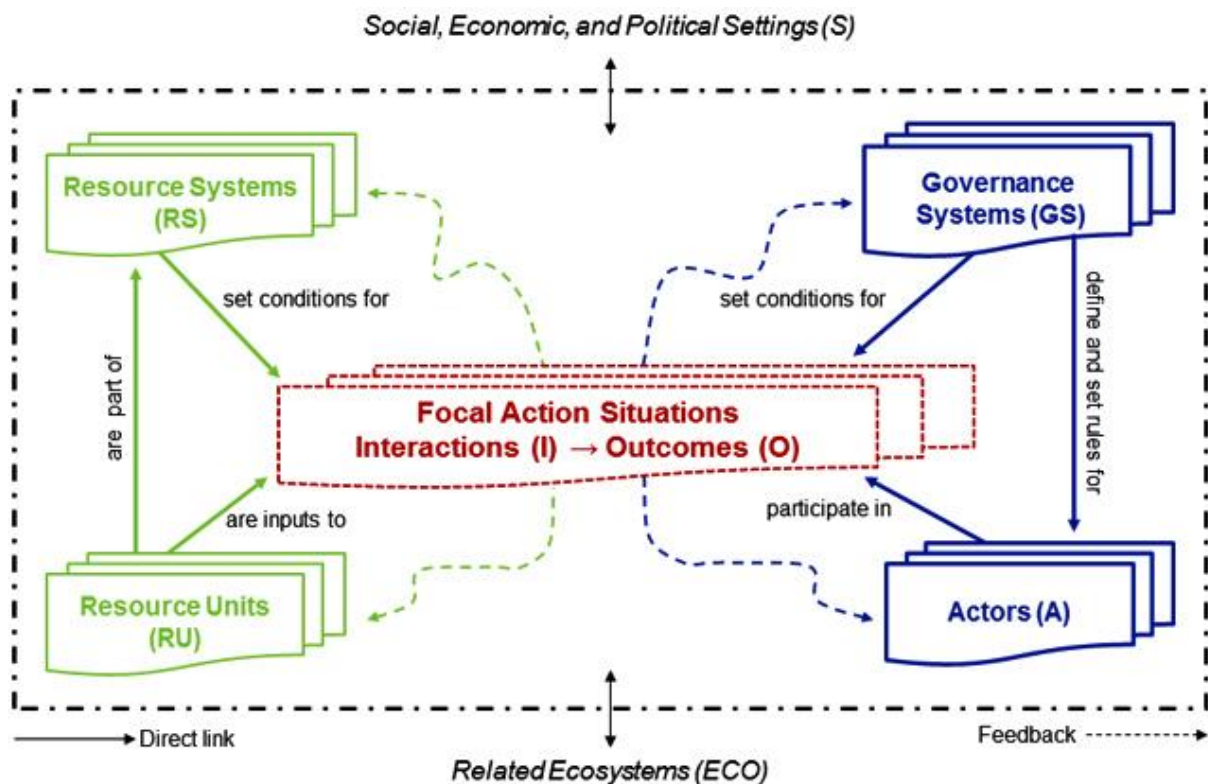


Figure 3: The Social-Ecological-Systems Framework according to the revised version from McGinnis and Ostrom (2014). The solid boxes denote first tier variables, which contain multiple second-tier variables. The dotted line around the figure represents the openness and dependency of the SES with regard to superordinate or neighbouring social-ecological influences.

2.2 Social-ecological resilience – the Resilience Principles

Resilience describes a system’s ability to absorb perturbations (Holling et al., 1998), but also to transform, re-organize and develop when prompted by changing factors (Folke et al., 2016; Walker et al., 2004). The notion of resilience has informed science and politics across disciplines (Linkov & Trump, 2019; Mahajan et al., 2022). Social-ecological resilience is closely linked and infused by SES thinking in the sense that it entails the recognition of complexity and the interconnectedness of social-ecological components (Berkes & Folke, 1998). Complementary to SES thinking, resilience thinking feeds on the dynamics within and outside of a system that affect how SES co-evolve (Anderies, 2014; Nettiier et al., 2017). It is for this dynamic character and the bridging to applied scholarship on governance (Ostrom, 2005), scenario planning and participatory approach (Eelderink et al., 2020; Walker et al., 2002), for which I integrate resilience in this dissertation in **Articles I-II**. Understandings and definitions of social-ecological resilience vary depending on intellectual and thematic entry points and have evolved over time (Mahajan et al., 2022). In this work, I draw on Biggs et al.’s (2015, p. 13) definition of social-

ecological resilience “as the capacity of an SES to sustain human well-being in the face of change, both by buffering shocks but also through adapting or transforming in response to change”.

Amongst the various applications of resilience thinking, I draw on its practical ambition to evaluate and enhance SES’ resilient capacity (Resilience Alliance, 2010; Sellberg, Quinlan, et al., 2021; UNU-IAS et al., 2014). For this purpose, I employ Biggs et al.’s (2015) seven “Principles for Building Resilience” (resilience principles, RP, in the following). Amongst the different resilience-frameworks, I employ RP because they combine inductively theoretical considerations with practical findings (cf. Table 2). Practical ambitions of resilience thinking, as I understand them in this dissertation, are normative in the sense that they consider resilience as a desired capacity of SES (Anderies et al., 2013; Hahn & Nykvist, 2017).

Table 2: Resilience Principles in social-ecological systems. Based upon Biggs et al. (2015) and taken from Article II.

	Principle	Rationale to enhance resilience
RP 1	Maintain diversity and redundancy	Heterogeneous or redundant structures with similar functions increase institutional diversity and reduce dependencies. The more diverse the response to disruptions, the more positive the contribution. However, there may be an increased effort in coordination.
RP 2	Manage connectivity	Networking and exchange or the expansion of SES boundaries increases the ability to react to disturbances. However, there is the possibility of uniform reactions in homogeneous structures (c.f. RP1).
RP 3	Manage slow variables and feedbacks	Improve interactions of SES components as well as identify thresholds for adaptations and transformations.
RP 4	Foster complex adaptive systems thinking	Allow for diverse and adaptive governance approaches and enhance the ability of different SES components and stakeholder groups to interact.
RP 5	Encourage learning	Incorporate different knowledge types to grasp the complexity of SES and use it as an opportunity for change. Thus, increase the awareness for SES governance.
RP 6	Broaden participation	Horizontal and vertical connections of actors lead to the dissemination of information, improve the legitimacy of SES governance and increase the ability to detect resilience-compromising dynamics.
RP 7	Promote polycentric governance systems	Interconnects multiple levels of (horizontal and vertical) decision-making.

2.3 Common’s governance – the Ostrom Design Principles

Governance is a abroad term that has various context-specific meanings but generally refers to the coordination of human behaviour by a multitude of social mechanisms (Bevir, 2013). In the context of SES thinking, governance is concerned with the institutional arrangements underpinning social-ecological processes and phenomena (Frantzeskaki et al., 2010). Adaptive governance, a recurrent notion in SES thinking and which I incorporate in this dissertation, is particularly concerned with identifying and shaping collaborative learning and action, and to acknowledge the polycentric and intertwined setup of SES (Koontz et al., 2015; Levin et al., 2013). My overall use of governance infuses

SES thinking in the sense that I seek to capture the dynamic processes that play into the governance of SES (Folke et al., 2010; Ostrom, 2007; Partelow, 2018).

In particular, I employ the “Ostrom Design Principles” (DP) in **Article I**, which feature eight inductive principles of organizational design to characterize sustainable management of common pool resources (CPR) (Baggio et al., 2016; Cox et al., 2010; Ostrom, 1990). The term Design Principle refers not to a scientific principle or law, but to an “essential element or condition that helps to account for the success of these institutions in sustaining the CPRs and gaining the compliance of generation after generation of participants to the rules-in-use” (McGinnis & Ostrom, 1992, p. 8). I make use of the Ostrom DP similar to the RP in the sense that they are an analytical tool that provides inference for practical aspects of change (cf. Table 3).

Table 3: "Ostrom Design Principles" (DP) for institutions governing common pool resources. Taken from Ostrom (1990, p. 90).

	Principle	Rationale of Design Principle
DP 1	Clearly defined boundaries	Individuals or households who have rights to withdraw resource units from the CPR must be clearly defined, as must the boundaries of the CPR itself.
DP 2	Congruence between appropriation and provision rules and local conditions	Appropriation rules restricting time, place, technology, and/or quantity of resource units are related to local conditions and to provision rules requiring labor, material, and/or money.
DP 3	Collective-choice arrangements	Most individuals affected by the operational rules can participate in modifying the operational rules.
DP 4	Monitoring	Monitors, who actively audit CPR conditions and appropriator behavior, are accountable to the appropriators or are the appropriators.
DP 5	Graduated sanctions	Appropriators who violate operational rules are likely to be assessed graduated sanctions (depending on the seriousness and context of the offense) by other appropriators, by officials accountable to these appropriators, or both.
DP 6	Conflict-resolution mechanisms	Appropriators and their officials have rapid access to low-cost local arenas to resolve conflicts among appropriators or between appropriators and officials.
DP 7	Minimal recognition of rights to organize	The rights of appropriators to devise their own institutions are not challenged by external governmental authorities.
DP 8	Nested enterprises	Appropriation, provision, monitoring, enforcement, conflict resolution, and governance activities are organized in multiple layers of nested enterprises.

Albeit a common theoretical grounding of the SESF and Ostrom DP in the work of Elinor Ostrom (Ostrom, 1990, 2009; Ostrom & Cox, 2010; Schlager & Cox, 2018), the Ostrom DP are not essentially social-ecological, as they recognize ecological entities and processes only marginally. However, the Ostrom DP connect to SES thinking in two respects. First of all, the Ostrom DP provide a systems’ approach on governance and institutions to social-ecological aspects that precede the systems’ perspective inherent to SES thinking (Cole et al., 2019). Second of all, the Ostrom DP fit into the variable system of the SESF, which not only captures the evolution of both concepts but also the fact that the Ostrom DP are widely used within SES community (Anderies et al., 2004; Thiel et al., 2015).

CPR theory emerged in the field of political economy to challenge claims that common goods are prone to depletion without private property rights (Gordon, 1954), exclusion (Hardin, 1968) or in large groups of users (Olson, 1965). What makes the Ostrom DP appealing to my research objectives is that they were mostly applied in the context of resource scarcity and to prevent over use. As landscape stewardship in the Black Forest Biosphere Reserve is threatened by under use, the case of this dissertation will not only benefit from the inductive approach, but also provide empirical evidence that could be used for further under-use contexts. The theoretical guiding theme of under use originate in the considerations of the Ostrom DP (**Article I**) but will be developed through the complementary insights of resilience thinking and resonance.

2.4 Relational approaches and resonance theory

Relational approaches to SES advocate for a better consideration of interactions and relationships in SES. Following West et al. (2020), I use the term “relational turn” in referring to recent SES concepts and frameworks such as “leverage points” (Fischer & Riechers, 2019; Pérez-Ramírez et al., 2021; Riechers et al., 2022), “relational” (West et al., 2018, 2020) or “embodied” approaches (Artmann et al., 2021; Manheim & Spackman, 2022; Raymond et al., 2018) and “care” (Enqvist et al., 2018; Jackson & Palmer, 2015; Puig de la Bellacasa, 2017; Singh, 2015). The relational turn claims a non-dualistic approach on human-nature connectedness as pivotal for transformations.

I employ and explore the insights of the relational turn in **Article III** to investigate the quality of relationships in landscape stewardship, which I have found to be underrepresented in literature and practice. I seek to connect relational paradigms to the notion of under use (cf. Chapter 5.1.1). The epistemological underpinnings of SES thinking applied in **Articles I-II** differ from the non-dualistic stance of the relational turn. I sought to bring in resonance theory in the debate on relationships and transformations at the interface of humans and their environment (Artmann, 2023; Stone-Jovicich, 2015; West et al., 2018).

I employ resonance theory as a concept to investigate social and environmental conditions that enable or hinder meaningful relationships between self and world (Rosa, 2019). Following a Critical Theory tradition, resonance theory questions dominant socio-political power structures, which lead to alienation and thus drive the current sustainability crises (Brand & Wissen, 2018; Rosa, 2015; Taylor, 2021). Resonance theory is not (yet) recognized in the social-ecological literature, but it shares the notion of a deep connectedness of human and nature (SES thinking) or self and world (resonance). I follow Artmans’s (2023) and Müller et al.’s (2023) recent impetus to demonstrate how resonance can contribute to current debates on social-ecological sustainability and transformations.

The starting point of resonance theory is a subject-object duality to conceptualize self-world-relationships. Following Charles Taylor (1989, 2007), resonance theory posits that subject and world constitute one another. World, in this perspective, is an open term that includes human and non-human entities that operate outside the sphere of the self. Rosa applies the concept of resonance to a diversity of relationships, ranging from individual relationships between body and mind to societal or global paradigms (Rosa, 2019; Sommer, 2019). In this dissertation, I take resonance as a qualitative characterization of relationships that may lead to transformations from individual to collective level. In **Article III**, I make use of Rosa's (2019) definition (cf. Figure 4) and framework to analyse resonance along the "axes of resonance" (cf. Table 4).

Resonance describes tangible self-world relationships in which subject and world are mutually affected and transformed. The term is borrowed from physics, describing vibrations between receptive subjects and objects. According to Rosa (2020:398) the following elements define resonant relationships (adapted by the authors of Article III).

1. Af←fection: A subject (or an entity more general) feels 'called upon' and is touched, moved or gripped by something or someone 'out there', as part of the world he or she encounters.
2. E→motion or Self-Efficacy: The subject responds to this affection in a self-efficacious mode of reaching out and touching or influencing the object or entity encountered.
3. Transformation: In this dynamic, two-way process of encounter, both sides – self and world – are transformed to some extent. Hence, resonance is not about the affirmation of identity, but rather about its transformation.
4. Uncontrollability (German: Unverfügbarkeit): Resonance in this sense is essentially open ended, i.e. uncontrollable and unpredictable in two respects: Firstly, it is constitutionally impossible to predict or deliberately establish its occurrence, and secondly, if it happens, it is impossible to predict or control the outcome or result of the unfolding transformation.
5. Mutuality: Resonance can be established only in mutually accommodating resonant spaces, i.e. of the appropriate temporal, spatial, social, physical and psychical conditions. (In Rosa's view, this point should be considered a precondition, rather than an element of resonance).

Considering these principles, resonance is irrespective of the emotional content that relationships feature. This implies that resonant relationships are not necessarily harmonic or consonant per se. In fact, resonance often requires friction, difference or alienation in order to become tangible. This requires that both subject and world need to be self-consistent "so as to each speak in their own voice", while remaining permeable "to be affected or reached by each other" (Rosa 2019:174). As such, modes of relationships that contain the unknown or exhibit sadness also have the potential of bearing resonance. In a similar way, resonance can become apparent through confrontations with the mute and alienated.

Figure 4: Definition of Resonance. Adapted from Rosa (2019; 2020, 398 and taken from Article III).

Table 4: Axes of resonance (Rosa, 2019 and taken from Article III).

Axis of resonance	Exemplification of resonance axes
Horizontal – social relationships	Family Friendship Politics
Diagonal – relationships to the world of things	Objects Work School Sports Consumption
Vertical – relationships to the whole	Religion Nature Art History

2.5 Change – adaptations and transformations

The paradigms that underpin this dissertation recognize, scrutinize or call for change. In social-ecological literature, change is often referred to by the notions of adaptations and transformations. Both terms are defined in contrast to one another, although the understanding of what kind of change they imply varies and remains ambiguous. While adaptations are understood as change so that core functions of an SES are maintained, transformations imply deep change of how the system operates, including its function, structure or feedback-process (Olsson, Folke, & Berkes, 2004; Wilson et al., 2013; Zanotti et al., 2020).

The research objectives of this dissertation are concerned with both adaptive and transformational change. The conceptualisation of initiation and course of an adaptive or transformational processes differs along research paradigms. The governance perspective is concerned with guiding and managing transformations (Chaffin et al., 2016; Kemp et al., 2007). The Ostrom DP are directed towards robust institutional arrangements and their adaptations (Anderies et al., 2004) but remain vague to their contribution to sustainability transformations. SES thinking and resilience thinking are inherently concerned with adaptability within a system (Wilson et al., 2013) but incorporate transformability as a required capacity towards sustainability (Olsson et al., 2014; Sellberg, Quinlan, et al., 2021). They refer to ideas of co-production (Chambers et al., 2022), agency (Charli-Joseph et al., 2018; Westley et al., 2013) or stewardship (Enqvist et al., 2018) to explain how change comes about. The relational turn extends agency beyond the human realm and focusses on holistic accounts of human-nature connectedness (Latour, 2007; Raymond et al., 2018; Singh, 2015; West et al., 2020). Resonance theory, in turn, provides a novel perspective on social-ecological transformations that shifts a focus from

enabling transformations towards the unpredictable and uncontrollable emergence of resonance (Rosa, 2019).

Given these different views on transformations and adaptations, I adopt in this dissertation a broad understanding of adaptations and transformations. It acknowledges different types of change in structures, functions and processes (Olsson et al., 2014; Wilson et al., 2013), of power (Boonstra, 2016), identity and goals (Andrachuk & Armitage, 2015), as well as the quality of relationships (Rosa, 2019). As I will argue in the discussion (cf. Chapter 5.1.3), the identification of change as adaptive or transformational is contingent to the object of analysis, to place and time and to the perspective within SES.

Adaptations, but in particular transformations, are descriptive concepts whose normative dimensions implies that change will lead to a more sustainable configuration of SES and that it prevents negative trajectories (Horcea-Milcu et al., 2020; Maru et al., 2017).

2.6 Landscape stewardship

I use the concept of landscape stewardship to link and bring together the above-mentioned paradigms and concepts to the case of the Black Forest Biosphere Reserve. The European Landscape Conventions understands landscapes as “an area, as perceived by people, whose character is the result of the action and intreraction of natural and/or human factors” (Council of Europe, 2000, p. 2). This definition, which is widely picked up by landscape research recognizes the ecological, social and relational dimensions of cultural landscapes (Arts et al., 2017; Sayer et al., 2013). Landscape approaches allow for different disciplinary entry points to address real world sustainability questions, in line with social-ecological thinking (Martín-López et al., 2017), resilience (Plieninger & Bieling, 2012; UNU-IAS et al., 2014), governance (Penker, 2009; Winkler & Hauck, 2019) and relational perspectives (Cockburn, Rosenberg, et al., 2020; Raymond et al., 2016). This holistic but articulated point of view on landscape sustainability connects to the practical role of biosphere reserves (Cf. Chapter 3.3 as well as Torralba et al., 2020; UNESCO, 2021; Winkler & Hauck, 2019)

The notion of stewardship implies diverse perceptions, meanings and values which ultimately lead to action in pursuit of sustainability (Bieling et al., 2020; West et al., 2018). As Plieninger and Bieling (2017, p. 6) put it, the essence of landscape stewardship is “the appreciation, awareness and actions of people for multiple landscape values that they perceive as crucial for their own wellbeing”. Landscape stewardship encompasses distinct ideas of what action is socially desirable (Chapin et al., 2011), including and mixing ideas of preservation (Gottwald & Stedman, 2020), adaptations (Sayer et al., 2013; Wu, 2013) and transformations (Arifi et al., 2017; Chapin et al., 2010). Context-specificity in

landscape stewardship means that stewardship goals will depend, i.a., on social-ecological conditions and the perspective of analysis (Arts et al., 2017; Sayer et al., 2013).

In line with my conceptual foundations, I consider that stewardship informs action at different levels of SES. Stewardship mediates or balances distinct elements of change (Cockburn, Cundill, et al., 2020; Cockburn et al., 2019; García-Martín et al., 2018), and thus links notions of adaptations and transformations to concrete action. Therefore, I use landscape stewardship in **Articles I-III** to investigate ideas of change of practitioners in the Black Forest Biosphere Reserve that are accompanied by different transformations and adaptations at individual or systems levels.

3 Research approach

This section explores the dissertation’s research approach, i.e. my stance on transdisciplinarity, the case study design, the methodological approach as well as my role as researcher in and employee of the Black Forest Biosphere Reserve. I aim to show that my research approach is concomitant with the scope, objective and conceptual underpinnings of this dissertation. I adopt a qualitative methodological approach but include quantitative data to illustrate and support my findings. Due to this engagement, the methodology incorporates practitioners perceptions in contextual, illustrative or aggregated forms (West et al., 2016; Westley, 2002). Figure 5 illustrates and summarizes the methodology employed and how it connects to the articles. Detailed information on methods can be found in the corresponding sections of the articles (cf. PARTS II-IV)

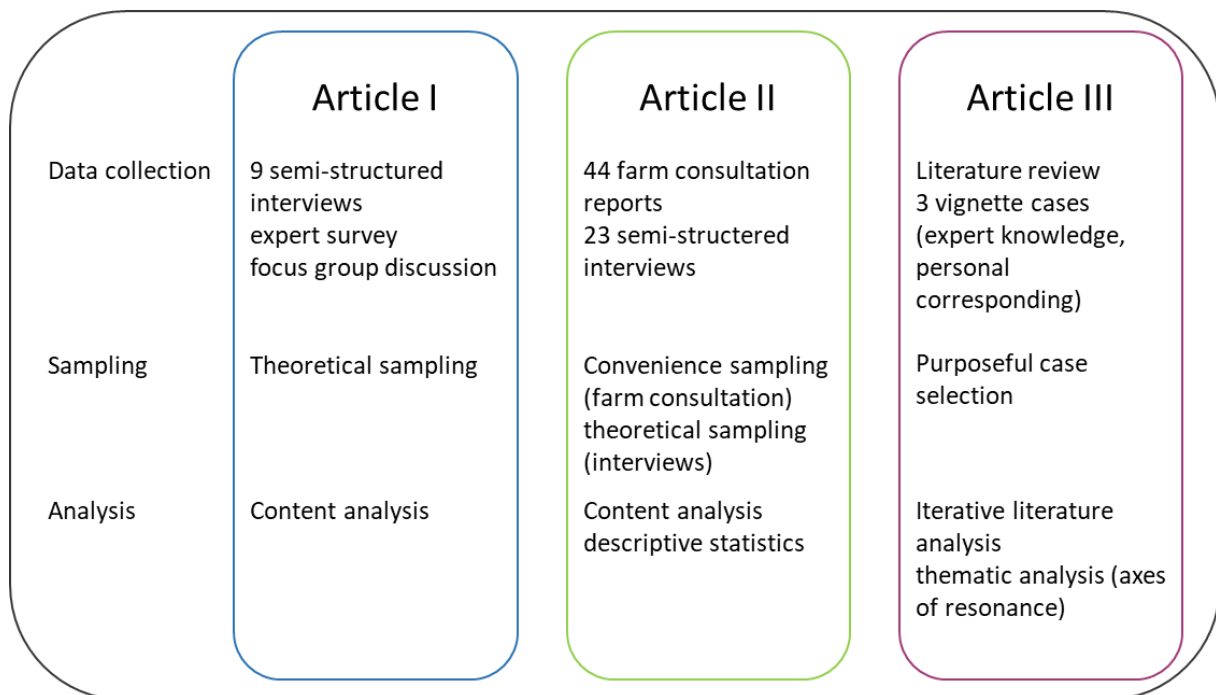


Figure 5: Summary of methodology employed in Articles I-III.

Given the transdisciplinary embedment (cf. Chapter 3.1) and connection to the biosphere reserve (cf. Chapter 3.2), this dissertation follows an open and iterative research process. Reflections on practical and conceptual contributions took place during the entire process, i.e. while working on a specific article but, in particular, subsequent to having explored a specific social-ecological perspective in an article (cf. Figure 6). Discussions with supervisors, practitioners and literature helped me to align the scope of each article but also the overall dissertation. A central criterion for the reflections follow Balvanera et al’s (2017, p. 2) aspiration of successful pace-based sustainability research to “enhance

social-ecological understanding among both research and user communities while engendering actionable policy or management recommendations and options”. In this sense, the open and iterative research process extends the conceptual frame from relatively well-defined organizational arrangements (**Article I**) to the more ample relational approaches (**Article III**). Concomitant to this is the open but solution-oriented impetus of landscape stewardship, which extends specific hands-on practices to wider social spheres.

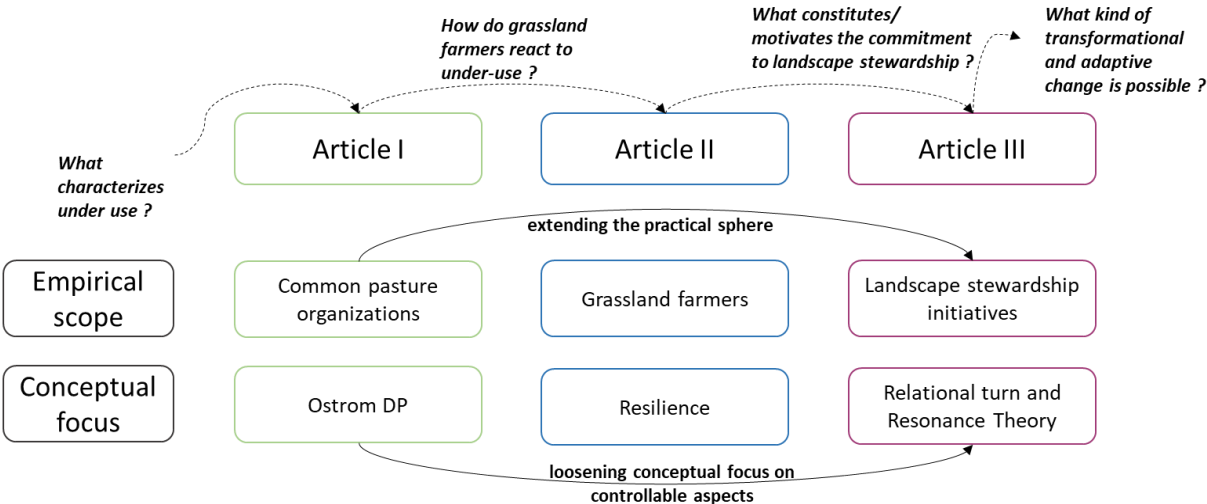


Figure 6: Schematic overview of research process with related empirical and conceptual scope. The Italicised text and dashed lines exemplify reflections that shape empirical and conceptual choices.

3.1 Transdisciplinary approach

Transdisciplinarity is a research approach that engages with practical concerns in scientific processes (Lang et al., 2012). As this dissertation connects to the practical work I am doing for the Black Forest Biosphere Reserve, the transdisciplinary approach I follow aims at combining practical and scientific perspectives in the context of my research objectives.

There is no unified definition of transdisciplinarity or the extent and forms of collaboration between science and outside of academia (Jahn et al., 2022). Diverse terms such as interdisciplinarity (Beichler et al., 2014), co-production (Chambers et al., 2022), co-design (Moser, 2016), participatory action research (Eelderink et al., 2020) or integrative approaches (van Kerkhoff, 2014) contain elements that make up and are shared by the notion of transdisciplinarity. In this dissertation, I use an understanding of transdisciplinarity that combines the integration across scientific disciplines and the engagement with non-scientific actors.

Drawing on Bergmann and Klein (2012), it implies for this dissertation, that I

- (i) incorporate knowledge outside the discipline of qualitative research;

- (ii) refer to real-world problems and seek to solve sustainability issues in the social-ecological context of the Black Forest Biosphere Reserve;
- (iii) integrate non-academic perspectives into the research process;
- (iv) seek to feed-back findings to non-academic actors through my work for the Black Forest Biosphere Reserve;
- (v) reflect upon my dual role as researcher and staff in shaping scientific and practical outputs of this work.

In the context of social-ecological research, transdisciplinarity is used as a buzzword. The discourse on transdisciplinary approaches cross-feeds with the above mentioned notions of collaboration (Jahn et al., 2012; Schöpke et al., 2018). Scholarship on transdisciplinarity affirms the suitability of transdisciplinary principles to make sense of the complexity and uncertainty connected to transformational change (Bergmann et al., 2021; Horcea-Milcu et al., 2020; Marshall et al., 2018) and thus to address the social-ecological theory background. In addition, I use transdisciplinarity to connect the different concepts with respect to under use.

Empirical findings on transdisciplinary approaches also show that practitioners involvement, in particular at the outset, increases the societal impact of research. However, it corrupts the scientific output in terms of lower impact, publications and, as to what doctoral dissertations are concerned, a longer timespan to finish the projects (de Jong et al., 2016; Newig et al., 2019; Ruppert-Winkel et al., 2015).

3.2 Connection of research project to practical project

The research approach of this dissertation makes use of the work I am doing for the Black Forest Biosphere Reserve in the sense that practical and academic goals partly converge but that formats of communicating research outputs differ. In order to clarify the connectedness and distinctness of academic and practical work, I briefly describe the project “Allmende 2.0”, for which I was employed and out of which this dissertation evolved. The project ran at the Black Forest Biosphere Reserve office between 2019 and 2022. The objective of “Allmende 2.0” was to develop pathways for sustaining the cultural landscape of the Black Forest Biosphere Reserve against the background of multiple challenges grassland farmers are facing. The German term “Allmende” translates into common land but, in the southern Black Forest, denotes common pastures. Content, workflow and outputs of “Allmende 2.0” were defined by the project’s advisory group, comprising 20 representatives from farmers, scholars, municipalities, local and regional administration as well as the farmers’ union. At the outset of the project, work content and expectations were defined along several thematic fields by the project

advisory group. Claudia Bieling, the supervisor of this dissertation, was part of the “Allmende 2.0” project advisory group and provided guidance on how the practical project and research project could benefit one from another. In this regard, the dissertation complements the work content of “Allmende 2.0”.

Even though practical work for the biosphere reserve partially overlaps with the scientific work (in particular in data collection), cross-feed and is a central part of my research approach, findings were presented in separate formats. As to what “Allmende 2.0” is concerned, several project reports in German (Black Forest Biosphere Reserve Office, 2020, 2021, 2023), non-academic articles (Brossette & Kemkes, 2021; Huber et al., 2021), a webpage, as well as a podcast were made available in German language to a large audience in addition to numerous presentations and workshops on the ground or online. **Article II**, published in the journal “Naturschutz und Landschaftsplanung”, well-established in the German landscape management community, tries to bring together scientific and practical ambitions of both projects. Despite the close connectedness of “Allmende 2.0” and this dissertation, the findings and practical recommendations of both projects are not identical but complementary.

3.3 Case study - the Black Forest Biosphere Reserve

The designation of the Black Forest as a biosphere reserve in 2017 embeds the study area in a politico-institutionally charged background. Launched in 1971 and hosted by UNESCO, the Man and the Biosphere Programme developed the concept of biosphere reserves as place-based approaches to address the global sustainability agenda (Coetzer et al., 2014; Reed & Price, 2019). The notion and discourse of biosphere reserves as “learning laboratories for sustainable development” (Ishwaran et al., 2008, p. 118) connects to cultural landscapes, the social-ecological paradigms and research approach of this dissertation, including transdisciplinarity (Schultz et al., 2018; UNESCO, 2017; Walk et al., 2019). Without explicitly referring to the concept of biosphere reserves, SES thinking and resilience thinking have taken up the notion of biosphere as “integrating all living beings and their relationships ... and the dynamics of the Earth system as a whole” (Folke et al., 2016, p. 1). The idea of “reconnecting to the biosphere” uses the biosphere as a metaphor to conciliate social, economic and ecologic dimension while pointing to the need of adaptations and transformations (Cooke et al., 2016; Folke et al., 2011).

The Black Forest Biosphere Reserves transfers these higher-level and conceptual considerations to a concrete place-based social-ecological setting. Situated in south-west Germany, the biosphere reserve covers a surface of 630 km² in the south of the Black Forest mountain range (cf. Figure 7). What distinguishes the southern part of the Black Forest from the rest of the mountain range are the mosaic

landscape with varied patterns of grassland and forests as well as an undulated topography ranging from 230 m to close to 1.500 m above sea level. Climatic conditions are characterised by annual temperatures between 5 and 7 C° and precipitation between 1.200 and 1.900 mm without significant seasonal variability. Within Germany, the Black Forest represents the landscape type “grassland rich forest landscapes” (Brockamp et al., 2016, p. 52). The common pastures of the Black Forest form the feature of the biosphere reserve. The denomination of common pastures refers to the common pool resource character of the land – traditionally used collectively by neighbouring farmers, albeit differing property rights regimes. Today, most pastureland is property of the municipalities and leased out to farmers.

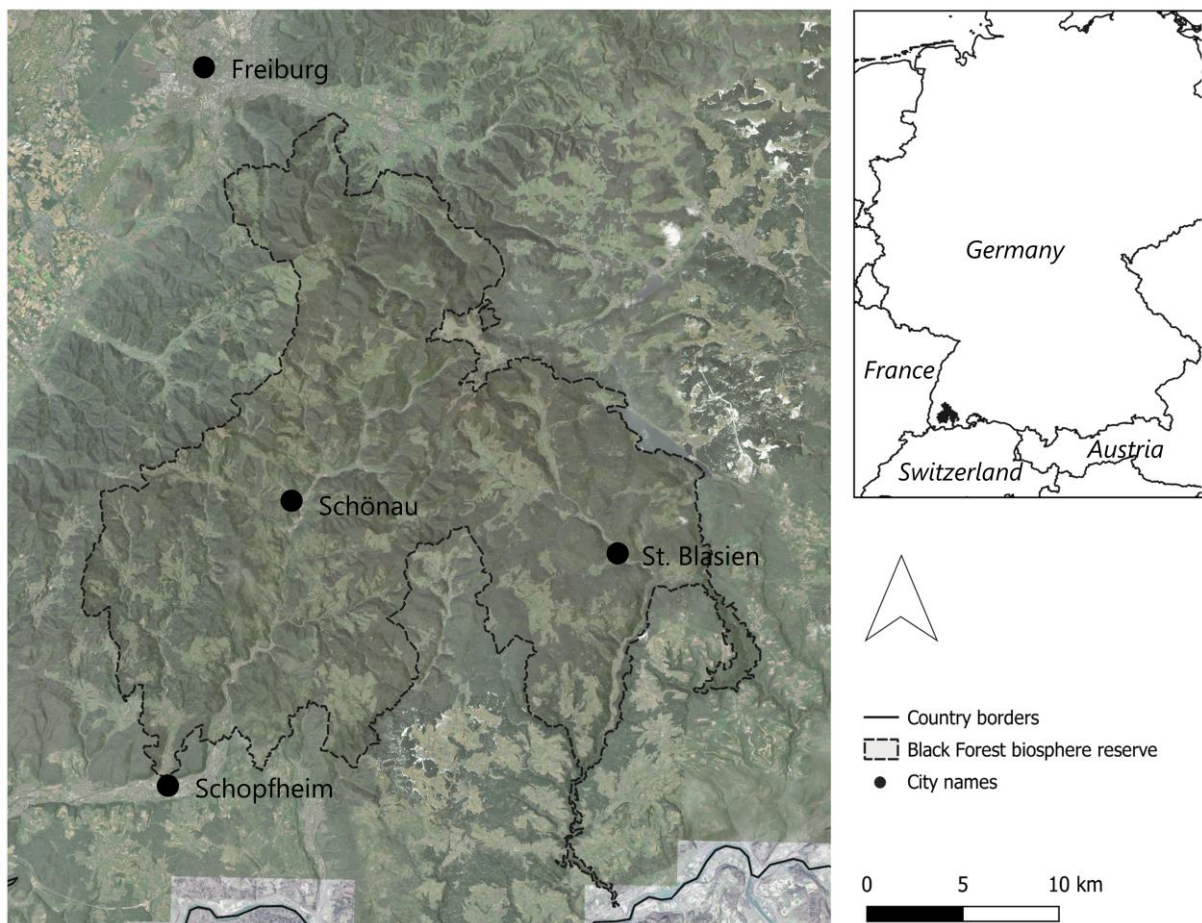


Figure 7: Map of the Black Forest Biosphere Reserve taken from Article I. The map was created using QGIS Geographic Information System open source software. Base maps from ArcGIS are intellectual property of Esri and used herein under licence.

Although grassland covers only 25 % of the biosphere reserve area, grazing activities are the basis for the social-ecological meaning of the biosphere reserve (cf. Table 5). As an example, the designation of large portions of the common pastures as European Natura 2000 sites translates into a public obligation to preserve the extent and ecological quality of the pastures. On the other hand, the high

number of visitors in the Black Forest compared to residents illustrates the importance of landscape-based tourism.

Table 5: Social-ecological characteristics of the Black Forest Biosphere Reserve connected to common pastures or grazing. Data: Black Forest Biosphere Reserve (2021). Adapted from Article II.

Variable (unit)	Value
Nature protected area by German law (ha)	9.784
Nature protected area by European law (ha)	25.922
Vascular plant species on German red list (n)	110
Inhabitants (n)	38.000
Overnight visitors per year as of 2018 (n)	2.301.000
Day visitors per year as of 2018 (n)	1.729.000

In the ecological context of the Black Forest, continued and adequate grazing is a precondition to sustain pastures. The intensity of grazing, such as stocking rates and duration, are an important factor for the ecological and visual quality of pastureland – resulting in more or less heterogeneous structures. High grazing intensity leads to bare surfaces, eventually provoking erosion whereas very low densities will lead to the development of shrubs and trees. In short, the sustenance of common pastures requires the right intensity and regime of grazing. However, the extent of grassland farming is in decline, in particular since the 2nd half of the 20th century (cf. Table 6), resulting in visible changes in the landscape (cf. Figure 8). However, grassland farming has remained relatively small-scale and often a part-time activity, with an average farm size of around 20 ha. An overwhelming majority of grassland farmers works within the region. Households generally do not financially rely on grassland farming. Livestock, in particular cattle and goats, are mostly kept for meat production and landscape sustenance. The southern Black Forest Biosphere Reserve is home of the “Hinterwälder Rind”, an endemic cattle breed, which is rather small, sturdy and comes along with nutrient-poor fodder (cf. Figure 9). The Hinterwälder cattle co-evolved with local conditions and requirements of subsistence-farming, supplying families with milk, meat, manure and traction force. However, the breed is relatively unproductive.

Table 6: Development of grazing in the Black Forest Biosphere Reserve. Data: 1 Statistics Office of Baden-Württemberg (2021), 2 Geiger (1990) for the year 1990, 3 own estimation (Article I).

Variable (unit)	Year 1979	Year 2020
Farms (n) ¹	1.434	507
Cattle (n) ¹	14.699	10.385
Agricultural area (ha) ¹	15.812	13.183
Pastureland in common use (ha, estimation)	7.420 (year 1990) ²	1.200 ³

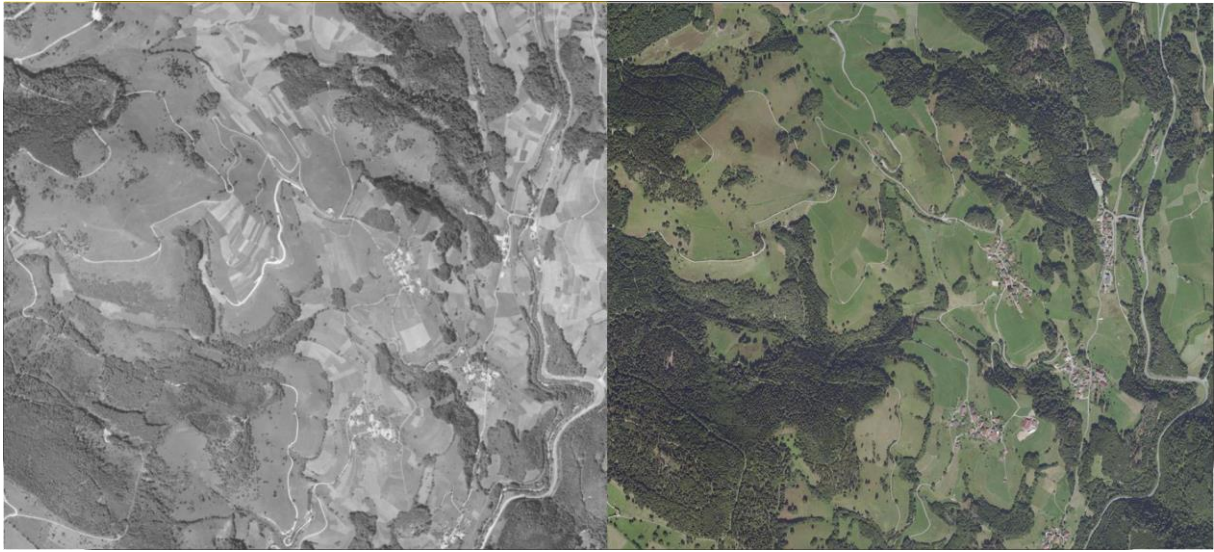


Figure 8: Orthophotos of the Black Forest Biosphere Reserve (near municipality of Fröhnd). The imagery depicts the advancements of forest to the detriment of common pastures. The orthophoto on the left is from 1968; on the right is a current image. Images are taken from leo-bw.de/kartenvergleich. Sources for Orthophotos: Landesarchiv BW and Landesamts für Geoinformation und Landentwicklung BW.



Figure 9: Picture of typical livestock in common pastures. The endemic cattle breed “Hinterwälder Rind” (left) and goats (right).

In general, grassland farming in the Black Forest Biosphere Reserve is challenging due to specific social-ecological and political conditions. Over generations, grazing practices have transferred harsh climatic conditions and unfertile soils into ecologically and socially valuable pastureland. However, diverse regulations from forestry, agriculture and nature protection restrict the self-contained scope of grassland farmers. As there is a general under-use challenge with respect to farming, there are specific farm schemes that subsidize grassland farmers and that try to offset ecological conditions and regulatory restrictions. Nonetheless, farming is seldomly economically viable.

Traditionally, common pastures were used for joint grazing by common pasture organizations. Following a general decline of grazing in the region, many common pasture organizations dissolved and pastureland was re-distributed among the remaining farmers.

To counter this development, several initiatives from civil society and policy were launched to take action against the under use of common pastures. As an example, local associations such as the voluntary fire brigade or carnival associations contribute to shrub cutting. In addition, political engagement led to a major nature conservation project (“Naturschutzgroßprojekt”) in the area from 2002 to 2012, leading to process of becoming a biosphere reserve.

The starting point for this dissertation lies in the recognition of the strong connection between common pastures and people that take initiatives to sustain these pastures – grassland farmers and common pasture organizations in particular.

3.4 Introspection and ethical considerations

Transdisciplinary sustainability sciences are characterised through reinforcing interrelations and dependencies between researchers, practitioners and the scientific paradigms (Preiser et al., 2021). To question and relate to the normative assumptions of concepts and paradigms I seek to integrate reflexivity in this research. Reflexivity calls for deliberation of collective processes of problem framing and solving, an openness to the context and people research engages with in order to acknowledge values, assumptions and power structures (Lamine, 2018; Lawhon et al., 2010; Popa et al., 2015). I do not use reflexivity to dissolve or cover conceptual ambiguities, ontological beliefs or epistemological proceedings. Instead, reflexivity acknowledges the plurality of practical perspectives on landscape stewardship in the Black Forest Biosphere Reserve. In particular, it leads me to introspect on the multiple roles I took on as a researcher and employee of the Black Forest Biosphere Reserve (cf. Figure 10).

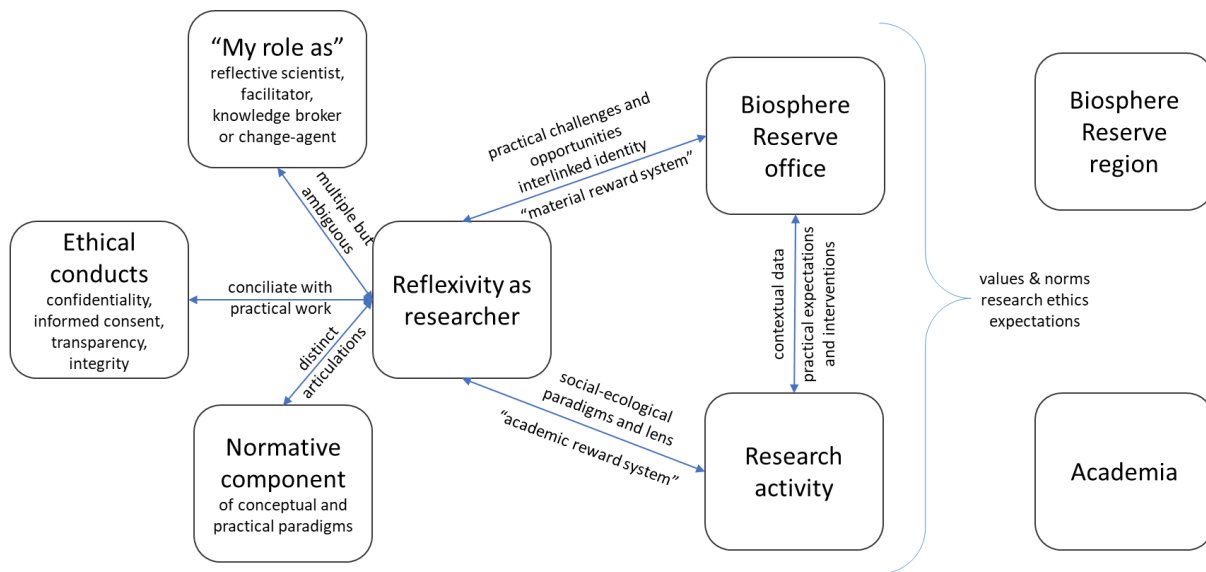


Figure 10: Focal aspects of the reflexive work throughout the dissertation process.

Following Wittmayer and Schöpke’s (2014) identification of ideal-type roles of researchers in sustainability sciences, I view my role foremost as a reflective scientist, but given my simultaneous presence as a representative of the biosphere reserve, I embody roles of facilitator, knowledge broker and change-agent. These notions are widespread in transdisciplinary scholarship, in particular in PhD research (Cockburn, Sellberg, et al., 2018; Sellberg, Cockburn, et al., 2021; Thapa et al., 2022). Following these roles, I acknowledge that while engaging with landscape stewardship in the Black Forest Biosphere Reserve, I intervene in the system to an extent that is impossible to control.

Ethical conducts in qualitative research call for confidentiality, informed consent, transparency, integrity (Kang & Hwang, 2021; Keitsch, 2021; Wolff et al., 2019) and reflexivity to comply with these principles in transdisciplinary research (Popa et al., 2015; Wolff et al., 2019). While requirements such as partakers’ informed consent, confidentiality or data security could be fulfilled through written forms and careful data analysis, ex-post reflections lead me to acknowledge flaws in integrity. An agreement with the biosphere reserve office that results related to my work for the Black Forest Biosphere Reserve can be used for research, but that research does not form part of my (paid) work time, has led me to separate practical and research work when possible. In addition, my position as biosphere reserve staff is favourable to creating mutually beneficial relationships with partakers, in the sense that I represent a change agent. I refrained from explicitly stating my role as a researcher in early stages of this PhD when engaging in activities where my position as biosphere staff took on a central role, even though I would take advantage of participant observation. In more advanced stages of this dissertation, I became more confident to acknowledge the organizational separatedness but inextricability of scientific and practical work with regards to content. This led me to present myself

also as a researcher when I felt that information relevant for the transdisciplinary approach of this dissertation would emerge.

This research engages with practitioners that hold strong values and opinions on landscape stewardship. In this context, working with different social-ecological paradigms has led me to adopt conditional assumptions that affect my (re)interpretation of empirical observations. As such, working with Ostrom DP in the under-use context has drawn my attention to scrutinize beneficiaries and contributors of landscape stewardship (**Article I**), whereas resilience has shifted the perspective to consider social-ecological diversity and hidden processes (**Article II**). However, it is in particular resonance theory and the meaning of resonant relationships for transformational change (**Article III**) which has implications for the becoming of this cumulative dissertation. Looking out for resonant relationships within the concepts applied: to social-ecological components that are part of this research or the research outputs has become a normative orientation for my work. This implies, for instance, a cognitive and emotional openness to people or to the landscape, feeding back results in appropriate ways or acknowledging the unpredictable and uncontrollable character in the becoming of this dissertation, albeit following a clear scientific approach. Engaging with resonance beyond its analytical scope has led me ask the question how resonance can be integrated into a research approach and how resonance contributes to the becoming of (transformational) research outputs.

4 Synthesis of results

In this section, I summarize the main findings of this dissertation according to articles and research objectives.

All publications are collaborations of scholars and practitioners. As the main and corresponding author of the articles, I took a lead in formulating research questions, data analysis and writing. Co-authors gave substantial support throughout the process, in particular in terms of conceptualization, interpreting results, finding suitable narratives and reviewing the articles. In **Article II**, Lukas Kiefer conducted farm consultations and brought in quantitative data.

4.1 Summary of articles

Article I: Governance in under use

Key findings: This study supports the suitability of employing different social-ecological concepts for practical and conceptual advance. It finds that Ostrom DP for under use should (i) consider broader social boundaries to include all actors benefiting from the resources, (ii) achieve congruence of provision, appropriation and local conditions that focus on sufficient levels of landscape stewardship services involving new beneficiaries for burden sharing, (iii) match appropriators' rights and duties as well as incentives for and motivations of pasture management.

Implications for practice: The article finds that a holistic understanding of social and ecological dimensions is required for CPR management and advocates in favor of multi-level adaptive governance. In a context in which the importance of common pastures shifts from provisioning services to regulating and cultural ecosystem services, actors outside the range of common pasture organizations are called on to assume responsibility.

Article II: Social-ecological resilience and perspectives

Key findings: The study supports RP as an analytical framework for landscape stewardship in the Black Forest Biosphere Reserve. It finds that farmers' support measures connect to elements central in resilience thinking: encourage learning, connectivity, maintain diversity and redundancy. Resilience reinforces the meaning of adaptations along multi-layered chains of effect.

Implications for practice: The article finds that horizontal and vertical axes of decision making should be better integrated into landscape stewardship.

Article III: Relationships and transformations

Key findings: In distinguishing between self and world and highlighting the role of relationships, resonance theory brings ontological and epistemological clarity, while overcoming a strict dichotomy between social and ecological. This study finds that resonance theory provides a much-needed framework to describe how system-wide transformations emerge from interactions and out of relationships at the individual level. Resonance theory contributes to SES thinking by adding the notion of uncontrollability in transformations and shifting the debate on agency towards relationships.

Implications for practice: Cases of landscape stewardship in the Black Forest Biosphere Reserve nurture resonant self-world relationships along different axes of resonance. The article illustrates the importance meaningful relationships between people, animals and landscape hold for past, present and future sustainability transformations that contribute to sustaining the cultural landscape. Thus, it calls for enabling meaningful relationships in landscape stewardship.

4.2 Research objectives

4.2.1 Explore adaptive governance and resilience in the under-used context of common pastures

This dissertation explores social-ecological perspectives for under-used common pastures in the Black Forest Biosphere Reserve. **Article I** develops a conceptual framework with respect to resilience thinking to interlink Ostrom DP, SESF and RP (Cf. Figure 11). While the Ostrom DP indicate institutional resilience, RP operationalize resilience building and the SESF depicts complexity of social-ecological thinking. Integrating these interconnected concepts in to the case of common pasture organizations allows for theoretical advancements (Folke, Colding, and Berkes 2013; Partelow 2018), as well as for a multifaceted understanding of practical management issues. **Article I** demonstrates that this tripartite approach is suitable for describing governance arrangements in an under-use context, and that RP and SESF provide additional insights to inform possible Ostrom DP in the light of under use. As such, the article finds that,

- (i) *resource boundaries* (DP 1) should comprehensively recognize social-ecological components that contribute to and take advantage of common pastures,
- (ii) to attain *congruence between appropriation and provision rules and local conditions* (DP 2), comprehensive interactions between social-ecological components must be made apparent and integrated in governance arrangements,
- (iii) *monitoring* (DP 4) should include contributions to landscape stewardship,
- (iv) next to the *recognition of appropriators' rights* (DP 7), contributors to landscape stewardship require arenas for self-fulfilment and autonomy.

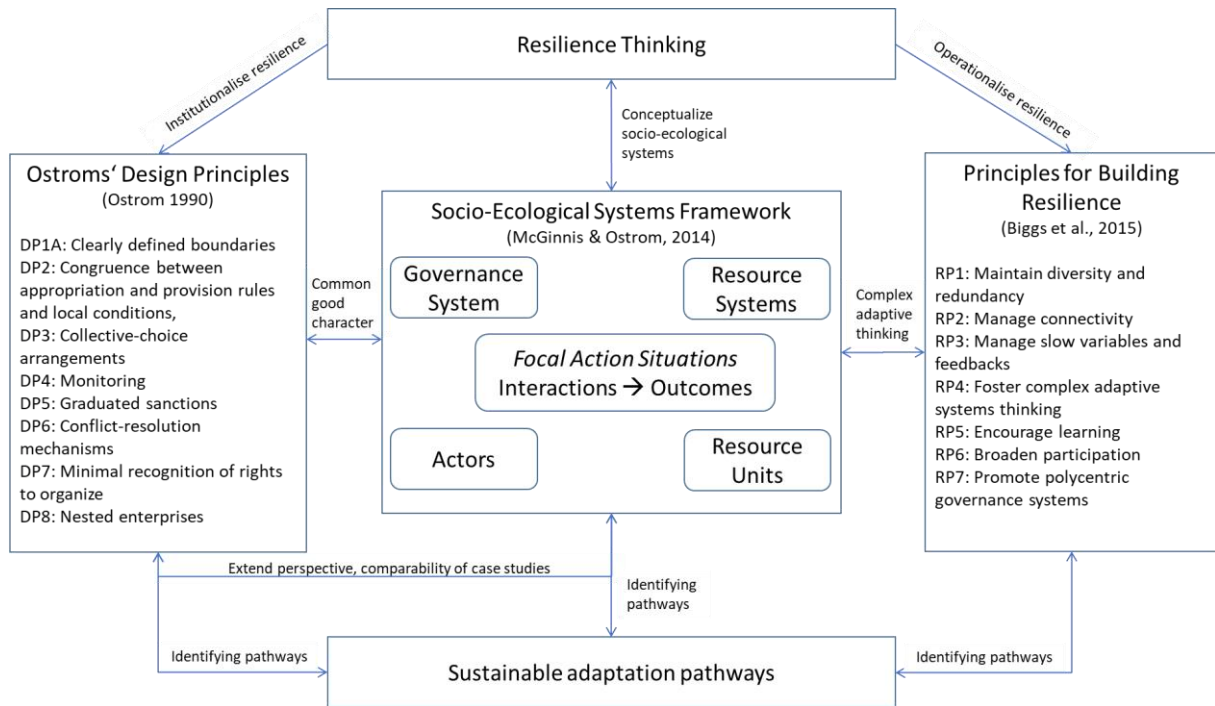


Figure 11: Conceptual links between Ostrom Design Principles, Social-Ecological Systems Framework and Resilience Principles. Taken from Article I.

With regards to improving resilience and governance, **Article I** and **Article II** develop support measures respectively for common pasture organizations and grassland farming (cf. Chapter 4.2.3). Practitioners' claims strongly connect to resilience thinking, in particular to encourage learning (RP 5), maintain diversity (RP 1), manage connectivity (RP 2) and polycentric governance (RP 7). As a framework, RP allow to assess the contributions of practical measures to social-ecological resilience while recognizing different levels of effects. **Article II** scrutinizes the diversity of actors that constitute the regional governance of common pastures. It finds that polycentric governance approaches should find stronger application to better respond to the specificity of under use. This implies fostering cross-sectoral and cross-scale connectivity to incorporate social-ecological components that contribute to and take advantage of common pastures. Contributions of resonance theory to common pasture governance lie in the notion of uncontrollability. **Article III** explores the quality of relationships between self and world or humans and their environment as a starting point for sustainability transformations. Recognizing the uncontrollable character of resonance points to a governance function that is often left out in social-ecological literature, i.e. to enable or favour resonant relationships at the interface of humans and their environment.

4.2.2 Explore conceptualizations of relationships at the interface of human-nature and self-world in the context of transformations

Interactions and relationships between humans and their environment play an important role for sustainability transformations in SES literature. Given the current critique concerning the capacity of social-ecological frameworks to conceptualize relationships, **Article III** investigates conceptualizations of transformations through self-world relationships and uses resonance theory to infuse SES thinking. A fundamental critique of the relational turn within SES concepts addresses their theoretical grounding and methodology. By aiming at a broad integration of human and non-human entities and phenomena, they lack ontological (i.e. beliefs about the nature of reality) and epistemological (i.e. theories to represent reality) lucidity (Raymond et al., 2021; West et al., 2020). Explicit ontologies of SES, such as “intertwined” (Folke et al., 2016; Preiser et al., 2021) or “inextricable” (Martín-López et al., 2017) contradict with analytical proceedings that tend to separate between the social and the ecological spheres (Binder et al., 2013; Hinkel et al., 2015). Responding to this, **Article III** refers to the “relational turn” (West et al., 2020) as an emergent strain of non-dualistic social-ecological approaches that emphasizes on unfolding processes and relations.

Focussing on ontological and epistemological characteristics, **Article III** introduces resonance theory as a novel frame to conceptualize and analyse self-world relationships in the context of transformations. It is the very recognition of self and world as different but interdependent entities that allows focusing on the quality of these relationships to explore the connectedness of humans to their environment. In resonance theory, the experience of resonance precedes transformational processes. With respect to transformations, **Article III** identifies the following contributions of resonance theory to SES literature by

- (i) considering the uncontrollable and unpredictable character in the emergence of resonance and consequently of transformations,
- (ii) proposing the axes of resonance as an analytical frame to analyse and pursue the quality of relationships of the self to different segments of the world (cf. Table 4),
- (iii) dissolving the current debate on agency towards relationships in the sense that bringing about change is neither restricted to social nor attributed to ecological entities only but mediated through the experience of resonance,
- (iv) applying Durkheim’s concept of “collective effervescence” (2008) to exemplify the expansion of transformations between individual and systemic level.

By substantiating theoretical considerations of resonance theory and the relational turn to real-world cases of landscape stewardship in the Black Forest Biosphere Reserve, **Article III** demonstrates the ontological and epistemological coherence that resonance theory brings to SES thinking.

4.2.3 Infer social-ecologically informed recommendations for landscape stewardship at the interplay of adaptations and transformations

Drawing on adaptive governance and resilience, **Articles I** and **II** develop support measures respectively for common pasture organizations and overall grassland farming. In both articles, support measures were validated by practitioners as part of the transdisciplinary research approach and were incorporated in the biosphere reserve project “Allmende 2.0”. The social-ecological frame, in particular Ostrom DP and RP, connects in two ways to support measures. Firstly, by contextualizing an evaluating the meaningfulness of farmers’ assertions with regard to resilience and governance. Secondly, by depicting causative links of processes that support measures would initiate. These processes remain often unnoticed by practitioners but they are crucial within resilience or governance perspectives. The content of support measures differs between the level of landscape stewardship methodologically addressed, reflecting the specificity of common grazing (**Article I**) but also challenges many grassland farmers have in common (**Article II**). Farmers’ support measures (Cf. Table 7) reflect the diversity of social-ecological components that can potentially contribute to landscape stewardship in the Black Forest Biosphere Reserve.

Table 7: Support measures for grassland farmers in the Black Forest Biosphere Reserve and their link to resilience principles. Taken from Article II. Article I presents an overview of specific support measures for common pasture organizations.

Field of action	Content of support measure	Link to resilience principles (RP)
Consultation and contact persons	Better coordination between authorities and other stakeholder groups. Establishment of contact persons that bundle competencies in agriculture and nature protection. More comprehensive and binding advisory services.	Improved connectivity (RP2). Reduced transaction costs through clear allocation of competences of stakeholder groups. More coherent action (RP1).
Moving away from tethering	Development of socially, ecologically and economically adapted loose-hose systems to small-scale farming (i.e. community barns, shelters, conversion of existing barns).	For instance, community barns provide arenas for networking, cooperation, exchange of experiences as well as knowledge (RP6, RP2).
Livestock protection and wolf	Development of social-ecologically suitable livestock protection measures against wolves and their implementation.	Development of new approaches (RP5). Identify threats to social-ecological system (RP3). Create arenas for discussing conflicts and promote understanding (RP5).
Cooperation in forage production	Forage production in cooperative forms (shared instead of individual machinery, make use of services). Provide machinery for rent.	Shared machinery use provides arenas for cooperation and networking (RP6, RP2) and cost-saving (RP2).
Training	Offering social-ecologically adapted and decentralised training for farmers.	Development and dissemination of knowledge (RP2, RP5). Exchange between supporting stakeholders and farmers (RP6).
Commercialisation initiative	Initiative of a social-ecologically comprehensive commercialisation initiative (knowledge, networking, organization, marketing offers, impact on creation of value, slaughtering opportunities, fitting grassland conditions).	Addressing the entire value chain (RP2). Strengthen the importance of animal production and economic diversification (RP1).

Field of action	Content of support measure	Link to resilience principles (RP)
Maintenance of grassland	Enabling organic fertilization without compromising species diversity. Evidence-based monitoring of fertilization impacts.	Monitor and control feedback loops (RP3). Enable diverse farm structures (RP1). Involve horizontal and vertical linkages in the SES (RP4).
Governance and networks	Establish a working group for grassland-based farming. Equal participation of farmers, administration, municipalities, Black Forest Biosphere Reserve.	Promote exchange and mutual understanding (RP1, RP2). Involve relevant stakeholder groups in the social-ecological system (RP6). Promote multi-level exchange and decision-making.

Given the transdisciplinary approach and interdisciplinary conceptual foundations, practitioners' perspectives and further contextual data informed practical social-ecological recommendations of this dissertation that were not explicitly addressed by practitioners. This concerns, for instance, the integration of all actors taking advantage of the cultural landscape but contributing insufficiently in sustaining common pastures (**Article I**). Engaging civil society or the tourism sector in landscape stewardship requires greater connectivity and polycentricity in governance. Due to strong implications of different administrations, farmers perceive the current governance system as sluggish and wanting transparency. To manage diversity and redundancy in adaptive governance, a key recommendation of **Article II** is to foster the quality and profoundness of interactions and relationships, rather than the mere quantity. **Article III** supports the importance of frame-conditions favourable to resonant relationships between social-ecological entities with regards to transformations. It exemplifies how initiatives with different causal links to landscape stewardship benefit from resonant relationships. Arguably the most important practical recommendations of this dissertation are to appreciate the presence of multiple predominantly small-scale grazing initiatives and support them with regard to integrating new actors (**Article I**), exploring resonant relationships with the social, material and natural (**Article III**), and strengthen their competences to alter frame conditions (**Article II**).

5 Discussion

In this section, I seek to show that the research presented in this dissertation is worth it with respect to the social-ecological literature strains I engage with and the practical inference for landscape stewardship in under-use contexts. I seek to show convincingly that, due to their common ontological grounding but distinct epistemological proceedings and analytical focus, employing and combining social-ecological concepts with different perspectives complements theoretical and practical understandings of under use. I will argue that the synopsis of social-ecological concepts allows to develop ideas on transformational change, uncontrollability and complexity that have theoretical and practical implications. The context-specific character and research approach of this dissertation implicate important limitations and restrictions of this research. I seek to discuss both contributions and limitations, while acknowledging that this discussion remains incomplete with respect to all practical and conceptual aspects mentioned in the previous sections of this dissertation and **Articles I-III**.

5.1 Scrutinizing the social-ecological conceptual lenses

Due to the context-dependent nature of SES and the innate impetus to inform change towards sustainability, social-ecological research requires the integration of different types of knowledge, disciplines and methods (de Vos et al., 2019, 2022; Preiser et al., 2018). Social-ecological frameworks and concepts originate in efforts to conciliate a methodological and social-ecological pluralism. The continuous efforts to develop frameworks and theory in SES research steam from a recognition of science and practice that novel perspectives are needed. In this regard, scholars draw on distinct considerations within or beyond the body of social-ecological literature (Chambers et al., 2022; Preiser et al., 2021; Raymond et al., 2018; West et al., 2020).

This dissertation follows a plurality of doctoral projects that employ different social-ecological concepts to bridge academic and real-world demands (Björkvik, 2020; Koh, 2022; West, 2016). Sustainability science has long recognized the requirement of “doing science with society” (Thapa et al., 2022, p. 1562), but transdisciplinary approaches remain uncommon in social-ecological doctoral works (Sellberg, Cockburn, et al., 2021; Wolff et al., 2019). Due to the strong connection of this dissertation’s research process and goals to the work of the Black Forest Biosphere Reserve, the extensive transdisciplinary approach I engaged with is a feature of this dissertation. It particularly validates the practical findings to which I will turn later on.

Employing different conceptual and analytical perspectives calls for scrutinizing dissimilarities, overlaps and synergies. Reflecting on the synopsis of resilience, Ostrom DP and resonance theory in

the context of SES thinking raises many further questions, such as on the interconnectedness of governance and relationships, the starting point for change, the level of analysis or the ability to derive practicable recommendations. In addition, it allows to bridge theoretical and practical considerations on what under use means.

5.1.1 Under use in social-ecological paradigms and resonance

A practical but also conceptual guiding principle in this dissertation has been to explore perspectives for landscape stewardship of under-used common pastures. The different social-ecological concepts I draw upon in **Articles I-III** follow specific causal chains of reasoning. While Ostrom DP focus on institutional and organizational arrangements, resonance questions the quality of relationships that people entertain with the world. Resilience, in turn, engages with how SES can cope with disturbances. With respect to under use, the governance perspective of the Ostrom DP considers the congruence of contribution and benefit, thus interrogating the incentive structures in landscape stewardship. From a resilience perspective, under use is a disturbance of the SES that calls for adaptations or transformations. In addition to promoting polycentric governance, resilience thinking emphasizes cross-sectional learning, social-ecological diversity and self-organization as key elements to cope with under use. From a relationship-based access, under use can be interpreted as a threat to entertain meaningful relationships, for instance, in the context of landscape stewardship. In short, what under-use implies differs according to the conceptual lense applied.

Resonance proposes to regard the connection between people and the landscape not primarily as a responsibility, but as a shared “responsability”, thus referring to the receptivity, affectivity and openness of encounters (Rosa, 2020, p. 411). In the context of under use, social-ecological changes such as decreasing number of farmers or a decline in pastureland might lead to an eroding capacity of common pastures to promote resonant self-world relationships. Resonance theory indicates the importance of frame conditions that allow for resonant self-world relationships. For common pastures in the Black Forest Biosphere Reserve, this means to uphold the existing relationships while creating arenas for new relationships to emerge.

With respect to institutional arrangements in under-use situations, there is a scarce empirical and conceptual knowledge base on what under use implies for governance (Baur & Nax, 2021; Hirahara, 2020; Miyanaga & Shimada, 2018; Shimada, 2015). **Article I** found that certain Ostrom DP require reinterpretation when adapted to the under-use context. Reflecting on the findings of **Article I** for this synopsis, I think that there are certain aspects that characterise common pasture organizations, which do not fit into the rationale of the Ostrom DP but that are vital with respect to under use. In the Black Forest Biosphere Reserve, these are relational characteristics such as the importance of leaderships, personal bonds between members that go beyond common pasture activities or shared beliefs of the

importance of grazing. From the resonance perspective, these aspects indicate the presence of meaningful relationships within common pasture organizations and common pastures. In **Article II**, resilience thinking highlighted the importance diversity and redundancy of common pastures and to foster the quality of social-ecological interactions and relationships. Considering the understanding of resonance theory on the uncontrollability of relationships, under-use contexts might imply a stronger requirement of meaningful relationships for landscape stewardship, compared to contexts where the material value is at the centre of resource use. On the other hand, under use uncovers the relational aspects that characterize landscape stewardship and which are often masked by economic paradigms in over-use systems. Whether the institutional capacity to allow for meaningful relationships might be an additional DP of under-used common pool resources or whether resonance is incompatible with institutional arrangements needs further reflections. In particular, it requires further validation from other social-ecological contexts.

5.1.2 Complexity and uncontrollability in social-ecological governance and relationships

The conceptual lenses I adopted in this dissertation vary concerning the kind of effect they suggest to exert upon SES. Ostrom DP and resilience thinking are oriented towards inferring active interventions to the SES (Baggio et al., 2016; Berkes & Folke, 1998; Biggs et al., 2015), while resonance theory criticises the higher-order frame conditions that (dis-)favour the emergence of resonance (Artmann, 2023; Rosa, 2019). These positions are neither rigid, nor are they irreconcilable. As an example, SES thinking, including Ostrom DP (DeCaro, 2019; McGinnis & Ostrom, 1992) and resilience (Folke et al., 2005; Walker et al., 2004), offer the notion of self-organization to refer to the capacity of SES to organize, adapt and transform in a self-contained way. SES literature indicates that self-organization can be self-reflexive (Morçöl, 2014) or non-intentional (Levin, 1998), i.e. acknowledging both active and self-contained capacities of SES.

Resonance theory's main contribution to SES thinking is to account for the uncontrollable occurrence and unpredictable outcome of resonant relationships and, consequently, of transformations. Rosa (2019) employs the German term "unverfügbar" to argue that relationships resist institutionalisation and that the role of governance is "to remove structural obstacles to a resonant disposition" (Rosa, 2020, p. 413). Resonance theory offers arguments in favour of changing our collective attitude towards the world. In an attempt to connect resonance theory to SES literature, **Article III** focussed on the link between resonant relationships and transformations in the context of sustainability, resulting in a specific approach to resonance theory. Resonance theory informs about the presence of relationships that constitute many connections in SES (Müller et al., 2023). However, as a social science framework, it focusses on individual and collective relationships of humans to the world, leaving out interactions outside the human realm.

Before discussing how resonance theory contributes to conceptualizing transformations, I try to link the “controllable” stance of Ostrom DP and resilience with the “uncontrollable” character of resonance. I argue that the idea of complexity bridges both perspectives. The study of complexity, as an inherent systemic property of SES, has evolved together with SES literature (Berkes et al., 2003; Levin, 1998; Moore et al., 2014). Preiser et al.’s (2018) typology of properties of complexity picks up central elements of resilience thinking. As an example, they highlight the importance of contextual responsiveness rather than blueprint reactions. Further properties of complexity are to understand complex processes as open and emergent, i.e. to acknowledge the surprising occurrence and unintended consequences of processes in SES (Preiser et al., 2018; Sellberg, Quinlan, et al., 2021). Although complexity is embedded in the idea of governance, the aspects mentioned above connect to resonance theory. For example, resonance could be considered as a further property of complexity, appealing to the relational character within different human and non-human components of SES (Artmann, 2023; Ojeda et al., 2022; West et al., 2020). To make this clear, I will now turn to the different levels of perspective SES thinking and resonance theory focus on.

5.1.3 Perspectives of adaptive and transformational change: from self-world to system

The biggest contrast between SES thinking and resonance is the systemic perspective of the former versus the self-world perspective of the latter. Irrespective of the level of analysis, SESF, Ostrom DP and resilience focus on the connectedness of social-ecological components. Applications in literature range from local to global and from specific to comprehensive framings of SES, making the relation between the different dimensions explicit (Cox et al., 2010; McGinnis & Ostrom, 1992; Partelow, 2018; Stone-Jovicich, 2015). In this dissertation, the practical frame looks out on landscape stewardship in the Black Forest Biosphere Reserve but constitutes different SES depending analytical frame and research questions of **Articles I-III**. The integration of the resonance perspective into SES thinking relies on how central notions of resonance theory can be connected to SES literature.

The notions of adaptations and transformations have been mentioned throughout the respective articles, without engaging with the question of what kind of change they imply. Despite a general agreement that transformations entail profound changes in the setup and functioning of a system, conceptual and empirical findings in SES literature challenge a clear delineation between transformations and adaptations (Barnes et al., 2017; Moore et al., 2014; Reyers et al., 2022). Given the complexity and interwoven character of SES, whether change is considered as deep or marginal, depends on the social-ecological perspective of analysis and the practical reality, for instance, of common pastures (Cinner & Barnes, 2019; Pelling, 2011). The recognition of cross-scale relations of adaptations and transformations implies that adaptations at specific levels might result in transformations at a different scale and vice versa (Barnes et al., 2017; Few et al., 2017). The context

of under use, for instance, implies different challenges to the system depending on whether it is considered at the level of the landscape, farming, public administration or the individual (cf. Chapter 5.3). Resonance theory's perspective on transformations proposes a novel outlook on the above-mentioned challenges. It points towards the uncontrollable occurrence of resonance as an impulse for transformations at the individual level, but without claiming that this will necessarily lead to radical changes at a higher level. Relational social-ecological literature, as I read it, focusses more on the (transformational) outcomes but does not reject the open character of relational changes (Raymond et al., 2018; West et al., 2020).

Resonance illustrates how transformations extend from the level of selves to a group of people by referring to moments of collective effervescence (Rosa, 2019). This process seems to be particularly characteristic in what Rosa (2019) refers to as "moments of vertical resonance", i.e. relationships that appeal to our existential sphere, such as the natural world. The notion of "care" bridges the relational character of SES research and resonance theory in referring to the reciprocal relationships that constitute social-ecological care (Durkheim, 2008; Goebel, 2021; Latour, 2009; Puig de la Bellacasa, 2017; Rosa, 2020; West et al., 2018).

SES thinking contains conceptual elements of how transformational changes emerge at the individual and spread to the systemic level (Eakin et al., 2019; O'Brien & Sygna, 2013). However, these considerations remain marginal in literature, reflecting SES thinking's tendency to elide mind, body and cognitive-emotional processes (Raymond et al., 2018). In response, resonance theory accounts for implicit assumptions of the relational turn and makes them explicit through its own conceptual and analytical frame (Fischer & Riechers, 2019; Rosa, 2020).

Yet, while the resonance perspective might be valuable for understanding changes of values, norms or systems' paradigms (Moore et al., 2014), resonance theory does not substantiate changes initiated outside the realm of resonance, i.e. the part of the SES that is not constituted by relationships. Ecological phenomena, such as extreme weather events or climate change, will thus be accounted for of how they affect relationships, instead of how they directly impact SES. Rosa (2019) argues that resonance often emerges at the backdrop of alienation, which can be triggered, for instance, by ecological regime shifts. However, there is a need for further conceptual work to explore the link between ecological phenomena and the (human) ability to relate to them.

In short, the use of notions of adaptations and transformations depends on the scientific paradigm in which the analysis is positioned. As this dissertation employs different paradigms, I acknowledge a certain ambiguity with regards to how adaptive and transformational change is considered throughout **Articles I-III** to address under use (cf. Chapter 5.3).

5.1.4 Normative dimension and leverage

The transdisciplinary social-ecological approach I follow in this dissertation implies normative understandings of the practical insights and literature contributions (Hahn & Nykvist, 2017; Horcea-Milcu, 2022; Maru et al., 2017). These normative aspects are mediated through the scientific and societal lens I employ (Scholz, 2017), i.e. the specificity of research paradigms, under use as a guiding theme and practitioners' worldviews. In order to make use of the full potential for adaptive and transformational change, literature calls for making the normative dimensions more explicit in social-ecological research (Abson et al., 2017; Bieling et al., 2020; Horcea-Milcu et al., 2019).

Concomitant to the evolution of social-ecological research, and resilience in particular, are ample understandings what these concepts imply (Milkoreit et al., 2015; Zanotti et al., 2020). Early definitions understood the SESF and resilience framework as objective measures (Ostrom, 2009; Walker et al., 2004), while their normative aspects have been emphasized in recent years with respect to promoting change (towards something worthwhile) (Hahn & Nykvist, 2017; Mahajan et al., 2022; Partelow, 2018). As an example, Biggs et al.'s (2015, p. 13) definition of social-ecological resilience, which I draw upon, seeks to "continue providing key ecosystem services that underpin human well-being". The goal of the Ostrom DP is to derive organizational arrangements that match with social-ecological conditions and allow for sustainable resource use (Ostrom, 1990). The orientation on normative goals also applies to resonance theory. The conception of resonance is a normative criterion for a good life, and the four characteristic elements of resonance – affection, emotion, transformation, uncontrollability – are a means of assessing the quality of relationships (Rosa, 2019).

This normative character of these paradigms appeals to different categories of values. SES literature usually distinguishes between three types of values: "instrumental" values emerge from considering the benefits or services SES provide to humans; "intrinsic" values pertain to the inherent virtue of SES; "relational" (or "eudemonic") appeal to the meaningfulness of relationships in SES (Chan et al., 2016; IPBES, 2022; See et al., 2020). Depending on the values, research paradigms and peoples' argumentation, different dimensions of reasoning call for specific changes, adaptations or transformations (Bieling et al., 2020; Chan et al., 2018; Eser et al., 2014). The paradigms used in **Articles I-III** partly address these different types of values. For instance, in underscoring the requirement of deep and meaningful relationships within SES, resonance theory entails relational values. Resilience thinking, in contrast, exhibits a dimension that connects to instrumental values of SES, i.e. the direct benefit of SES to humans that could be hampered in the face of crisis. Instrumental values also substantiate the Ostrom DP in the sense that prudence motivates sustainable collective action.

SES research has adequately shown that distinct value types coexist and are deployed in science and practice (Arias-Arévalo et al., 2017; IPBES, 2022). A central ambition to better understand under use is to extend perspectives (Hirahara, 2020; Miyanaga & Shimada, 2018), which also applies to taking into

account the diversity of values that wheel landscape stewardship initiatives (Bieling et al., 2020; Chakroun & Droz, 2020). Whether Black Forest common pastures should be sustained because they enable resonant relationships, provide direct benefits to people, or whether they have inherent social-ecological value depends on the kind of reasoning and the individual connection to the biosphere. The arguments contained in **Articles I-III** go beyond solely ecological or economic reasoning, still prevalent in the Black Forest Biosphere Reserve and add views hitherto inadequately recognized in governance. In addition to elevating marginalized agendas, values are levers of sustainability transformations (Abson et al., 2017; Horcea-Milcu, 2022). Recognizing values as leverage points could imply a discursive work, i.e. to help better articulate values favourable to sustainability while challenge those that hamper sustainability (IPBES, 2022; Rosenberg, 2022). In the context of cultural landscapes threatened by under use, this could mean to engage with the diversity of values held by people that engage in landscape stewardship, rather than mainstreaming values by resorting to one-sided approaches of valuation (Bieling et al., 2020). Scholarship on “leverage points” has drawn attention to the potential of relational values for transformational change (Mattijssen et al., 2020; Riechers et al., 2021). In the case of the Black Forest Biosphere Reserve, this means to make apparent the different values that are present in common pasture organizations, smallscale farming and further initiatives of landscape stewardship.

Reflecting on the normative implications of this dissertation’s conceptual and transdisciplinary approach connects to the question of how the insights generated in this dissertation – conceptually and empirically – might benefit sustainability sciences beyond the case of the Black Forest Biosphere Reserve. Following **Article III**, I argue that resonance theory bears the potential of serving as a boundary object. Boundary objects are concepts that exhibit discursive power to transcend science (Star & Griesemer, 1989). The concept of ecosystem services, resilience and, to some extent, Ostrom DP are typical boundary objects (Abson et al., 2014; Brand & Jax, 2007). As a metaphor for a physical process, resonance theory forms a coherent concept that goes beyond its analytical function (Artmann, 2023; Müller et al., 2023). Resonance can become a mental and embodied experience. The importance of lived experiences, such as resonance, is acknowledged within SES literature (Meyfroidt, 2013; West et al., 2020), but also in psychology (Hunecke, 2018) and education (Rieckman, 2018). Promoting resonance beyond its theoretical scope towards a culturally embedded discourse might enable transformations towards sustainability.

5.2 Meaning and transferability - the Black Forest Biosphere Reserve and beyond

The distinct social-ecological concepts allow for theoretical considerations valuable for under-use contexts, such as common pastures in the Black Forest Biosphere Reserve. In order to live up to the practical aspirations of this dissertation, I seek to reflect in this chapter on the meaning these insights entail for the Black Forest Biosphere Reserve, how they can contribute towards sustainability and how they are transferable.

Meaning is context-specific in the sense that it depends on conscious interpretations of information but also on subconscious contextual elements (Wagenaar, 2014). The complex and unpredictable character of SES legitimates a plurality of interpretations, mediated by theoretical and practical perspectives (Schultz et al., 2018). Scientific work that seeks to be useful with respect to addressing sustainability challenges should be aware of how the non-scientific community can make sense of insights based on SES thinking (Clark et al., 2016; Milkoreit et al., 2015). I attempted to include these considerations in my transdisciplinary approach. As an example, all articles comprised feedback loops to check the validity of interpretations (**Article III**) or to evaluate the accuracy and importance of the findings (**Articles I-II**). As I conducted this dissertation concomitant to my work for the biosphere reserve office, I had a chance to observe, assimilate and relate to some of the practitioners' perspectives. These aspects of participant observation allowed me to (partly) account for how partakers would position themselves with respect to the social-ecological concepts (Lamine, 2018; Lawhon et al., 2010).

Notwithstanding, the choice of methods and the formulation of research questions reflect my interpretation and paradigmatic lens, rather than what practitioners would directly have asked for or what they would have considered of paramount importance. The support measures identified for grassland farming in the Black Forest Biosphere Reserve (**Article II**) illustrate the concrete link to prevailing challenges (e.g. moving away from tethering or the presence of wolves). Rather than providing fixes ready to be implemented, resilience thinking suggests at best pathways for how the SES can deal with these challenges. From a practical point of view, the concepts applied here indicate "why" certain social-ecological or relational aspects are important or "why" change is required but point to practitioners' intuition on "how" to do this. The empirical work of this dissertation illustrates the perceptions and approaches of practitioners to address landscape stewardship in an under-use context. It brings together and interprets knowledge that seeks to exhibit meaning for practitioners (Lamine, 2018; Wittmayer & Schöpke, 2014).

Because framings of SES are contingent to conceptual and practical considerations and SES boundaries open, perceptions of under use differ across the literature. Despite some accounts of literature

referring to opportunities of land abandonment and under use (Frei et al., 2020; García-Ruiz et al., 2020; Massenberg et al., 2023), literature supports the prevailing negative perception of landscape change by practitioners in the Black Forest Biosphere Reserve. For instance, threats brought about by under use are seen as a decline in ecological diversity (Baur & Nax, 2021), landscape features (Shimada, 2015), aesthetic beauty (Krebs, 2014), cultural practices and values (van der Zanden et al., 2018; Weissgerber et al., 2023).

With respect to how this dissertation provides a transferable approach and insights to scholars and practitioners will depend on the similarities of the Black Forest Biosphere Reserve with other regions. The validity of inferring or extending findings of place-based research eventually relies on the original assessment of those that seek to transfer it (Lincoln & Guba, 1985). Transferring or even generalizing findings in the context of place-based research faces important challenges that are inherent to the complexity of SES (Balvanera et al., 2017; Bennett et al., 2021; Sellberg, Quinlan, et al., 2021). To address this, I aimed at transparency in providing sufficient contextual data within the articles and the present dissertation. In addition, the way in which I applied the different concepts follows established frameworks in literature (Biggs et al., 2015; Cox et al., 2010; Ostrom, 2009; Rosa, 2019).

With regards to social-ecological characteristics comparable to the Black Forest, there is a literature body that relates to the abandonment of farmland (Mauerhofer et al., 2018; Munroe et al., 2013; Subedi et al., 2022). Particularly comparable seem to be mountain ranges in temperate climatic zones and specialized economies in Europe (Ceaușu et al., 2015; Frei et al., 2020; MacDonald et al., 2000) and Japan (Miyanağa & Shimada, 2018; Shimada, 2015). But there are also accounts of similar issues of under use under further social-ecological conditions around the world (Castonguay et al., 2016; Gupta et al., 2022; Luvuno et al., 2018). The European Union, and in particular their Common Agricultural Policy, provide similar institutional conditions for grassland farming. In consequence, opportunities such as the presence of special support schemes (Darnhofer et al., 2017; Martino & Muenzel, 2018), but also challenges, such as the strict delimitation of pastureland and forests (Erős et al., 2020; Sandberg & Jakobsson, 2018), or the conciliation of common farming and farm support schemes are shared between many European mountain ranges (Dodsworth et al., 2020; Galán et al., 2022; van Gils et al., 2014). A further link between the present case and other under-use contexts is UNESCO's World Network of Biosphere Reserves, currently comprising more than 738 sites (UNESCO, 2022). Biosphere reserves claim to be model sites for sustainability (Ishwaran et al., 2008; UNESCO, 2017). In Europe, biosphere reserves are partly situated in unproductive settings, threatened by under use and connect to ideas of landscape stewardship (Cibien & Mathevet, 2020; Eliasson et al., 2023; Winkler & Hauck, 2019). Consequently, biosphere reserves appeal for transferring knowledge within their network, but also beyond.

5.3 Practical implications – between adaptations and transformations

A practical weakness of social-ecological paradigms as a guiding principle for landscape stewardship is that concrete recommendations are difficult to determine – they require interpretation, as discussed previously – or to measure (Cabell & Oelofse, 2012; Plieninger et al., 2014). Resilience is a forward-looking capacity of change and resonance its spontaneous occurrence. The notion of change permeates the theoretical and practical insights of this dissertation.

The support measures practitioners call for appeal to a large variety of stakeholders and entail different demands. When questioning these support measures to the kind of change they enquire, it becomes apparent that the magnitude or meaning of change varies on a horizontal and vertical gradient. For instance, better commercialization of animal products has high potential for farmers (in terms of visibility, financial gains, self-esteem) but comparatively low meaning for regional governance or local population. On the other hand, rearranging competencies of different administrative units for comprehensive advisory services and implementation of policies would require an enormous effort for public administration, and would increase the social-ecological coherence of pasture management for practitioners. On the other hand, the common pastures would still be subject to external governance mechanisms and thus, from a systems' perspective, this change would rather be considered as an adaptation. Against the background of the previous discussion on transformations and adaptations (cf. Chapter 5.1.3), these examples show that whether change is profound or shallow depends on perspectives of who is concerned by certain change and who is evaluating the profoundness of change. Consequently, transformations for farmers might be considered as adaptations in the local governance and vice versa. I argue that this holds as well for the connection between selves and systems. Proposing adequate social-ecological training for farmers, for instance, might entail new perspectives on grassland farming and common pastures. This can lead to transformations of the relationships between grassland farmers and pastures. However, it is unlikely that training will radically alter grazing regimes in the sense that drastic changes of the ecological features that characterize the Black Forest Biosphere Reserve are to be expected. The overall goal that practitioners in the Black Forest seek to achieve via the suggested support measures is to strengthen the social-ecological diversity of small-scale grassland farming. Resilience-based arguments in particular, but also relational considerations, support practitioners' assertions. For instance, multiple and diverse approaches to grazing will increase the social embeddedness of grassland farming in local communities, which in turn will raise the awareness of landscape stewardship.

My experience from working in the in Black Forest Biosphere Reserve leads me to believe that the distinction between adaptations and transformations has theoretical appeal but less hands-on relevance for practitioners (Pelling et al., 2015). In general, biosphere reserves mediate efforts to

preserve and develop social-ecological characteristics, resulting in an nuanced (but arguably ambiguous) position of what kind of change is required (Schultz et al., 2018; Stoll-Kleemann & O’Riordan, 2018). The social-ecological uniqueness of the Black Forest common pastures is due to a certain resistance to follow supra-regional patterns and the determination of local people to continue with long-established practices of land use (Bieling & Konold, 2014; Konold, 2004). Desirable social-ecological change in the Black Forest Biosphere Reserve refers to enhancing or strengthening small-scale grazing and the relationship between people and the landscape but rejects fundamental changes in land-use practices on landscape patterns. Ideas of afforestation (Fernández-Manjarrés et al., 2021), energy landscapes (Arifi et al., 2017), or to convey common pastures to wilderness (Gurney et al., 2023), employed at federal to international policy agendas are thus viewed critically by local stakeholders.

Hence, the context of transdisciplinary work requires to transfer ideas of change between scientific and practical paradigms and to employ adequate language (Mattor et al., 2014; Wittmayer & Schöpke, 2014). A starting point for this might be to identify social-ecological aspects that should be preserved or changed. In practice, biosphere reserves are required to formulate management plans, in which strategic development goals are stated (UNESCO, 2021). In the case of the Black Forest, the 2021 management plan (Black Forest Biosphere Reserve Office, 2021) contains many measures but it is not always clear how their implementation would contribute to preservation or change, what would drive change or how these measures would be adaptive or transformational. Further work is this needed to discern how practical impetus of change towards sustainability can be supported through conceptual clarity.

5.4 Reflections on approach, methods and limitations

This dissertation would not have come into existence if it had not been for the project “Allmende 2.0” and the different local actors from the Black Forest that brought questions of landscape stewardship on the agenda. Consequently, the transdisciplinary approach has inspired the research objectives of this dissertation as well as the concepts and methods employed. Transdisciplinarity has allowed this research to provide conceptual and practical insights, shown in this dissertation and in the corresponding publications. However, transdisciplinarity is also connected to constraints and limitations of my work.

Most importantly, the dissertation is restricted to the Black Forest Biosphere Reserve. The case of the Black Forest provides arguably rich contextual data. However, this analytical limitation narrows down my findings to this specific social-ecological context and necessitates caution when transferring

insights gained. This applies for both conceptual and practical proposals. Hence, I recommend comparative endeavours to better explore the conceptual aspects mentioned in this discussion.

In addition, working in the context of a biosphere reserve comes with external and internal constraints. For instance, in order to reconcile practical expectations and scientific rigour, I aligned the process of doing research so that the academic activities would fit into my work environment. In order to reconcile practical expectations, my personal work capacities and scientific rigour, I opted for the rather efficient theoretical sampling in **Article I** and drew on expert knowledge in all three publications to substantiate my findings. In addition, the empirical data collection was connected to my work for the biosphere reserve and suited these purposes. I do not think that the specific conditions in which I wrote this dissertation discredit my findings. However, this rather uncommon practical implication of a doctoral student in qualitative sustainability research has certainly affected the research. This concerns, for instance, my personal normative framework and reward system, both of which innately connect to the biosphere reserve. I believe that my personal normative stance on landscape stewardship in the Black Forest Biosphere Reserve has biased the findings of this dissertation. A personal conclusion of self-reflexive work has been that what I consider worthwhile is made up of practical and conceptual ideas, as these normative components seem to me self-enforcing and inextricably interrelated. This is probably the most important bias of this dissertation, which has also been reported from other transdisciplinary doctoral projects (Cockburn, Sellberg, et al., 2018; van Breda et al., 2016).

The eclectic application of different scientific concepts is a potential strength of this dissertation, but also an important limitation. Albeit practical and theoretical considerations given in this dissertation, there is no indispensable argument in favour of this specific selection amongst the plethora of social-ecological and relational concepts. Yet, as the inference drawn from SESF, Ostrom DP, RP and resonance theory is complementary but coherent, I do not believe that a different social-ecological framework would have brought about entirely novel practical insights.

SESF, Ostrom DP, RP and resonance theory form more or less self-contained bodies of literature. However, there is relatively little scholarship that indicates how to apply them in a combined manner. In particular, the integration of resonance theory in SES thinking is challenging, due to their ostensibly different perspectives. In **Article III**, I referred to the debate on the relational turn, which recognizes individual relationships and systemic emergences (Raymond et al., 2018; West et al., 2020). However, the elaborations in **Article III** do not bridge resonance theory with the firm systems' perspectives of Ostrom DP or the SESF. It is not the ambition of this dissertation to provide a conceptual framework that comprehensively integrates resonance theory into social-ecological research. However, I felt the need to discuss how resonance connects to Ostrom DP and SESF. Consequently, the aspect of conceptualisations of adaptive and transformational change have received more attention in this

discussion than my research objectives and the case of the common pastures in the Black Forest Biosphere Reserve have called for. The close connection between social-ecological concepts and practical insights from the Black Forest is better document in the discussion section of **Articles I-III**.

In order to bring together **Articles I-III**, I have used the under-use character of common pastures, adaptive and transformational change as well as landscape stewardship as common denominators. I see two limitations in this design. First of all, employing under use as a guiding theme necessitated to integrate the ideas of under use in social-ecological resilience and relational approaches, in which these considerations have remained marginal. This lack of references questions whether my interpretation of what under use implies for relationships or resilience in SES is coherent with cases outside of the Black Forest. Second of all, other themes, such as the common good character or resilience would have also been suitable metaphors to explore conceptual and practical aspects, ranging from relational to governance considerations. For instance, this could have facilitated to reflect upon links between common governance, common reorganisation of social-ecological systems or mutual relatability to common pastures.

Finally, I want to point to out methodological limitations of this work. Although SES thinking has the ambition of being interdisciplinary (Beichler et al., 2014; Levin et al., 2013), this research is limited to qualitative social science (with the exception of **Article II**). In this, I follow a general shortcoming of social-ecological research, which has been recurrently criticised to unequally consider and integrate social and ecological processes, interactions and relationships (Epstein et al., 2020; Vogt et al., 2015; West et al., 2020). Furthermore, my empirical focus on the Black Forest Biosphere Reserve was on the local level. Drawing on SES thinking and my practical experience, I am convinced that a better recognition of the governance mechanisms at different levels, ranging from the federal state to the European Union, would have been insightful with respect to understanding constraints and identifying opportunities for change (Schoon et al., 2015; Shimada, 2015).

The aspects mentioned here are as much a limitation of my dissertation as they are an indication for future research.

6 Conclusions

6.1 Scientific contributions

The central goal of the present dissertation is to develop and scrutinize perspectives for landscape stewardship in the context of under-used common pastures in the Black Forest Biosphere Reserve. Due to the transdisciplinary approach and connection to the Black Forest Biosphere Reserve, the work conducted reflects a joined interest of practitioners and scientists and aims at providing concrete solutions to challenges present in landscape stewardship. Employing different concepts, the findings contribute to specific fields of social-ecological literature, such as on governance of common pool resources (**Article I**), social-ecological resilience (**Article II**) or relational approaches (**Article III**).

In addition, the synopsis of the scientific work conducted brings together considerations for the notion of under use. Given the sustainability challenges connected to this topic, under use remains underrepresented in social-ecological literature. Depending on the social-ecological paradigm, under-use can be considered, inter alia, as threatening the resilience, relational capacities or governance mechanisms of SES. At the same time, pathways to address under use include fostering cross-sectoral and cross-scale connectivity to incorporate social-ecological components that contribute to and take advantage of common pastures and that can support landscape stewardship. Moreover, it means to uphold and strengthen the capacity to enable meaningful relationships and resonance between social-ecological entities. The case of the Black Forest Biosphere Reserve provides evidence of how initiatives successfully mediate between controlling the governance of common pastures on the one hand while maintaining open spaces for resonant relationships to thrive on the other hand.

These aspects connect to the most important conceptual contribution of this dissertation, i.e. to introduce resonance theory to SES thinking. In distinguishing between self and world and highlighting the role of relationships, resonance theory brings ontological and epistemological clarity, while overcoming a strict dichotomy between the social and the ecological that is present in SES thinking. The axes of resonance and the notion of collective effervescence contribute to relational approaches in providing a framework that describes how system-wide transformations emerge from different types of relationships at the personal level. Moreover, by highlighting the uncontrollable and unpredictable character of resonance, and consequently of transformations, resonance theory provides powerful arguments in the debate on the much-needed transformations towards sustainability.

These insights call for further research on the integration of resonance theory into SES thinking. For instance, there is a need to investigate how contextual, institutional and cultural conditions that foster or inhibit resonance can be integrated into relational paradigms.

A central theme of this dissertation is to identify what change is required to foster landscape stewardship and landscape sustainability. The synopsis of the theoretical and empirical considerations suggests that there is a seamless transition between adaptive and transformational change and that to evaluate the scope of change will depend on the individual or systemic perspective and how distinct social-ecological entities will be impacted by change.

To conclude, this dissertation calls for further place-based research that pursues the theoretical considerations and validates the practical findings at the context of different land-use settings. For instance, there is a need to scrutinize how governance and relational approaches can reinforce one another in theory and practice. Likewise, future research will need to question the assertions on under use made in this dissertation. These are that under-use is characterised by the mismatch of provision and appropriation and that relational characteristics are important for landscape stewardship in under use. The need to explore underlying drivers but also pathways to address under use extends beyond under-used landscapes but is relevant for interactions between humans and their environment in many settings. Lastly, there is a potential to conduct transdisciplinary research in order to align science with needs and capacities of people that are capable of initiating change. UNESCO biosphere reserves across the world will need to actively demand but also support transdisciplinary sustainability research as much as research should accommodate frame conditions to incentivize rather than disfavour transdisciplinarity.

6.2 Insights for practitioners

This dissertation shows that practitioners play central roles in sustainability research. Their perceptions, ideas and estimations are of utmost importance when it comes to developing trajectories for the sustenance of common pastures in the Black Forest Biosphere Reserve. In the scientific work of this dissertation, people and their environment are always thought of in terms of what unites them. Regarding as to how common pastures can be sustained, this work has found that common efforts are needed. The predominantly small-scale grazing initiatives should receive stronger appreciation within the region. This regards different groups of people that are in the position to support grassland farming. There is a particular need that those that benefit from the cultural landscape contribute to its sustenance. For instance, local people living within the landscape or the tourism sector take advantage of the ecological diversity or aesthetics of common pastures but their material, financial or moral contributions to grassland farming are marginal. In addition, the body of rules and regulations that guides grazing practices needs to be flexible enough to live up to the abilities and needs of grassland farmers in the Black Forest Biosphere Reserve. Agricultural, nature protection and forest policies which

are implemented at European, national or federal levels will need to consider the cultural, social and ecological features that characterize cultural landscapes threatened by insufficient land-use intensity. One further insight of this work is that relationships between different people and their environment are vital, because they build the basis for what can happen on the ground. Meaningful relationships allow to bring in new ideas, to share them and thus enable change. Landscape management and practitioners should pay more attention on how current practices but also management decisions affect the relationships between people, livestock and the landscape.

This dissertation captured the ideas and demands of grassland farmers in terms of what change is needed to sustain common pastures. These propositions address many on-farm needs, such as to identify feasible alternatives to tethering or to enable better forage production and nutrient feedback to grassland. In addition, recommendations such as to improve training for part-time farmers or to establish a working group for grassland-based farming indicate a future-oriented perspective. Against the backdrop of the scientific frameworks used, the ideas of practitioners were found to contribute to the resilience of common pastures and thus to sustainability in the Black Forest. In consequence, practitioners on the ground should not shy away from making their voices heard, as much as policy makers will need to better consider knowledge on the ground.

This dissertation calls for more research in which practitioners become integral parts of scientific work. Scientists and policy makers need to improve the frame conditions for such research, while practitioners can demand to be present in scientific processes from beginning to end.

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PART II – Article I

Title: Adapting Common Resource Management to Under-Use Contexts: The Case of Common Pasture Organizations in the Black Forest Biosphere Reserve

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Abstract

Commonly used pastures have provided great socio-cultural, economic and ecological values across European mountain ranges. Since the last century, under-use is threatening these socio-ecological systems. Preserving common pastures as an integral part of cultural landscapes is the principal objective of the recently established Black Forest biosphere reserve in south-western Germany. We use the example of Black Forest common pasture organizations to scrutinize organisational arrangements, challenges and support of common resource sustenance in under-use contexts by drawing on Ostrom’s Design Principles, the Socio-Ecological-Systems Framework and resilience theory. To this end, we use mixed methods for data collection (semi-structured interviews, expert survey, focus group discussion) rooted in qualitative empirical social-ecological science. The suggested tripartite framework offers insights for conceptual and theoretical advancements in under-use contexts. As such, this research shows that design principles for under-use should (1) consider broader social boundaries to include all actors benefiting from the resources, (2) achieve congruence of provision, appropriation and local conditions that focus on sufficient levels of landscape stewardship services involving new beneficiaries for burden sharing, (3) match appropriators’ rights and duties as well as incentives for and motivations of pasture management. Concerning practical aspects, measures to support CPO’s adaptation state the need to incorporate CPR management in multi-level governance and to increase connectivity.

Key words

Ostrom’s design principles; institutional analysis; social-ecological systems; resilience; high-nature-value farmland; marginal areas; mountain farmland; agricultural policy; governance

1. Introduction

In western and central Europe, common property and joint agricultural land-use systems have been predominately maintained in extensive or unproductive land-use settings (Warde, 2015). In mountain ranges, such as the Alps (Bassi & Carestiato, 2016; Baur & Binder, 2013; Premrl et al., 2015; van Gils et al., 2014), the Pyrenees (Eychenne & Lazaro, 2014) or the Carpathians (Sutcliffe et al., 2014), common use of grassland-systems, in particular pastures, have been maintained under different arrangements. In the southern Black Forest of south-west Germany, common pastures, “Allmende”, are an emblematic feature of the traditional landscape, include high-nature-value and are connected to the cultural heritage of common grazing (Bieling & Konold, 2014). The recognition of the southern Black Forest as an UNESCO biosphere reserve in 2017, directly connects to the preservation of common pastures (German Commission for UNESCO, 2017). In 2019, the biosphere reserve launched the project “Allmende 2.0” to develop pathways for sustainable grazing and landscape management (Black Forest Biosphere Reserve, 2020).

This article addresses the aforementioned endeavour of the biosphere reserve. One important challenge landscape stewardship in the southern Black Forest have in common with European mountainous regions are detrimental effects to the ecological (MacDonald et al., 2000; Recio et al., 2020; Schulz, 2015) and social (Hunziker et al., 2008; MacDonald et al., 2000; Vila Subirós et al., 2016) sphere of mountain commons brought about by under-use. Yet, this feature has been neglected in the debate on sustenance of European mountain commons even though it is characteristic for the context in many socio-ecological and commons studies (Bassi & Carestiato, 2016; Gatto & Bogataj, 2015; Premrl et al., 2015; Sutcliffe et al., 2014; van Gils et al., 2014). To our knowledge, there are five case studies applying socio-ecological frameworks on under-used common pool resources (CPR) in comparable socio-ecological contexts. Shimada’s (2015) case study on multi-level natural resource governance of Japanese semi-natural grasslands depicts governance changes to address under-use. Further, Miyanaga & Shimada (2018) stress drivers and consequences of under-use while Hirahara (2020) proposes elements that would help to solve this issue. In the Swiss Alps, Baur & Nax (2018, 2021) model policy responses to address under-provision and under-appropriation. None of the above-mentioned scholars has systematically applied Ostrom’s design principles (DPs) for validation to the under-use context. The case of the southern Black Forest demonstrates the suitability of applying a set of socio-ecological research frameworks to analyse common grazing with the goal to provide new contextual and conceptual insights on the governance of under-use. In particular, we ask the following research questions:

- (1) What are organisational arrangements and socio-ecological components of common pasture organizations?
- (2) With the goal of increasing common pasture organizations’ resilience, which support measures and adaptations are required?

(3) What changes to existing socio-ecological frameworks can be proposed to address common pasture resource management in an under-use context?

2. Conceptual Aspects

Our research draws on a set of socio-ecological frameworks, i.e. Ostrom’s DPs (Ostrom, 1990), the Socio-Ecological-Systems (SES) Framework (SESF) (Hinkel et al., 2014, 2015; McGinnis & Ostrom, 2014; Ostrom, 2007), resilience theory (Anderies et al., 2004; Biggs et al., 2015; Folke, 2006). These concepts are interlinked and partially overlap, but each provides a specific perspective on sustainable socio-ecological systems adaptation (cf. Fig. 1 for the conceptual relations), as we will demonstrate in this section.

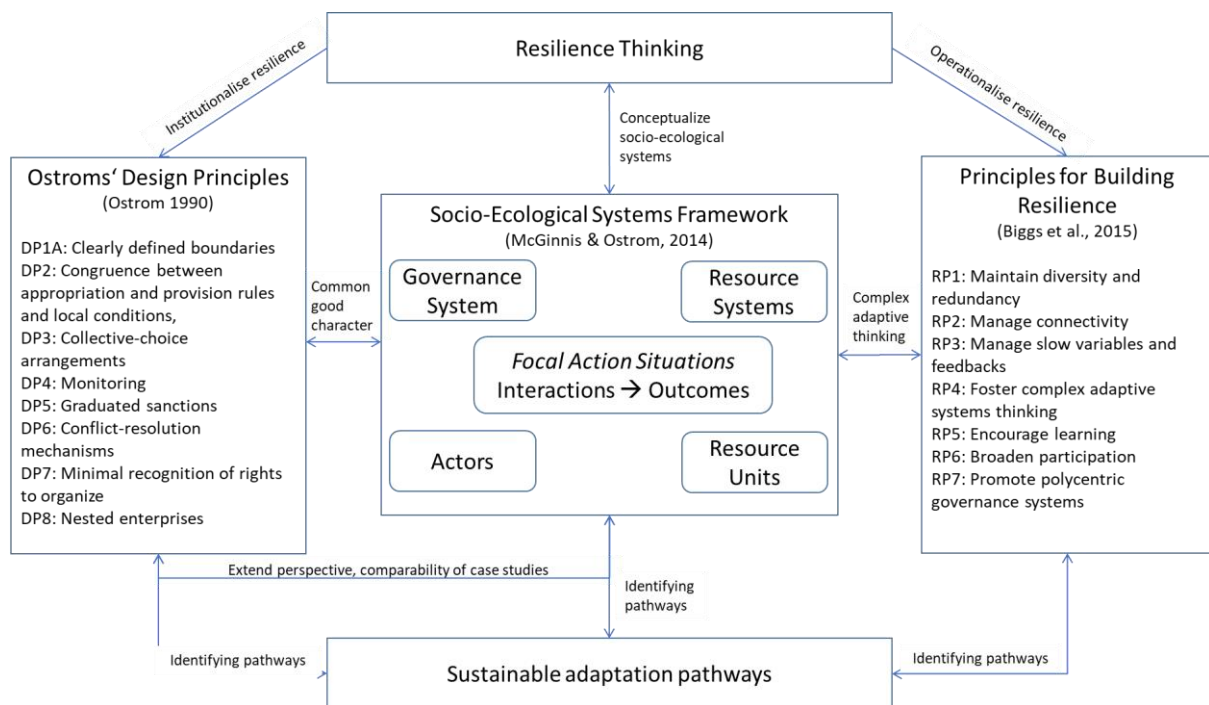


Figure 1: Underlying conceptual links of Ostroms' DPs, SESF and Resilience principles.

In Ostrom’s textbook on commons’ governance (1990), eight DPs are proposed as a set of rule arrangements characterising sustainable governance of CPR. These DPs have proven to be relevant in various socio-ecological and governance arrangements (Baggio et al., 2016; Cox et al., 2010). To our knowledge, this is the first study applying Ostrom’s DPs to mountain pastures in Germany.

The SESF evolved on the basis of the empirical work on CPR systems, with the goal of advancing this research towards all socio-ecological systems regardless of the property rights regimes and to adequately address the interaction of both social and ecological realms (McGinnis & Ostrom, 2014; Partelow, 2018; Partelow & Winkler, 2016). SESF and Ostrom’s DPs have a common theoretical origin

(Ostrom, 2007) and are connected in the sense that the set of (normative) prescriptions provided by the former are present in the latter, mostly in the “Governance System” tier (Partelow et al., 2018). Resilience thinking, a concept used in both ecological as well as social sciences, describes a system’s ability to absorb perturbations (Holling et al., 1998), but also to transform, re-organize and develop when prompted by changing factors (Folke, 2006). The concept of robustness of SES is closely related to resilience theory (Anderies et al., 2013; Gatto & Bogataj, 2015), even though conceptual differences remain. Both concepts are closely linked and applied to common studies (Anderies et al., 2004; Mosimane et al., 2012) as well as to the SESF (Leslie et al., 2015; Risvoll et al., 2014). While the DPs provide institutional resilience (Anderies et al., 2004), the SESF conceptualises complex adaptive thinking, a core of resilience thinking (Levin et al., 2013; Walker et al., 2002). One practical goal of resilience thinking is to identify mechanisms which promote a system’s adaptive capacity. Drawing on a large empirical basis, Biggs et al. (2015) propose seven “Principles for Building Resilience” (resilience principles, RP, in the following) which provide intuition to operationalize resilience building measures of socio-ecological systems. As DP and SESF, RP can be applied to case study analysis and used for theory building. All three frameworks have been applied to CPR management (Cox et al., 2010; Mosimane et al., 2012; Partelow, 2018), however, not jointly.

3. Case Study – Common Pasture Organizations in the Southern Black Forest

The southern Black Forest mountain range is the core of common grazing in the region. The study area comprises approximately 800 km², of which roughly one-third are grasslands. A majority of this area (632 km²) is part of the Black Forest biosphere reserve (cf. Fig. 2). What distinguishes the southern part of the Black Forest from the rest of the mountain range are the wide open landscapes and an undulated topography ranging from 230 m to close to 1500 m above sea level. Climatic conditions are characterised by annual temperatures between 5 and 7 C° and precipitation between 1200 and 1900 mm without significant seasonal variability. Pasture season is usually from May to October. Pastureland has high ecological and societal value. Grazing activities are the basis for the designation of protected areas at national and European level and landscape based touristic activities (cf. Tab. 1). Of all pastureland, approximately two thirds are in municipal property, a part of which is still used for common grazing today.

*Table 1: Socio-ecological characteristics of the Black Forest biosphere reserve. Data from * Black Forest Biosphere Reserve (2021) and “ Statistics Office of Baden-Württemberg (2021).*

Variable	Values
Nature protected area by German law (ha)*	9.784
Nature protected area by European law (ha)*	25.922
Vascular plant species on German red list (n)*	110

Variable	Values
Bovine animal heads 2019 (n)''	10.654
Inhabitants (n)*	38.000
Overnight visitors 2018 (n)*	2.301.000
Day visitors per year*	1.729.000

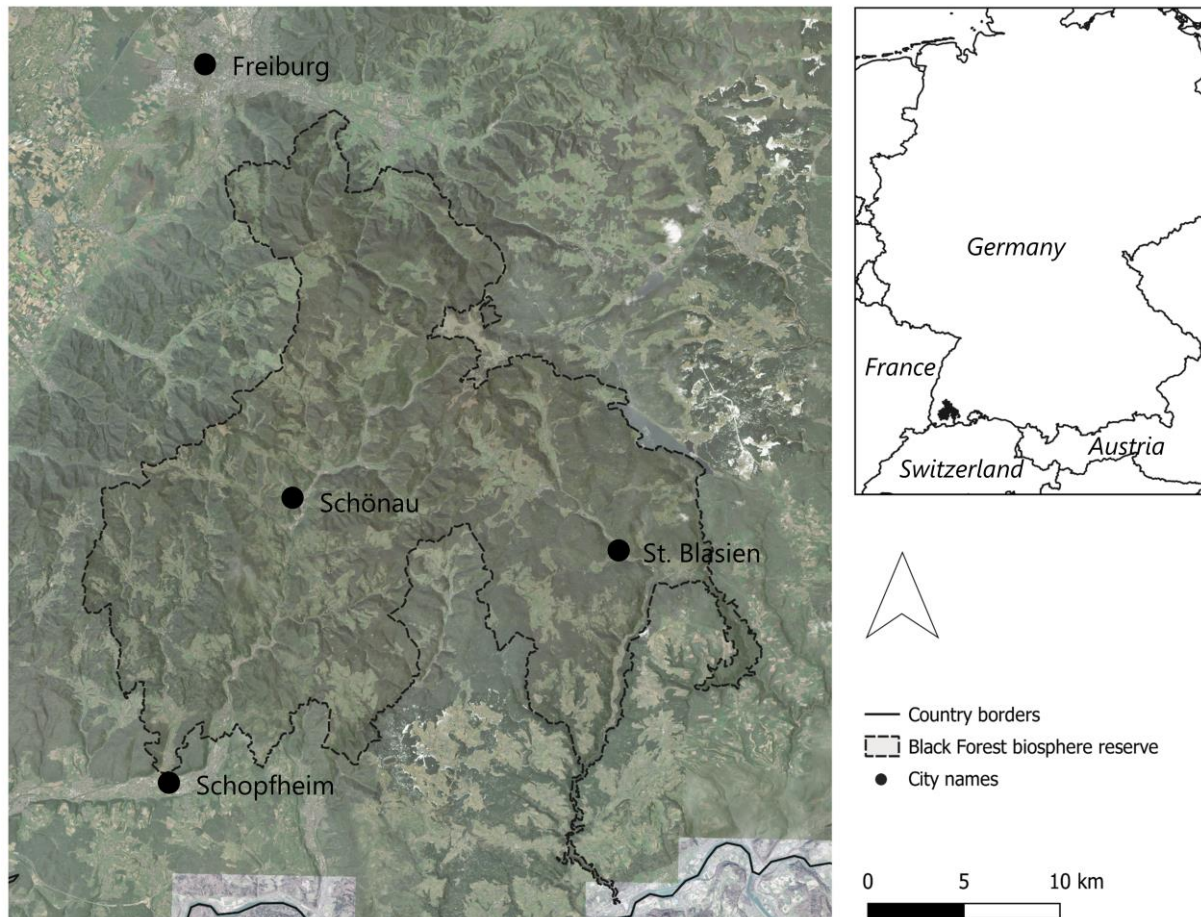


Figure 2: Map of the Black Forest biosphere reserve in south-western Germany. The map was created using QGIS, Geographic Information System open source software. Base maps from ArcGIS are intellectual property of Esri and used herein under license.

While common pastures and its management in the southern Black Forest have been well-documented in German scientific reports (Budig, 1990; Hellgardt, 2013; Konold, 2004; Reif & Katzmaier, 1997), they have received little attention internationally (Bieling & Konold, 2014). As regards content, an emphasis has been placed on historic common pasture management, as well as on challenges in the 20th and 21th century for agricultural and landscape management. They neither acknowledge the drastic change that common pasture management in the southern Black Forest has undergone in the last thirty years, nor do they discuss its role for addressing challenges in landscape stewardship. From 1979 to 2016, the number of farms in the Black Forest biosphere reserve dwindled from 1520 to 636 (own calculation based on data from Statistisches Landesamt Baden-Württemberg, 2021). Concerning

common pasture organisations (CPOs), many dissolved and pastureland was re-distributed among the remaining farmers. The area of commonly managed pastureland was reduced from 7.420 ha in 1990 to approximately 1.200 in ha 2019 (according to Geiger (1990) and own estimation), with the Black Forest biosphere reserve covering 15.926 ha of grassland (Brockamp et al., 2016). Two key changes in the governance structure also contributed to this process. A 2003 reform of the European common agricultural policy (CAP) changed the subsidy system from per animal head to per hectare payments (decoupling) while a 2014 reform necessitated linking agricultural area to one farm. These changes required CPOs to adopt a legal structure (forming an agricultural enterprise) and subsequently led to further issues (liability, taxation, fees for agricultural pension scheme, etc.).

In terms of this study, we identified 35 CPOs in the Black Forest that fulfil the definition of common grazing in the next section (cf. 4.1.).

4. Methods

The methodology of this paper is rooted in qualitative empirical social-ecological science. We use a mix of methods for data collection (case study, semi-structured interviews, expert survey, focus group discussion). DPs (Ostrom, 1990, p. 90), SESF (McGinnis & Ostrom, 2014, p. 4) as well as resilience theory (Biggs et al., 2015; Folke et al., 2010) were used in the design of the data collection methods.

As the first author (F. B.) is working at the Black Forest biosphere reserve office for the project “Allmende 2.0”, we could draw on a network of regional actors involved with common pastures as well as on insider knowledge on land-use and governance systems. A co-author (C.B.) has extensive experience in carrying out research in the area and is part of the “Allmende 2.0”’s expert group. The insider perspective, on the one hand, allowed us to formulate research questions having both practical and academic relevance, as well as to identify important aspects of the present socio-ecological system. This knowledge, in turn, facilitated the drafting of interview guidelines for the questionnaire. On the other hand, it also required us to reflect on assumptions taken in this work during the research process.

4.1. Interviews

Semi-structured interviews were carried out with CPOs’ leaders. The interview guideline comprised a list of pre-defined questions concerning the organisation’s recent development, its current situation, ambitions for future development, challenges, reactions to changes as well as questions aiming at the presence of certain institutional arrangements according to the DPs (Ostrom, 1990). Interviews were concluded by an open discussion on prospective development pathways.

For the selection of the interviewees, we first created a list of all CPOs still present today that fall within the following definition. As CPO, we consider (1) a group of at least three members engaged in pasture

activities, (2) exercising its activities predominantly on common land (i.e. in municipal ownership), (3) holding own cattle or taking animals into agistment (i.e. the taking of other livestock owner's cattle for the grazing season), and (4) with all members engaged in appropriation and provision activities. We identified a total of 35 pasture organizations fulfilling these criteria. The interviewees were sampled in an iterative theoretical sampling process. Interviews lasted between 45 to 75 minutes, depending on the quality and novelty of the information provided. Given that the simultaneous analysis of interviews revealed a saturation of information (variance) on the study's key variables after a total of nine interviews, we did not carry out further interviews. Since one interviewee had a central role in two CPOs, this adds to ten cases. All interviews were conducted outdoors between May and September 2020 by the first author.

Data analysis took place directly after the interviews. A written transcript was produced and analysed in the qualitative data analysis software MaxQDA 10 (VERBI software). In a first step, coding focused on the arrangements in which Ostrom's DPs are present in the sample (Ostrom, 1990, p. 90), but also included other aspects mentioned by the interviewees. This helped to highlight equivocal aspects that could be stressed in further interviews. A content analysis was conducted with all coded material.

In terms of the analysis of DPs, we checked how rules are implemented and which organizational structures exist. As it became clear during the process of interviewing that substantial aspects responsible for a successful management of CPOs were not addressed by these design principles, we decided to extend coding to the SESF's 2nd tier variables (McGinnis & Ostrom, 2014).

4.2. Expert survey and focus group discussion

Building on the analysis of Ostrom's DPs, SESF-variables and additional inductive codes identifying other interview material directly relating to research questions but not coded as DP or SESF variables, we drew up a list of nine support measures for CPOs. The action options either were mentioned during the interviews as (1) successfully implemented, (2) propositions for positive change or (3) could be derived from the challenges CPOs are currently facing. They match at least one RP, DP or SESF variable. We then conducted an expert survey to evaluate the anticipated effectivity of the measures, their feasibility and the actors that could promote their implementation. Interviewees as well as members of the biosphere reserve's project "Allmende 2.0" working group, comprising 20 representatives from practitioners, scholars, municipalities, local and regional administration as well as the farmers' union were asked to participate in the survey. The survey results and means of implementation were then discussed during an online workshop with 13 members of the "Allmende 2.0" working group.

5. Results

In this section, we provide an overview of ten CPO structures, the organizational modalities of the design principles, SESF 2nd tier variables and support measures for building CPOs' resilience. Ostrom's DPs and SESF are matched with the support measures to showcase their empirical support for these.

5.1. Overview

Black Forest CPOs are facing similar socio-ecological conditions and are confronted with comparable challenges. CPOs consist of 4 to 18 members and pasture size varies between 17 to 81 hectares. The governance setting is the same with the exception of the municipality, whose context-specific impact on CPOs' activities varies strongly. Livestock farming is a part-time activity for all CPO members, meaning that there is no financial dependence on grazing for sustenance. CPOs' activities are in line with maintaining the extensive pasture conditions and pastures' high ecological value. Yet, CPOs can be classified into two groups that exhibit substantial differences. These are traditional grazing collectives ("Weidegemeinschaften") and landcare groups ("Landschaftspflegevereine"). Table 2 summarizes main differences between these two groups. These groups are not self-contained, with some CPOs exhibiting characteristics of both grazing collectives and landcare groups. The most important difference between landcare groups and grazing collectives in terms of their perception by local actors lies in their historical development. While the latter are traditional CPOs which date back for centuries of continued common grazing activities, the former were established in the 1990's by local people with the aim of preserving open land from forest overgrowth. These differing backgrounds translate into a series of structural differences. As table 2 illustrates, the collective aspect of landcare groups exceeds grazing collectives in aspects as pasture equipment, animals and investments. However, grazing collectives greatly appreciate the long tradition of common grazing, whereas landcare groups consider themselves as an innovation answer to changes in land use structures.

Table 2: Distinction of common pasture organisations: grazing collectives and landcare groups.

Realm	Variable	Grazing collectives	Landcare groups
Members' situation	Demographic situation	Regional average and diverse situation	Mostly advanced age structure
	Link to grazing	Members are livestock farmers	Members are no active farmers, but some have a background in grazing
	Motivation	Preservation of the landscape, maintenance of tradition of collective farming, financial interests	Preservation of the landscape, social commitment, leisure activity
Resource	Pasture quality	Regional average in terms of productivity, high in terms of environmental value	Below regional average in terms of productivity, high in terms of environmental value
	Livestock	Dominance of cattle	Dominance of goats
	Property of pasture equipment	Dominance of private property, i.e. of the individual member	Dominance of collective property, i.e. of the landcare group

Realm	Variable	Grazing collectives	Landcare groups
	(machinery, buildings, animals)		
	Use of financial gains	Division among CPOs' members	Investment in pasture equipment towards a continuity of CPO
Legal framework	Legal form	Mostly private corporations ("Gesellschaften bürgerlichen Rechts" according to German federal law)	Mostly associations ("eingetragene Vereine" according to German federal law)

5.2. Design Principles

DP1: Clearly defined boundaries

For all CPOs, members are clearly defined (by either membership to or contract with the legal form of the CPO) and related resource boundaries set. Legal and administrative frameworks require the delimitation of pastureland to forests and assignment to an agricultural holding. Hence, fences are present for reasons of liability but also for pasture management. CPO members come from the municipality or locality the pasture is associated to. CPO members are those that are currently affected by appropriation and provision rules (DP2), while the realm of beneficiaries of wider ecosystem services (ES) produced, such as scenery, was not considered by our interview partners.

DP2: Congruence between appropriation and provision rules and local conditions

In the under-use context of pastures, provision and appropriation activities as well as local conditions include regulating under-provision of pasture quality in terms of pasture management, fencing, mowing or shrub cleaning. CPOs emphasise burden sharing instead of benefit sharing to address the challenge of ensuring enough provision of pasture management services needed to maintain the environmental and societal values. Pasture appropriation services include fodder supply (rearing animals, meat production, etc.) and public financial support. The latter aspect is of particular importance for CPOs' activities given the high financial gains agri-environment-schemes can provide compared to low productivity levels of the grassland and animal value. Pasture provision includes elements that are fulfilled individually (i.e. checking cattle and fences on a daily basis) or collectively (i.e. clearing woody plant encroachment, entertainment of pasture infrastructure, etc.). Traditionally, provision was assured in the form of compulsory work duties ("Frondienst") for cattle brought to common pastures. Nowadays, provision requirements have adopted a liberal form, for instance in offsetting CPOs' members' supplied manual or machine provision by higher financial appropriation levels. In grazing collectives, congruence of appropriation and provision aligns on a gradient from compulsory to self-contained execution of provision activities (i.e. compulsory provision duties, provision targets combined with financial compensation, voluntary provision levels and financial compensation). Financial appropriation levels in landcare groups are lower than in grazing collectives, since in landcare groups, infrastructural costs related to goat farming are covered by the CPOs,

whereas such costs in grazing collectives must be covered by the individual farmers. Further appropriators, such as local population and tourists, were mentioned by three CPOs as using pastures for leisure activities.

DP3: Collective choice arrangements

All CPOs' studied in this context provide collective choice arrangements that allow appropriators to change operational rules. In the cases of CPOs that do have the legal form of an association (mostly landcare groups), collective choice rules are defined in the organizations' statutes. Despite this, acceptance and execution of operational choice decisions relies on CPOs' members' consent and is expressed informally. CPOs' decision making depends on the level of magnitude of the decision. Day-to-day decisions on pasture management are taken directly by either the CPOs' chairperson or herder. Aspects with medium-term impact such as modifying pasture rotations or discussing pasture maintenance require consultation and exchange with CPOs' members and are taken in informal meetings. Long-term decisions that impact CPOs' functioning, setup, financial aspects and collective choice rules are taken at general meetings on an annual basis.

DP4: Monitoring

Monitoring of appropriators' provision activities is present to differing extents in seven out of ten CPOs. Chairpersons or herders control the reported provision activities on a monthly or annual basis, relying on members' or herder's reporting. The absence of active monitoring of provision activities in the remaining CPOs is due to the inexistence of incentives for abusing appropriation (i.e. no financial gains) or mutual trust. One grazing collective recently abandoned strict monitoring, a move that was considered as a sign of future-oriented collective action. However, this case illustrates that factual monitoring could be intermitted due to the presence of arenas for trust building, a preponderance of joint provision over individual work duties and a small number of appropriators. In addition, monitoring in this case goes beyond conventional audits. Transparency of each member's provision and appropriation activities, arenas for communication and collective choice decisions are as much a means of incentivizing adherence to operational rules as active audits. The monitoring of resource state is conducted in accordance to provision rules (DP2) by CPOs' members or herders. These influences pasture management, i.e. fertilization strategies, pasture rotations.

DP5: Graduated sanctions

Formalized or institutionalized graduated sanction systems are present in two CPOs. Even though a small degree of freeriding on joint provision activities or other minor internal conflicts are inherent to CPOs, the implementation of severe sanctions was rarely an option. Verbal admonitions or warnings

by CPOs' chairpersons or herders, presumably as a first level of sanctions, often suffice in this respect. One example of a graduated sanction system is from one grazing collective, whose member was excluded from the common pasture as a final step in a graduated sanctions' system due to repeated and multiple violations of operational rules (insufficient provision, unreliability, and insufficient care for animals).

DP6: Conflict-resolution mechanisms

The degree to which conflict-resolution mechanisms are present, active and institutionalised, varies across the sample CPOs. In one municipality, a structured and multilevel conflict resolution approach exists, which involves a municipal staff member, a representative of the municipal council, and the chairperson of the federating common grazing collectives of the municipality. This tripartite mediation body is defined in the municipality's pasture charter ("Weideordnung"). In the other cases, informal and formal CPOs' meetings are used as arenas for conflict resolution.

DP7: Minimal recognition of appropriators' rights to organize by external governmental authorities

CPOs existence and rights to self-organize are not challenged by municipalities (legal owner of common pastures) or any government authority. Yet, the degree of autonomy that CPOs are granted by municipalities varies from case to case. This concerns, for instance, CPOs' autonomy to decide on the amount of cattle each appropriator can bring to the pasture. On a more general level, decision making of CPOs is constrained by legal, administrative and funding requirements. In order to fulfil legal and administrative constraints, such as being eligible to support schemes or to be covered by insurances, CPOs were driven with the 2003 CAP reform to constitute a legal form that would be accepted by state authorities. In many cases, CPOs devised around the legal form of private corporations ("Gesellschaften bürgerlichen Rechts" according to German federal law) to meet this requirement. This led to a mismatch between customary CPOs and private corporations. Members of CPOs include all those who appropriate of or provide to CPOs, whereas private corporations only constitute a legal body for fiscal and judicial issues. These corporations are often formed by some CPOs' members or even outside of the circle of CPO.

DP8: Nested enterprises in the organization of the aforementioned principles

Currently, nested enterprises as meant by this design principle do exist only in the case of one municipality. Since this municipality consists of several localities and common pastures in each locality form separate entities, a head organization interlinks CPOs and municipality. In addition, this head organization serves as mediator in case of conflicts, distributes cattle between the CPOs, etc. Next to this, machinery associations exist at the level of each locality, which support local farmers in

collectively buying, using and maintaining farm machinery. This complex multi-layered structure of common pasture organizations is framed in the municipality's pasture charter. This situation is a harsh contrast to CPOs from other municipalities, where nested structures do not exist. There, CPOs and municipalities are main actors to be considered for decision-making with varying autonomy of CPOs.

5.3. Socio-Ecological Systems Framework 2nd tier variables

Table 3 provides an overview of SESF 2nd tier variables according to McGinns & Ostrom's (2014). The second tier variables were mentioned by interviewees without further prompting, thus underlining their importance. The following sections describe the variables that go beyond the scope of Ostrom's DP and have relevance for CPOs' resilience in terms of their applicability to support measures.

Table 3: SESF 2nd tier variables mentioned in interviews.

SESF variables	2nt tier variables	Variable summary
S (Social, economic, and political settings)	S4 Other governance systems	CPOs and common grazing are considered increasingly less important in local to state governance systems.
RS (Resource systems)	RS3 Human-constructed facilities	Pasture infrastructure includes fences, provision of drinking water for cattle, stable or shelters and machinery. This infrastructure is either owned by CPOs or CPOs' members. Infrastructural support by municipalities exists in some cases.
	RS4 Productivity of system	Pastureland is unproductive but exhibits high ecological value. Agri-environmental schemes incentivize / favour non-intensive grazing.
	RS6 Predictability of system dynamics	Pasture dynamics are relatively well predictable (constant rainfall, vegetative season from April to October). In recent years, summer droughts occurred, as a foreboding of increased weather variability induced by climate change.
RU (Resource units)	RU4 Economic value	The economic value of the resource lies in its ability to generate agricultural subsidies, which exceeds pasture productivity.
	GS4 Property rights system	Since communal property reform of 1966, municipalities are, de jure, owners of common pastures in the southern Black Forest. CPOs are "claimants", i.e. they withhold access and withdrawal, as well as management rights.
	GS7 Constitutional choice rules	Formal constitutional choice rules have reduced importance of CPOs' activities. Leadership and readiness of CPOs' members to take on responsibilities are decisive for constitutional and operational choice rules.
A (Actors)	A2 Socioeconomic attributes	CPOs' members originate from the municipality of the pasture and are predominantly male.
	A3 Historic or past experiences	Grazing collectives have a long tradition in the region. However, administrative requirements at the beginning of the 21th century led to important transformations in pasture systems (cf. DP 7). Landcare groups were established in the 1990's by local people with the aim of preserving open land from vegetation overgrowth.
	A5 Leadership	Chairpersons and herders take on important roles in CPOs (cf. DP 3). Leadership is an important aspect to functioning of CPOs.
	A6 Norms, trust, social capital	Social cohesion, mutual trust and following norms are important elements of CPO functioning.
	A7 Knowledge of SES, mental models	CPOs' socio-ecological-systems knowledge and mental models are distinctive for the functioning of common grazing. Both are important for sustaining CPOs' activities.
	A8 Importance of resource	Pastures generate economic value important for landscape sustenance (cf. RU4). Next to this, pastures have ecologic, cultural and touristic importance that goes beyond the scope of CPOs.

SESF variables	2nt tier variables	Variable summary
I (Interactions)	I2 Information sharing	In most CPOs, there are arenas for low-cost and efficient information sharing (cf. DP3).

S4: Other governance systems

In addition to the requirement to adapt legal frameworks (DP7), the common pasture category (“Gemeinschaftsweide”) was eliminated with the 2014 CAP-reform in the application for support schemes. At the local level, municipalities’ outdated pasture charters (DP6) and partial hands-off approach in common-pasture related issues underline the decreased importance attached to common grazing. CPO members claim that fiscal consequences from the adopted legal frameworks discriminate against some common grazing and against CPOs members in particular. CPOs’ revenue transfer to its members is subject to taxes that would not arise if pasturelands were discretely managed.

RS4: Productivity of system

The southern Black Forest's common pastures produce relatively low amounts of fodder but high levels of ES in comparison to other grassland in the region. Extensive grazing is widely agreed upon as optimal for sustaining ES production. In recent years, pasture productivity has decreased due to compliance to contractual nature protection schemes which constrain CPOs from spreading manure. More manure would increase productivity but potentially lead to a loss in biodiversity. In addition, existing agricultural policies are contradictory to ecological goals, since it favours homogeneous vegetation structures that fulfil the eligibility criterion for basic support schemes. Furthermore, livestock density at times is too low to ensure the grazing intensity required to sustain local pasture quality (DP 2).

A2: Socioeconomic attributes

CPOs’ members usually work in a secondary sector, such as commerce, industry or crafts. The demographics of CPOs vary. Some grazing collectives are characterised by an ongoing generational change, whereas others are show the advanced average age of farmers in the southern Black Forest. Furthermore, demographics play an important role for landcare groups. Overaging of members threatens the ability of landcare groups to fulfil provision activities.

A5: Leadership

All CPOs studied here are characterised by the presence of leaders. These are chairpersons or herders who take on key roles in CPOs’ operations (DP3 and DP4). Interviewees in this study are leaders of their respective CPOs. CPOs’ leaders hold a wide array of roles (i.e. federating members, initiating change, monitoring, conflict resolution, and representation). Negative effects of leadership were reported in one CPO, where an overly dominant herder deters new members from entering the organization.

A6: Norms, trust, social capital

Social cohesion, trust and shared values are important for CPOs. To this end, arenas for communication are established (DP6). Another aspect that is mentioned is that having shared values, knowledge and motives of common grazing is beneficial for building cohesion. For instance, grazing collectives say that it is important that all members are farmers and hold cattle over winter. Fulfilling these conditions assures similar levels of knowledge on grazing, a sense of responsibility for cattle, dual obligation of helping in CPOs and having another farm enterprise next to it. Another aspect mentioned for building cohesion and trust is in sharing responsibilities and empowering CPOs' members to take decisions and provide initiatives.

A7: Knowledge of SES, mental models

Formal qualifications (vocational training, studies) in agriculture or grazing do not exist among CPOs' members. Hence, practical and ecological knowledge rely on traditions and learning from neighbouring farmers. Main motivations of CPOs' members include landscape maintenance, keeping up traditions, and seeing the activities as a meaningful task next to a full-time job. Common grazing is considered to have positive effects on social aspects (community building, reduction of individual workload) and in ecological regards (high cattle numbers allow for more flexible pasture management). In addition to this, nature protection is viewed as a by-product of grazing. In recent years, subsidies from environmental schemes increased consistently (SESF-RS4). The resulting decrease in productivity of fodder plants is viewed negatively by CPOs regardless of the potential increase in ecological value. This development illustrates CPOs' members' mental models focusing rather on the role of farming for production of provisioning ES than regulating or cultural ES.

A8: Importance of resource

CPOs' dependence on pastureland is due to its ability to generate subsidies, rather than due to a productivist understanding of pasture as a resource. Without these financial aids, CPOs would be hard pressed to survive. However, the amount of subsidies is subject to political decisions that are, mostly, unaffected by CPOs' behaviour. In addition, pastures exhibit cultural and touristic importance that go beyond what is covered by CPOs and the characterized governance systems (SESF-S4)

5.4. Support for building CPOs' resilience

Support measures for building CPOs' resilience were compiled by carefully analysing and combining elements that interviewees stated as existing challenges, desirable changes and successfully implemented innovations to CPOs by the first author. A total of nine support measures was proposed

and were subject to both expert survey and focus group discussion. These measures link with design or resilience principles, or SESF variables (cf. table 4) in the sense that they address issues that were identified as crucial by applying the above-mentioned frameworks.

Table 4: Support measures for building CPOs' resilience. Effectivity assessment took place in the expert survey and the proposition for actor groups responsible for implementation in focus group interviews. Measures link to the following frameworks are depicted: RP = resilience principles, DP = Ostrom's design principles; SESF = respective 2nd socio-ecologic-systems framework variable (cf. Fig 1).

Measure	Measure description	Assessed effectivity (number of votes for "effective"/ "effect unclear"/ "ineffective")	Actor group proposed for implementation	Link to framework components target by measure
Continuous consulting and advisory services	Establishment of voluntary annual or bi-annual meetings for each CPO with an advisor to facilitate exchange between CPOs and administration, following CPOs' development and needs.	12/2/1	Agricultural and nature protection advisory agents	RP2, RP5, SESF-A7
Inter-connecting CPOs	Provide an arena for discussing issues common to all CPOs, such as dealing with pressing challenges, adjustments of institutional rules or to meet administrative requirements.	10/2/3	Agricultural advisory agents and Black Forest biosphere reserve	RP1, DP8, SESF-A5
Federating CPOs in higher-level organization	Establishment of a higher-level association of CPOs. In addition to interconnecting CPOs and serving as a basis for addressing internal issues (including conflict resolution, institutional rules, etc.), a higher-level association could be active in lobbying and representing CPOs' interests.	9/2/4	Black Forest biosphere reserve and agricultural advisory agents	RP1, RP2, RP5, RP7, DP8, SESF-A5
Addressing legal and fiscal issues	Regardless of legal form, CPOs expressed the need to address fiscal and legal issues. This measure proposes to bring together relevant actors in this field and to jointly look for solutions.	12/3/0	Farmers' association, administration, CPOs, independent tax consultants	RP4, RP7, DP6, DP7, SESF-S4
Pasture festival - improving visibility, appreciation and added value of CPOs	An existing festival organized by a landcare group is a means to showcase common grazing, to strengthen visibility and appreciation of this unique feature and to have a positive financial effect. Extending this model to other CPOs seems possible given the popularity of existing pasture festivals.	12/3/0	CPOs, municipalities	RP5, RP6, DP1, SESF-A6
Making CPOs attractive for new members	This proposal addresses CPOs facing low levels of appropriation and provision and that would be open to extend membership. Activities in this respect include (1) increasing visibility of CPOs, (2) call attention to the need of adding members, (3) increasing attraction of CPOs' membership (for instance by	8/3/4	Municipalities, CPOs	RP3, RP6, DP1, DP2, SESF-A2, SESF-S4

Measure	Measure description	Assessed effectivity (number of votes for "effective"/ "effect unclear"/ "ineffective")	Actor group proposed for implementation	Link to framework components target by measure
	allowing machinery use for private purposes).			
Making provision activities more attractive	This proposal addresses CPOs facing low levels or unequally distributed provision activities. By increasing the assumed payoff for provision activities (wage rate for work effort), the balance between appropriation and provision can be re-established towards the required level of for CPR sustainment.	6/8/1	CPOs	RP6, DP2, SESF-A8
Infrastructural support	Providing special support for services of fencing and water supply for cattle (fencing material, maintenance, renewal of existing infrastructure) to CPOs would make investment in these activities more attractive.	11/2/2	Municipalities	DP1, SESF-RS4
Lobbying for CPOs and protecting CPOs from dissolvent	In order to prevent further individualization of grazing, CPOs call for a statement of preference of municipalities of common over individual grazing. The proposition also includes preferential treatments of common grazing in terms of infrastructural support as well as preferential access to pastureland owned by municipalities.	9/5/1	Municipalities	DP7, SESF-A6

The expert consultation revealed a consensus that specific CPOs' support schemes are required and that, conversely, doing nothing would worsen the situation. The efficacy of all measures' was overall positively assessed, even though support levels vary. During the focus group discussion, it became evident that actual implementation depends on the respective actors' readiness, capacity and sense of responsibility for common grazing.

6. Discussion

6.1. Combining different approaches

As we have demonstrated in section 2, DPs, SESF and resilience thinking are interconnected concepts (Anderies et al., 2004; Partelow et al., 2018). Yet, each concept provides its own analytical articulation in addressing socio-ecological systems. Integrating these approaches into one case study allows for theoretical advancements through reinforcing framework perspectives (Folke et al., 2013; Partelow, 2018) as well as for a multifaceted understanding of practical management issues. For example, Ostrom's DPs suggest that certain aspects of the institutional architecture of CPOs, i.e. a consistent

setup of rules and rights in governance, forms the basis for sustainable resource use. In addition to this, SESF provides a unified vocabulary to study CPOs as one entity, i.e. to integrate social and ecological aspects (Cole et al., 2019). Resilience thinking is suitable for analysing evolutions of socio-ecological systems and drawing conclusion on how to navigate them. In this study, this leads to insights on resilience-building that allow for the CPOs-system to thrive (Folke et al., 2010). In case studies of (common) grazing systems, scholars tend to apply a single framework (Bassi & Carestiato, 2016; Baur & Binder, 2013; Eychenne & Lazaro, 2014; Risvoll et al., 2014). One challenge for bridging the above mentioned frameworks lies in harmonizing underlying hypotheses and terminology (Partelow et al., 2018). The conceptual understanding we propose (Fig. 1) allows to recognize that concepts and suggested pathways overlap. For instance, collective choice arrangements (DP3), manage connectivity (RP2) and deliberation processes (I3) follow the hypothesis that those concerned by the outcomes of decision-making processes must have a say in this for successful collective action; i.e., they all call for participation. Likewise, nested enterprises (DP8), polycentric governance (RP7), and the maintenance of diversity and redundancy (RP1) share the idea that institutional resilience relies on multifaceted governance structures, which provide checks and balances as well as openness to innovation. SESF-variables such as knowledge of SES and mental models (A7) or norms, trust, social and capital (A6) advance understanding of CPOs and highlight feedback loops for complex adaptive thinking (RP4) and concurring appropriation, provision and local conditions (DP2).

In accordance with our research questions and research design, we focus on Ostrom's DPs in making use of complementarities and differing articulations of SESF and resilience thinking in an under-use situation. This tripartite analysis of rich contextual data allows for a theory-informed reconsideration of Ostrom's DP in the under-used context of the southern Black Forest.

6.2. Towards formulating design principles for under-used systems

The application of Ostrom's DPs shows that institutional arrangements are essential parts of southern Black Forest CPOs, but that the level of importance of these modalities varies. Scholars have agreed on case specificity as a prime principle, and consequently, on the need to find tailored responses to contextual governance challenges of socio-ecological systems (Cox et al., 2010; Hinkel et al., 2015; Ostrom, 2007; Schlüter et al., 2015). Yet, use dynamics of southern Black Forest CPR distinguishes the set-up in this study from traditional case studies of common-pool resources affected by challenges of over-use, which have been used for inferring the empirically validated DPs. Shifting from an over-use problem to an under-use-problem alters systems' functioning fundamentally. As we have pointed out previously, under-use problems in CPR management have gained little attention thus far. In addition, there is only a scarce empirical knowledge-base on what under-use situations mean for DPs (Hirahara, 2020; Miyanaga & Shimada, 2018; Shimada, 2015). In the case of southern Black Forest CPRs, under-

use occurs as resource dependence shifts on the traditional practitioners' level from livelihood sustenance and appropriators' need towards appropriators' self-determined motives (i.e. identity building, culture, landscape maintenance, nature protection). In addition, new actors such as tourism and local population are directly benefiting from farmers' landscape stewardship, without contributing. This aspect, upon which we will expand in the next section, should receive strong consideration in the DPs for under-use contexts (in particular DP1, DP2, DP7, DP8). Likewise, incentive structures for grazing moved from the economic value of grass fodder for producing food to financial compensation for overall ES production, but with the collective aspect being left out both by European and regional scale policies. Regional actors such as municipalities and farmers' associations lack feasible strategies and lobbying power to strengthen the role of common grazing, which is being ignored by European CAP. Despite differing socio-ecological and governance contexts, this reconsideration (for DP1, DP2) is in line with Shimada's (2015) previous analysis of under-used CPR governance. This research advances the scope of analysis in structurally applying the Black Forest case to DP, SESF and RP. This allows for a framework-based discussion on reconsideration or potential adaptation of DPs in under-use contexts.

Resource boundaries (DP1): The existing DP considers clearly defined boundaries as key for restricting access of land and preventing resource exploitation. Cox et al. (2010) disaggregate this DP into resource and social boundaries. In the under-use context of the Black Forest case, the boundaries of resource and social systems that interviewees perceived as clearly defined lead to negative socio-ecological consequences. A clear-cut distinction of natural entities (i.e. assignation of agricultural land, forests and land for nature protection) specified in support schemes (SESF-RS4, SESF-A8) disaggregates landscape units, which from an ecological perspective should be managed in an integrated way (Erdős et al., 2018). Moreover, taking full advantage of the resource has been made subject to external governance schemes (such as CAP and its application, national tax systems, social security system) that discriminate collective grazing (DP7). Social boundaries in our case study are currently fixed to CPO members. However, the evolution of landcare groups in the under-used system next to grazing collectives illustrates appropriators' extension beyond the range of traditional farmers. A DP on boundaries in under-use systems might acknowledge the requirement of including wider ES producers and beneficiaries (e.g., tourists) and thus extending the actors' range for service provision needed to maintain resource quality. Expansion of the range of participants and widening social boundaries have already been discussed (Hirahara, 2020; Shimada, 2015), even though there is no consensus if these should be open (Göttl & Penker, 2020) or clearly defined (Penker, 2017). Resilience thinking suggests broad participation (RP5) but acknowledges the requirement of managing boundaries (RP1, RP2). Studying the emergence and development processes, agents and modalities of broadening

participation as a successful element of under-used CPR management would provide further valuable insights.

Congruence between appropriation and provision rules and local conditions (DP2): Our findings suggest congruence between provision and appropriation of the natural resources in differing arrangements suitable for the context of CPOs. However, given that the notion of broad boundaries (DP1) in under-use situations, congruence does not aim at attaining a certain carrying capacity (over-use in the given Ostrom DP), but at minimum landscape stewardship services needed to sustain the resource (under-use). This highlights that congruence of appropriation and provision with local conditions is only partial. In fact, CPOs' provision activities focus on sustaining natural CPR aspects (provision of cattle and manual work) whereas appropriation emphasises financial aspects. Cox et al's (2010) disaggregation of this original DP into a dual understanding of "appropriation and provision rules congruent with local social and environmental conditions" (2010, p. 15) is useful for illustrating missing arrangements in Black Forest CPOs. Congruence with environmental conditions is influenced by external requirements (complying with legal framework and adherence to agri-environment support schemes). The extension of CPOs to social and ecological realms (in particular SESF-RS4, SESF-A6, SESF-A7, SESF-A8) and resilience theory (RP2, RP4) showcases missing feedback loops. Livestock densities are often too low from an ecological perspective due to ill-fitting incentives of agricultural policy (payments are per hectare instead of per animal heads). We suppose that mountain common pastures across Europe face this same issue. Baur & Nax (2018) identify the same shortcoming in the context of under-use in the Swiss Alps. They propose increasing provision requirements and incentivizing overprovision or appropriation subsidies as starting points for Swiss policy makers (Baur & Nax, 2021). A further aspect that we want to put forward is that in under-used grassland systems, provision and appropriation are reversed from their initial understanding. As incentives move from grass fodder to financial compensation, livestock becomes a means (provision) of CPOs rather than its end (appropriation). Consequently, the main difference between the original DP and one that proves useful for under-use cases is in changes in the variables' (appropriation, provision, local, societal and environmental conditions) interaction, rather than in a need of additional variables.

Monitoring (DP 4): Due to the under-use configuration, CPOs monitoring activities focus on fulfilling animal and work provision requirements rather than exceeding levels of appropriation, as in over-use situations. Concerning the pastures' environmental state, government actors monitor pasture conditions and compliance with both agricultural and nature protection regulations, whereas CPOs' members focus on adapting pasture management to changing environmental and local conditions (RP1). Our research shows that, on the one hand, formal monitoring of CPO's members can become obsolete if certain factors of CPOs change (i.e. congruence of appropriation and provision rules, small group size, and absence of financial incentives in landcare groups). On the other hand, the presence of

financial interests in grazing collectives requires some kind of, at least, informal monitoring. The reduced or adapted function of monitoring of CPOs is also reported in other case studies on European common pasture organizations in under-use configurations (Gatto & Bogataj, 2015; Premrl et al., 2015; van Gils et al., 2014). Monitors' presence and accountability to resource users as central notions in Ostrom's (1990) DP 4 are not contested in the under-use context. One way to achieve sustainable under-use CPR management and ES production could be to place more emphasis on monitoring burden-sharing within beneficiaries of landscape stewardship instead of monitoring appropriation or provision services within CPOs. To ascertain this, further research is required to understand how implicit monitoring in CPOs' functions and how this interacts with the external monitoring of the resource users' group (i.e. compliance with legal and support scheme requirements).

Recognition of appropriators' rights (DP7): Our results show that minimal appropriator rights to organize and take decisions are not challenged by municipalities, which suggests that the original DP is fulfilled. Yet, external governance requirements, such as the need to adopt a legal framework recognized by the governance system for controlling nutrient supply to pastures, impede the ability of self-relying CPOs to make decisions and thus hamper CPOs' autonomy (RP7). Regardless of over-use or under-use systems at hand, the analysis of rights and duties is crucial for Ostrom's DPs SESF and resilience theory (Partelow, 2020; Schlager & Ostrom, 1992). But what is distinct in under-use situations is the notion of duties and burden-sharing. On a theoretical note, as resource dependence of appropriators decreases with a situation changing from resource over-use to under-use, so too will their willingness to cope with imposed constraints, such as prohibiting manure spreading. This is why managing users' rights and duties in under-use situations requires particular caution when incentives for CPR use are small. For instance, CPOs' members' mental models (A7) favour the aspect of commodity production over being landscape stewards. We argue that the main rationale in the unequal appreciation of "agriculture" and "landscape management" among providers and appropriators stem from different levels of autonomy and self-fulfilment enjoyed by farmers, as providers. Meat, as an output of grazing activities, is a farmer's sovereign product in contrast to landscape, for which farmers have to follow predefined and societally agreed upon rules. Further research could clarify if DP7 in under-use situations requires a certain ratio of autonomy and top-down decisions. A working hypothesis could be that this ratio is positively correlated with the level of burden shared by these appropriators for ES production in the under-used CPR.

The support measures proposed by CPOs' members illustrate the requirement to adapt institutional arrangements and rearrange governance systems within and beyond Ostrom's DPs. Most influential in that regard are the principles for building resilience. While Ostrom's DPs describe already established institutional arrangements that provide resilience, the RPs highlight transformative pathways towards resilience. In the case of southern Black Forest CPOs, arenas that encourage learning (RP5) or foster

complex adaptive systems thinking (RP4) are either missing or ineffective. In addition, CPOs' structures exhibit low levels of connectivity (RP2) with only one case exhibiting positive polycentric governance (RP7). Further case studies with comparable contexts, such as on under-used European mountain pasture commons, are encouraged to broaden the understanding of institutional adaptations of CPR users' groups and to move towards a conceptual framework on sustainable management of under-used CPRs.

6.3. Ways forward for practical CPOs' management

As previously pointed out, CPO members are concerned with decreasing pasture productivity because of reduced nutrient feedbacks to pastures. Resilience thinking in changing socio-ecological contexts suggests equally maintaining an ecosystems' provisioning, regulation and cultural ES (Biggs et al., 2015; Partelow & Winkler, 2016; Plieninger et al., 2014). Consequently, governance should allow multifaceted land use intensities and management diversity, an end to which integrating practitioners' SES knowledge and concerns is a suitable means (Winter et al., 2011).

A driver for common grazing's decline in the last decades is a lack of attention for the issue on state to local governance levels. The importance of identifying a legal framework adapted to CPOs' legal and fiscal requirements was underlined in interviews and during expert discussions. It was also made clear that local and regional actors must put more effort into adapting CPOs. This point ties into the EU's CAP, which causatively provides room to manoeuvre for regional to local actors. The interplay of European, national and regional legislators in the design of agricultural policies for common grazing was not a focus of our study design. Nevertheless, these findings stress the need to integrate common approaches in agriculture into agricultural policies at all levels.

Given the demographics of CPOs, particularly fragile in landcare groups, other actors need to work towards sustainable development and preservation of common grazing in the southern Black Forest. Even though this study focuses on CPOs, it has become apparent that the changes accompanying the under-use context call for an increased accountability of all beneficiaries from ES production. Considering Ostrom's DP, landscape-level congruence of provision and appropriation of all beneficiaries (Penker, 2017; Shimada, 2015) is one principle that is currently unfulfilled. For instance, local population and tourism are two actor groups taking advantage of the landscape but contributing insufficiently. Public landcare days ("Landschaftspflegtage") provide occasional opportunities for the general public to support CPOs (Bieling & Konold, 2014). However, these rely on voluntary action and would require support in organizing and advertising such events to a much broader audience. Tourism also benefits from the southern Black Forest landscape, but does not contribute to landscape provision activities. To shrink this gap, the municipality of Münstertal adjoining the Black Forest biosphere reserve has been the only municipality in Germany transferring a portion of the visitors' tax (Kurtaxe)

to goat farmers for the past 20 years (Liesen & Coch, 2015 and personal statement). Due to the COVID-19 pandemic, the Black Forest experienced extraordinarily high numbers of tourists seeking nature escapes in summer 2020, during which we conducted fieldwork. This development sparked discussions about new strategies for sustainable tourism management. These discussions would be an ideal opportunity to consider tourists' support of livestock farming, which has not occurred so far.

7. Conclusions

In this study, we used DP, SESF and resilience thinking to identify challenges that southern Black Forest CPOs are facing and propose theory-informed measures to address these. Given the under-use context characterising common pastures in this study, and drawing on empirical insights, socio-ecological and resilience theory, we made propositions towards modifying existing design principles and highlighted elements that can serve as starting points for new principles. These are, most importantly (1) broaden social boundaries to include all actors benefitting from the resource, (2) achieve congruence of provision, appropriation and local conditions that focus on how sufficient levels of landscape stewardships can be attained within CPOs, but also include new potential beneficiaries for burden sharing, (3) match appropriators' rights and duties as well as incentives for and motivations of CPR management. The CPOs under study exhibit a rather homogeneous perspective of CPR management, by providing an example of common pasture management in a mountainous region in Western Europe. Further case studies identifying challenges for sustainable CPR use in various under-use context are required to allow a better understanding of what these systems have in common.

Concerning practical development pathways for southern Black Forest CPOs, we suggest a holistic understanding of social and ecological dimensions and advocate multi-level governance. In a context in which the importance of common pastures shifts from provisioning services to regulating and cultural ecosystem services, actor groups outside the range of CPOs are called on to assume responsibility. The Black Forest biosphere reserve provides an adequate arena to address this. In this sense, sustainable development of common pastures might imply systemic transformations. In this process, adaptations the CPOs have been and still are dealing with are only one phase. In order to successfully further this transformation, it is vital to follow resilience principles.

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PART III – Article II

Title: Sozial-ökologische Perspektiven zur Erhaltung der Land(wirt)schaft – Erkenntnisse zu den Allmendweiden im Biosphärengebiet Schwarzwald [English translation: Social-ecological perspectives on the preservation of agricultural landscapes – findings on common pastures in the Black Forest biosphere region]

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Zusammenfassung

Traditionelle Kulturlandschaften sind Grundlagen vielfältiger Ökosystemleistungen. Ihre Erhaltung ist an angepasste Landnutzungspraktiken sowie die dazugehörigen sozialen und ökologischen Voraussetzungen gebunden. Anhand der Allmendweiden des Biosphärengebiets Schwarzwald untersucht der vorliegende Beitrag Lösungsansätze für die Weiterführung landwirtschaftlicher Praktiken, die mit positiven Wirkungen für die traditionelle Kulturlandschaft verbunden sind. Dabei verwenden wir die sozial-ökologische Resilienz als vielversprechenden interdisziplinären Analyserahmen. Unter Resilienz wird die Fähigkeit der Land(wirt)schaft mit Veränderungen und Störungen umzugehen, ohne zentrale Charakteristika und Funktionen zu verlieren verstanden. Aufbauend auf Informationen aus 44 landwirtschaftlichen Betriebsberatungen sowie 23 halbstrukturierten Leitfadeninterviews zeigen wir, dass Leitlinien und Maßnahmvorschläge, welche landwirtschaftliche Betriebe für die Zukunft vorschlagen, Resilienz operationalisieren. Zentral hierbei sind eine verbesserte Vernetzung der Akteure, verstärktes Lernen sowie eine erweiterte Partizipation am Kulturlandschaftserhalt. Aus der Perspektive der Resilienz sowie der regionalen Governance empfehlen wir, dass polyzentrische Ansätze, also die Verknüpfung horizontaler und vertikaler Ebenen der Entscheidungsfindung und -steuerung, stärkere Berücksichtigung im Management der Land(wirt)schaft finden sollten.

Schlagwörter

Sozial-ökologische Systeme; Resilienz; Landschaftsmanagement; Gemeinsame Agrarpolitik; Südschwarzwald; Landschaftspflege-Tage; Interdisziplinäre Nachhaltigkeitswissenschaft.

Abstract

Traditional cultural landscapes are the basis for providing different ecosystem services. Their preservation is linked to adapted land use practices and the associated social and ecological conditions. Using the common pastures of the Black Forest biosphere area as an example, this paper examines possible solutions for the continuation of agricultural practices that are associated with positive effects for the traditional cultural landscape. We use the framework of socio-ecological resilience as a promising analytical framework. Resilience is understood as the ability of agriculture and the landscape to cope with disturbances and changes without losing central characteristics and functions. Based on the results of 44 farm consultations and 23 semi-structured interviews, we show that forward-looking guidelines and measures proposed by farmers operationalise resilience. Central to this are improved networking among stakeholders, increased learning, and expanded participation in cultural landscape preservation. From a resilience and regional governance perspective, we recommend that polycentric approaches, i.e., linking horizontal and vertical axes of decision making and governance, be given greater consideration in agricultural management and landscape stewardship.

Key words

Social-ecological systems; resilience; landscape management; landscape stewardship; Common Agricultural Policy; southern Black Forest; land-care days; interdisciplinary sustainability science

1. Einleitung

Traditionelle Kulturlandschaften sind Ausdruck des komplexen und sich ändernden Zusammenspiels natürlicher Bedingungen und Prozesse sowie kultureller Praktiken (Plieninger et al., 2015). Die Erhaltung sowie die Entwicklung von Kulturlandschaften haben eine große gesellschaftliche Bedeutung, da sie die Grundlage für vielfältige Ökosystemleistungen darstellen (Plieninger et al., 2014). In Europa nehmen hierbei Gebirgsregionen wie der Schwarzwald eine herausragende Rolle ein (Huber et al., 2013). Landwirtschaftliche Praktiken haben sich in den letzten Jahrzehnten tiefgreifend verändert, zum einen im Zuge von Intensivierung und Rationalisierung (Schirpke et al., 2017), zum anderen durch Nutzungsaufgabe (MacDonald et al., 2000). Die typischen Ökosystemleistungen der Kulturlandschaften als Räume für Erholung und Identifikation können daher vielfach nicht mehr erbracht werden.

Das 2017 durch die UNESCO anerkannte Biosphärengebiet Schwarzwald verfolgt als zentrale Aufgabe den „Erhalt des Grünlands in den Steillagen der Schwarzwaldlandschaft“ (Deutsche UNESCO-Kommission, 2017). Die Allmendweiden sind im Mittelalter als Gemeingüter entstanden (Henschel & Konold, 2008). Durch ihre mosaikartige Anordnung in der Landschaft, ihre Struktur- und Artenvielfalt sowie ihr kulturelles Erbe sind sie das Kernelement des Biosphärengebiets Schwarzwald (Brockamp et

al., 2016). Da die Zukunft der Allmendweiden durch eine landwirtschaftliche Unternutzung herausgefordert ist, entwickelt die Geschäftsstelle des Biosphärengebiets im Projekt „Allmende 2.0“, ab 2019, gemeinsam mit Akteurinnen und Akteuren der Region, zukunftsfähige Konzepte für die Erhaltung der Kulturlandschaft (Brossette, 2020).

Das Management von Kulturlandschaften ist ein fortlaufender dynamischer Prozess, der durch Wechselwirkungen zwischen Akteuren auf unterschiedlichen Ebenen begleitet wird. Es bedarf daher inter- sowie transdisziplinärer Ansätze, um diesen zu analysieren und zu steuern (Olsson et al., 2004). Als vielversprechend haben sich im internationalen Kontext Ansätze erwiesen, die Landschaften als sozial-ökologische Systeme (SÖS) verstehen (Kirchhoff et al., 2012; Prager, 2011) und deren Resilienz analysieren (Folke et al., 2010). Unter Resilienz wird dabei die Fähigkeit verstanden, mit Störungen und Veränderungen umzugehen, ohne zentrale Charakteristika und Funktionen des Systems zu verlieren (Walker et al., 2004). Das Konzept des SÖS macht auf die enge Verflechtung von sozialen und ökologischen Entitäten und Prozessen aufmerksam (Ostrom, 2007; West et al., 2020), die prägend für Kulturlandschaften sowie die Landwirtschaft selbst sind (Plieninger et al., 2015). Die landwirtschaftlichen Betriebe nehmen eine zentrale Rolle ein, indem sie Prozesse prägen und von diesen geprägt werden (Darnhofer et al., 2016; Raymond et al., 2016). Daher fokussieren wir uns in diesem Beitrag auf die sozial-ökologische Resilienz landwirtschaftlicher Betriebe als Ausgangspunkt.

Vor diesem Hintergrund geht dieser Beitrag folgenden Fragen nach:

- (1) Welche Herausforderungen bestehen aus der Sicht der Betriebe für das SÖS Land(wirt)schaft und welche Maßnahmen schlagen diese vor, um den Herausforderungen zu begegnen?
- (2) Wie lassen sich Maßnahmenvorschläge der Betriebe aus der Resilienzperspektive einordnen und bewerten?
- (3) Wie lässt sich die regionale Governance aus der Resilienzperspektive einordnen und bewerten?
- (4) Welche Perspektive bietet der Ansatz der sozial-ökologischen Resilienz, um Einsichten für eine zukunftsfähige Land(wirt)schaftsentwicklung zu gewinnen?

2. Konzeptionelle Aspekte

Das ursprünglich in der Ökologie entwickelte Konzept der Resilienz hat sich seit Beginn der 2000er Jahre für die praxisbezogene Analyse und das Management von SÖS als vielversprechende Alternative zu Ansätzen erwiesen, die diese Systeme aus der Perspektive einer einzelnen Disziplin (z.B. Betriebswirtschaftslehre, Vegetationskunde) analysieren und Veränderungsprozesse nicht explizit in den Blick nehmen (Fokus auf einen Zustand zu einer bestimmten Zeit) (Folke et al., 2010). Resilienz bringt als Neuerung mit sich, dass Veränderungen (als längerfristiger Wandel oder kurzfristig auftretende Störung) als integrale Bestandteile komplexer Systeme angesehen werden, auf die durch Anpassung oder Transformation reagiert werden kann (Folke et al., 2010). Es bestehen unterschiedliche interdisziplinäre Ansätze zur Analyse und Beurteilung der Resilienz von SÖS. Diese

haben die Elemente Selbstorganisation, Lernen, Vielfalt und Austausch gemein (Resilience Alliance, 2010; UNU-IAS et al., 2014). In der vorliegenden Untersuchung beziehen wir uns auf Biggs et al. (2015), die sieben empirisch validierte Organisations- sowie Entwicklungsprinzipien für resiliente SÖS ableiten. Diese Resilienzprinzipien (**RP**) geben Hinweise zur Stärkung der Resilienz von SÖS (Tab. 1). Sie sind nicht statisch-präskriptiv („wie sollen resiliente SÖS organisiert sein?“), sondern informativ-dynamisch („wie können SÖS resilienter werden?“) zu verstehen. Damit lassen sich die RP zum einen für die Analyse der Resilienz von SÖS nutzen, zum andern aber auch für die Entwicklung sowie Bewertung von Initiativen und Maßnahmen mit dem Ziel der Resilienzsteigerung.

*Tabelle 1: Resilienzprinzipien (RP) sowie Ansätze und Kontextualisierung der Steigerung der Resilienz nach Biggs et al. (2015). * "Langsame Variablen" ändern sich über lange Zeiträume, sind nicht leicht zu erfassen und werden daher in Entscheidungen nicht immer ausreichend berücksichtigt (z.B. Klimawandel, Normen und Einstellungen).*

Resilienzprinzipien	Ansätze zur Steigerung der Resilienz	Kontextualisierung
RP1: Diversität und Redundanz erhalten	Heterogene bzw. redundante Strukturen mit ähnlichen Funktionen erhöhen die institutionelle Vielfalt und verringern Abhängigkeiten. Je unterschiedlicher die Reaktion auf Störungen, desto positiver ist der Beitrag. Es kann jedoch ein erhöhter Aufwand in Abstimmungen entstehen.	Vielfalt und Unterschiedlichkeit auf ökologischer (z.B. Biotope, Terrassen und -arten, Bewirtschaftungsmethoden) sowie sozialer (z.B. Akteursgruppen, landwirtschaftliche Betriebe) Ebene.
RP2: Konnektivität steuern	Vernetzung, Austausch und Erweiterung von SÖS erhöhen die Reaktionsmöglichkeit auf sowie die Anpassungsfähigkeit bei Störungen. Es besteht jedoch die Möglichkeit gleichförmiger Reaktionen bei wenig diversen (RP1) Strukturen.	Vernetzung auf ökologischer (z.B. Biotopverbund) sowie sozialer (z.B. Interessensverbände) Ebene.
RP3: Langsame Variablen* und Rückkopplungsschleifen einbeziehen	Zusammenwirken der SÖS-Komponenten verbessern sowie Erkennen von Schwellen, die das SÖS grundlegend ändern würden.	Änderungen der Landnutzungspraktiken sowie der Einstellungen zur Landwirtschaft wirken sich wechselseitig und langfristig aus. Sich wandelnde ökologische (z.B. Klimawandel), ökonomische (z.B. Kosten und Erlöse) und soziale (z.B. gesellschaftliche Wertschätzung der Landwirtschaft) Faktoren können Veränderungen in Selbstverständnis und Zielsetzung landwirtschaftlicher Betriebe verursachen.
RP4: Denken in komplexen adaptiven Systemen fördern	Zulassen von vielfältigen und adaptiven Managementansätzen sowie die Fähigkeit der Interaktion unterschiedlicher SÖS-Komponenten und Akteursgruppen verbessern.	Unterschiedliche Konzepte der Bewirtschaftung und Kooperation verschiedener Akteursgruppen zulassen.
RP5: Lernen unterstützen	Durch Einbeziehung unterschiedlicher Elemente des Wissens die Komplexität von SÖS erfassen und als Chance nutzen. Dadurch das Bewusstsein für Entscheidungen in SÖS-Governance erhöhen.	Wissensaustausch und Entwicklung von Handlungsalternativen anregen.
RP6: Partizipation erweitern	Horizontale und vertikale Vernetzung von Akteursgruppen. Dies führt zu Verbreitung von Informationen und ermöglicht das Erkennen von Störungspotenzialen sowie	Integration von Akteursgruppen vor Ort (z.B. Landwirtschaft, Gemeinden, Tourismusgewerbe, Gastronomie) sowie auf unterschiedlichen regionalen Skalen (z.B.

Resilienzprinzipien	Ansätze zur Steigerung der Resilienz	Kontextualisierung
	die Steigerung der Legitimität von Entscheidungen.	regional, Bundesland, Bund) in Entscheidungsfindungsprozesse.
RP7: Polyzentrische Governance fördern	Vielgliedrige Ebenen (horizontal und vertikal) der Entscheidungsfindung zulassen und in Vernetzung bringen.	Wirkung auf vielfältigen Ebenen, z.B. durch Vernetzung (RP2), Erfahrungsaustausch (RP5), Einbeziehung langsamer Variablen (RP3) oder Erweiterung der Akteure (RP6).

3. Fallstudie: Allmenden im Oberen Wiesental des Biosphärengebiets Schwarzwald

Das Biosphärengebiet Schwarzwald befindet sich im Süden des Schwarzwalds (Baden-Württemberg, Deutschland). In dieser Fallstudie beziehen wir uns auf das Gebiet des Gemeindeverwaltungsverbands (GVV) Schönau im Schwarzwald, welches gleichzeitig das Untersuchungsgebiet des Projekts „Allmende 2.0“ ist (**siehe Abb. 1**). Der rund 7.870 ha umfassende GVV Schönau besteht aus den selbstständigen Kommunen Aitern, Böllen, Fröhnd, Schönau, Schönenberg, Tunau, Utzenfeld, Wembach und Wieden. Das Gebiet ist durch große Höhenunterschiede (470 – 1414 m ü. NN) auf engem Raum, mit steilen Hängen und wenigen flachen Bereichen (Bergkuppen und Talauen), gekennzeichnet. Die klimatischen Bedingungen sind durch ausgeprägte, ganzjährig humide, Jahreszeiten gekennzeichnet, die reliefbedingt stark variieren (Brockamp et al., 2016). In der Wetterstation Lenzkirch (852 m ü. NN, etwa 30 km östlich des Untersuchungsgebiets Schönau) wurde im langjährigen Mittel (1981-2010) ein Jahresniederschlag von 1301 mm gemessen. In den Jahren 2018 bis 2020 lag der Jahresniederschlag bei 86 % des langjährigen Mittels. Diese Reduktion ist auf Trockenphasen während der Vegetationsperiode zurückzuführen (wetterkontor.de, 2021: eigene Berechnung).

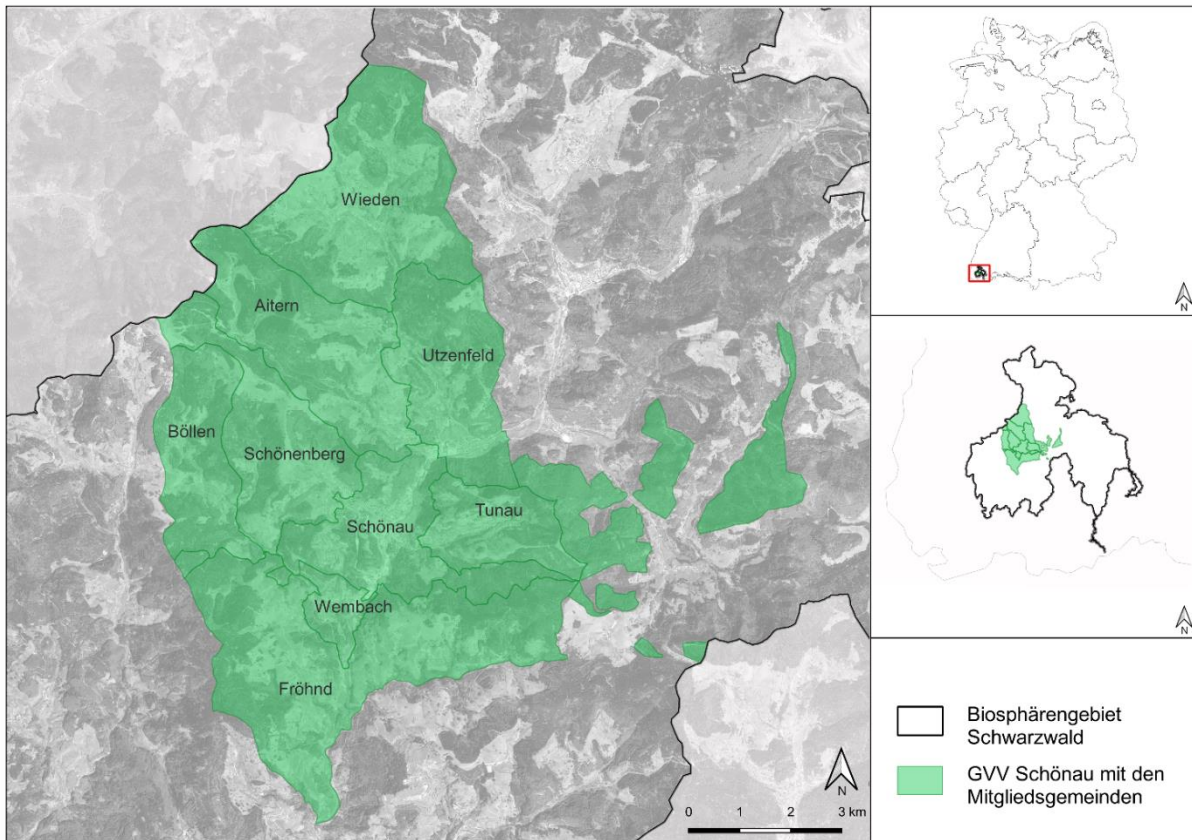


Abbildung 1: Lage des Gemeindeverwaltungsverband Schönau im Schwarzwald (grün) mit seinen Mitgliedsgemeinden im südwestlichen Baden-Württemberg innerhalb des Biosphärengebiets Schwarzwald. Kartengrundlage: Amtliches Liegenschaftskataster Informationssystem (ALKIS) © Landesamt für Geoinformation und Landentwicklung Baden-Württemberg. Autor: H. Röske.

Die Landnutzung des Untersuchungsgebiets ist durch traditionelle Familienbetriebe, häufig im Nebenerwerb, geprägt (siehe Tab. 2). Die Kulturlandschaft besteht aus großen, zusammenhängenden Weidfeldern in enger Verzahnung mit gemähtem Grünland und angrenzenden Wäldern. Rund ein Drittel der Flächen ist Offenland (Brossette, 2020). Ein deutschlandweites Alleinstellungsmerkmal des Südschwarzwaldes und des Biosphärengebiets Schwarzwald sind die sogenannten Allmendweiden (Deutsche UNESCO-Kommission, 2017). Hierbei handelt es sich um großflächige Weidfelder, die im Gegensatz zu vielen anderen mitteleuropäischen Regionen als Gemeingüter erhalten blieben (Warde, 2015; Wilmanns, 2001). In der zweiten Hälfte des vergangenen Jahrhunderts sind die Allmenden in das Eigentum der Kommunen übergegangen (Henschel & Konold, 2008). Bis zum Beginn des 21. Jahrhunderts war die gemeinschaftliche Weidenutzung verbreitet (Geiger, 1990), die aufgrund abnehmender Betriebszahlen sowie Problemen bei der Berücksichtigung in der Förderpolitik zurückgegangen ist. So führten insbesondere Neuerungen in der Förderperiode ab 2015 (z.B. Aufgabe einer spezifischen Kategorie für Gemeinschaftsweiden) zu einem höheren Organisationsaufwand und

steuerrechtlichen Nachteilen für gemeinschaftliche Beweidung (Brossette et al., in Druck; Röske et al., 2020).

Im Sprachgebrauch in der Region sind die Allmendweiden nicht ausschließlich durch eine kulturhistorische Perspektive definiert, sondern auch durch ihre landschaftsprägenden und ökologischen Eigenschaften. Durch die Jahrhunderte währende Nutzung der Weidfelder ist eine besondere Struktur- und Artenvielfalt entstanden. Es sind zahlreiche ökologisch wertvolle Sonderstrukturen wie zum Beispiel das Landschaftsbild prägende Weidbuchen, Felsen, Steinriegel und Trockenmauern, Fichtenanflug und Birkenwäldchen vorhanden. Diese sind in ihrer Gesamtheit überregionale Hotspots der Artenvielfalt (Seitz et al., 2004). Exemplarisch für den hohen naturschutzfachlichen Wert der Allmenden ist deren großflächige Ausweisung als FFH-Gebiete (gemäß der **Fauna-Flora-Habitatrichtlinie**). Aus produktionstechnischer Sicht handelt es sich bei Allmenden meist um vergleichsweise wenig produktive Flächen (Kiefer et al., 2020).

*Tabelle 2: Strukturdaten der Landwirtschaft und Landschaft im GVV Schönau. Quellen: 'Statistisches Landesamt (2021), *Biosphärengebiet Schwarzwald (2020).*

Strukturdaten	Werte
Landw. Betriebe 1979' (n)	240
Landw. Betriebe 2020' (n)	108
Landw. Betriebe Nebenerwerb 2020' (n)	97
Rinder 1979' (n)	2213
Rinder 2020' (n)	1440
Gesamtfläche (ha)	7.870
Grünland 2019* (ha)	2587
Kommunales Grünland 2019* (ha)	1641
FFH-Gebiete* (ha)	3708
Kommunales Grünland im FFH-Gebiet (ha)*	1157

Bestand bis zu Beginn des 20. Jahrhunderts eine Übernutzungsproblematik (Schwendemann et al., 1980), so stellt aktuelle die Unternutzung der Weiden durch den Rückgang landwirtschaftlicher Aktivitäten und die abnehmende Gesamtzahl der in der Region gehaltenen Rinder die größte Herausforderung für die Bewirtschaftung der Allmenden und die damit in Verbindung stehenden Ökosystemleistungen dar. Der Rückgang der Rinderzahlen im Untersuchungsgebiet ist durch eine Umstellung des Produktionssystems von Milchviehhaltung in Mutterkuhhaltung gekennzeichnet, wobei das endemische Hinterwälder Rind weiterhin eine zentrale Rolle einnimmt. Zusätzlich werden für die Sommerbeweidung der Weidfelder sogenannte „Pensionsrinder“, von nicht an die extensive Nutzung angepassten Rinderrassen aus den Tallagen außerhalb des Schwarzwalds, verwendet (Brossette, 2020). Die zu Ende des 19. Jahrhunderts typische Ziegenhaltung hat bis in die Nachkriegszeit so stark abgenommen, dass man in den 1980er Jahren davon ausging, dass dies „keine

Bedeutung mehr erlangen“ wird (Müller, 1983, S. 188). In den zurückliegenden Jahrzehnten wurde die Ziege jedoch für den Einsatz in der Landschaftspflege immer anerkannter, sodass 2020 62 Betriebe im GVV Schönau 1013 Ziegen hielten (Schmidt, 2020; Statistisches Landesamt Baden-Württemberg, 2021). In diesem Beitrag verstehen wir die Allmendweiden als nicht abgeschlossenes sozial-ökologisches System, welches die Landschaft und Kultur des Untersuchungsgebiets prägt.

4. Material und Methoden

In dieser Untersuchung nutzen wir unterschiedliche Methoden der Datenerhebung (halbstrukturierte Leitfadeninterviews, Beratungsberichte, Beobachtungsnotizen, Protokolle von Arbeitsgruppentreffen, teilnehmende Beobachtung) sowie der Datenanalyse (qualitative Inhaltsanalyse, Experteneinschätzung, deskriptive Statistik). Bei der Analyse liegt der Fokus auf der Perspektive der landwirtschaftlichen Betrieben.

Die Erfassung dieser Perspektive basiert auf der Auswertung und Analyse von 44 Betriebsberatungen sowie 23 darauf aufbauende halbstrukturierte Leitfrageninterviews, welche im Zeitraum August 2020 bis Juni 2021 durchgeführt wurden. Die Beratungen standen den Betrieben kostenfrei zur Verfügung und dienten der Besprechung der betriebseigenen Anliegen. Über die Möglichkeit zur freiwilligen Teilnahme wurde über das örtliche Mitteilungsblatt sowie über den Badischen Landwirtschaftlichen Hauptverband aufmerksam gemacht. Darin wurde auch damit geworben, dass die anonymisierten Ergebnisse durch das Projekt „Allmende 2.0“ praxisorientiert sowie darüber hinaus wissenschaftlich veröffentlicht würden. Die etwa dreistündigen Beratungen fanden vor Ort in den Betrieben statt und wurden durch einen Betriebsberater und Mitautor dieses Berichts (L.K.) durchgeführt. Ihnen lag ein standardisierter Erfassungsbogen zu Grunde, welcher Daten zur Betriebsstruktur, der Arbeits- und Betriebswirtschaft sowie Angaben zu weiteren sozial-ökologischen Parametern beinhaltet. Die Erfassung der arbeitswirtschaftlichen Daten beruht auf einer Einschätzung der Betriebsleitung zu den täglichen Arbeitszeiten im Jahresverlauf und einer anschließenden Hochrechnung. Die Erfassung der Betriebsergebnisse basiert auf den steuerlichen Gewinnermittlungen der Betriebe sowie den Betriebsumsätzen. Die Beratung wurde in einem Bericht zu betriebsspezifischen Fragestellungen, Herausforderungen und Entwicklungsmöglichkeiten dokumentiert (Brossette, 2021). Die Interviews bauten auf die Beratungsgespräche auf und wurden im Anschluss an diese durchgeführt. Hierfür wurden Betriebe ausgewählt, die sich hinsichtlich ihres Typs, der Herausforderungen, Zukunftsperspektiven und Visionen unterscheiden und in der Summe die Bandbreite der verschiedenen Gegebenheiten im Untersuchungsgebiet abdecken. Der Interviewleitfaden zielte auf Unterstützungsangebote, Leitlinien, Herausforderungen und Ideen für den eigenen Betrieb sowie die Landwirtschaft in der Region ab. In einem offenen Teil wurde den Betrieben die Möglichkeit gegeben, Themen anzusprechen, die sie für die Zukunft als besonders wichtig erachten. Die an den Beratungen

und Interviews Teilnehmenden haben ihr schriftliches Einverständnis zur wissenschaftlichen Verwendung der Daten erteilt.

Zusätzliche Erkenntnisse stammen aus teilnehmender Beobachtung der Autorenschaft des vorliegenden Beitrags, insbesondere als Mitglieder einer begleitenden Arbeitsgruppe zum Projekt „Allmende 2.0“. Diese Gruppe setzt sich aus Vertreterinnen und Vertretern der Landwirtschaft, der Kommunen, Wissenschaft und Verwaltung zusammen und trifft sich in etwa halbjährlichem Turnus. In diesen Treffen standen die Herausforderung der Landwirtschaft, der gemeinschaftlichen Bewirtschaftung sowie zukünftige Handlungsmöglichkeiten der Region im Mittelpunkt.

Die Analyse der quantitativen Daten beruht auf Methoden der deskriptiven Statistik. Die qualitative Datenanalyse erfolgte als Inhaltsanalyse mit MaxQDA 10 (VERBI software) durch Verdichtung von Codes zu den zentralen Elementen der Fragestellung (Mayring, 2015). Aus den Beratungen und Interviews mit den landwirtschaftlichen Betrieben wurden acht Maßnahmenvorschläge erarbeitet, die soziale und ökologische Aspekte adressieren. Die an den Beratungen teilnehmenden Betrieben erhielten diese Maßnahmenvorschläge zur Bewertung der Wirksamkeit und zum Hinzufügen weiterer Anmerkungen und Vorschläge. Die Ergebnisse wurden in einem Arbeitsgruppentreffen abschließend diskutiert und validiert.

5. Ergebnisse

In diesem Kapitel werden zunächst die aktuelle Situation, Herausforderungen und Motivation landwirtschaftlicher Betriebe analysiert (5.1). Daran schließen Leitlinien für die Landwirtschaft der Zukunft an, wie sie sich aus den Perspektiven der befragten landwirtschaftlichen Betriebe verdichten lassen (5.2). Es folgen Maßnahmenvorschläge, welche auf das Erreichen der Leitlinien abzielen, dargestellt in ihrem Bezug auf die Resilienzprinzipien (5.3). Diese Maßnahmen werden schließlich in den Rahmen einer regionalen Governance eingeordnet (5.4). Die Anordnung von Maßnahmenvorschlägen sowie unterstützenden Argumenten der Leitlinien spiegeln weder Häufigkeit noch Wichtigkeit der Maßnahmen wider, sondern dienen der Verständlichkeit.

5.1. Situation, Herausforderungen sowie Motivation

Aus der strukturellen Erfassung von Betriebsdaten der 44 landwirtschaftlichen Betrieben aus dem Oberen Wiesental lassen sich die aktuelle Situation und die Herausforderungen des Systems Landwirtschaft charakterisieren (Tab. 3). Die Betriebe richten sich in unterschiedlich starkem Maß auf das Ziel „wirtschaftlichen Erfolg“ aus; die tatsächlich erreichten Betriebsgewinne spiegeln diese unterschiedlichen Zielsetzungen wider. Der Betriebsgewinn des 0,75-Quantils (das in Bezug auf den Betriebsgewinn oberste Viertel) ist durch Betriebe gekennzeichnet, (i) die Investitionen im notwendigen Maße und vorausschauend tätigen, (ii) über die notwendige Infrastruktur (Laufstall,

Spezialmaschinen) und Ausstattung (Mähflächen) verfügen, (iii) durch Spezial- oder Direktvermarktung vergleichsweise hohe Fleischpreise erzielen und (iv) durch Vertragsnaturschutz- und Landschaftspflegemaßnahmen vergleichsweise hohe Fördersätze realisieren. Die landwirtschaftliche Förderung spielt eine entscheidende wirtschaftliche Rolle. So nimmt die Förderung im Durchschnitt einen Anteil von 66 % des Umsatzes ein. Im Gebiet überschneiden sich mehrere Förderkulissen, insbesondere aus der zweiten Säule der Gemeinsamen Agrarpolitik, aus denen die Betriebe wählen können. Der Umsatzanteil aus tierischen Erzeugnissen liegt bei 23%. Die gute Relation von durchschnittlichem Betriebsumsatz zu Gewinn deutet zwar auf effiziente Bewirtschaftung hin, jedoch ist diese vor der besonderen wirtschaftlichen Funktion der Landwirtschaft im Nebenerwerb, des hohen Finanzbedarfs für notwendige Investitionen sowie der aufgewandten Arbeitszeit zu relativieren. So ergibt sich für die Entlohnung einer landwirtschaftlichen Arbeitskraft rechnerisch ein Stundenlohn von 5,30 €. In Bezug auf die Hofnachfolge geben 72 % der befragten Betriebe an, dass diese gesichert oder in den kommenden 15 Jahren geplant sei. Der geringere Anteil von Betrieben mit offener oder ohne familiäre Hofnachfolge aus der Stichprobe stimmt nicht mit dem generellen Diskurs im Untersuchungsgebiet überein, demzufolge in den kommenden Jahren vielfach Betriebsaufgaben durch ausbleibende Nachfolgen zu erwarten sind.

*Tabelle 3: Überblick über die befragten landwirtschaftlichen Betriebe (n=44). Dargestellt sind Mittelwert sowie Varianzkoeffizient (VarK). *Eine landwirtschaftliche Arbeitskraft entspricht einem jährlichen Stundeneinsatz von 2380 Stunden.*

Strukturdaten	Mittelwert (VarK)
Betriebsgröße (ha)	25 (0,88)
Besatzstärke (Großvieheinheiten/ha)	0,68 (0,42)
Alter Betriebsleitung (a)	48 (0,23)
Mitarbeitende/ Betrieb (n)	2,9 (0,46)
Durchschnittliche Wochenarbeitskraft in Stunden	39,6 (0,57)
Anteil Betriebe ohne Hofnachfolge (%)	12
Betriebsumsatz (€)	33.633 (0,69)
Betriebsgewinn (€)	10.959 (1,05)
Betriebsgewinn, beste 25 % (€)	26.860 (0,43)
Anteil Betrieb an Familieneinkommen (%)	25 (1,12)

Die Bereitschaft und Möglichkeit der Nachfolgeneration die Landwirtschaft fortzuführen, wird durch die Betriebe in klarer Verbindung mit der Bewältigung der Herausforderungen gesehen, die mit der Betriebsführung verbunden sind. Die Herausforderungen sind in Tabelle 4 (Verdichtung der Inhalte der Beratungsberichte und Interviews) zusammengefasst. Diese betreffen sowohl die einzelnen Betriebe als auch die Landwirtschaft als SÖS insgesamt.

Tabelle 4: Fünf durch Betriebe wiederkehrend beschriebene Herausforderungen landwirtschaftlicher Betriebe sowie der Landwirtschaft als SÖS.

Herausforderung	Kontextualisierung durch befragte Betriebe
Erhaltung der Grünlandqualität	Reduktion der Produktivität sowie Nährwert des Grünlands durch trocken-heiße Sommer sowie ausbleibende organische Nährstoffrückfuhr. Bestimmungen des Vertragsnaturschutzes und geschützter Biotope erlauben eine Düngung nur in Ausnahmefällen. Als Reaktionen wurde der Tierbesatz reduziert sowie Winterfutter zugekauft. Dies hat negative Auswirkungen auf Betriebsergebnisse, Verbissdruck und den Arbeitsaufwand für Weidpflege (Brossette, 2021).
Erhaltung und Modernisierung der Infrastruktur	Vorhandensein angepasster Infrastruktur ist Voraussetzung für Betriebserhaltung. Die Finanzierung aus den Betriebsergebnissen heraus ist häufig nicht möglich. Dies betrifft (1) Maschinen (z.B. Hangspezialmaschinen, Doppelmesserbalkenmäherwerke), (2) Stallsystem (Umbau bestehender Anbindeställe in oder Neubau von Laufställen), (3) Infrastruktur der Weidwasserversorgung (z.B. Quellfassungen, Leitungen, Tränken).
Herdenschutz und Wolf	Das Vorhandensein von Wölfen im Untersuchungsgebiet sowie die Notwendigkeit der Umsetzung von Herdenschutzmaßnahmen bei Ziegen- und Schafhaltung werden als problematisch gesehen. Teilweise wird die Unvereinbarkeit von Wolf und Weidwirtschaft hervorgehoben, teilweise die Zweckmäßigkeit und Praxisauglichkeit der anerkannten und geförderten Herdenschutzmaßnahmen kritisiert. Die Daseinsberechtigung des Wolfs im Südschwarzwald wird unterschiedlich bewertet.
Qualifikationsmöglichkeiten und Wissen	An die Betriebe werden immer komplexere Anforderungen gestellt, die viel Praxis- und Theoriewissen notwendig machen (z.B. Grünlandbewirtschaftung, Naturschutz, Verwaltung, Recht). Das Aneignen von Qualifikationen und Wissen im Nebenerwerb ist herausfordernd und nur durch erheblichen Zusatzaufwand möglich.
Austausch und Vernetzung	Durch die Mehrfachbelastung der Betriebe (v.a. Hauptberuf, Landwirtschaft, Familie) beruht die Vernetzung mit anderen Betrieben und den weiteren regionalen Akteursgruppen mit Unterstützungsangeboten vielfach auf bestehenden persönlichen Kontakten. Jedoch gleichen sich die Situationen und Herausforderungen der Betriebe häufig.

In Bezug auf die Motivation der Betriebe, Landwirtschaft zu betreiben oder fortzuführen, wurde in den Interviews deutlich, dass Landschaftserhaltung sowie Fortführung der Tradition in Familie und der Region bedeutende Triebfedern sind. Freude an der Arbeit mit Natur, Tieren und Maschinen sowie Ausgleich zum Lebensalltag wurden zusätzlich genannt. Die Entscheidung der Nachfolgegeneration, den Betrieb fortzuführen zu wollen, wird teilweise eigenständig und bewusst getroffen. In manchen Gesprächen wurde klar, dass diese Erwartungen der Elterngeneration folgen. Möglichst hohe wirtschaftliche Gewinne zu erzielen wird nicht als zentraler Antrieb für die Fortführung der Landwirtschaft genannt. Vielmehr wird die wirtschaftliche Tragfähigkeit des Betriebs als eine Voraussetzung für die Fortführung der Landwirtschaft erachtet.

5.2. Leitlinien der Landwirtschaft der Zukunft

Aus den durchgeführten Interviews geht hervor, dass die Erhaltung der kleinstrukturierten Landwirtschaft im Nebenerwerb sowohl für die Betriebe selbst als auch für die Landwirtschaft als SÖS mit Blick in die Zukunft mehrheitlich angestrebt und als vorteilhaft erachtet wird.

Demnach planen viele Betriebe, die bestehenden Betriebsmodelle fortzuführen sowie an sich ändernde Rahmenbedingungen und Anforderungen anzupassen. Diese Betriebe können sich vorstellen, einige zusätzliche Flächen aufhörender Betriebe zu übernehmen, sollte es zu Betriebsaufgaben kommen. Die deutliche Ausweitung des Betriebs wird jedoch häufig nicht angestrebt, da die Voraussetzungen, insbesondere Arbeitskraft und Infrastruktur, nicht ausreichend sind. Auch der Schritt in den Vollerwerb sowie zur Tatigung von groen Investitionen ist schwer vorstellbar. Hingegen gibt es wenige Betriebe, die durch ein arbeits- sowie betriebswirtschaftlich optimiertes Betriebsmodell flexibel die Bewirtschaftungsflache erweitern konnten. Hierzu zahlen die lediglich fur die Sommerbeweidung aufgenommenen „Pensionsrinder“ sowie Ziegen.

Diese grundsatzlichen Uberlegungen aus der Analyse der Betriebsdaten finden sich auch in den Zielvorstellungen fur die Landwirtschaft im Untersuchungsgebiet insgesamt wieder. Im Mittelpunkt steht hier die Erhaltung einer kleinstrukturierten Landwirtschaft. Auf der sozialen Ebene werden als Vorteile vieler kleiner Nebenerwerbsbetriebe angefuhrt: (1) Die Fortfuhrung der Tradition. (2) Die Verankerung und damit die Erhaltung des Verstandnisses fur die Bedeutung und den Wert der Landwirtschaft in der Bevolkerung. (3) Ermutigung der Weiterfuhrung bestehender Betriebe.

Auf der okologischen Ebene wird hervorgehoben: (4) Die Notwendigkeit von viel Handarbeit fur die Offenhaltung. (5) Das Risiko, dass groe Haupterwerbsbetriebe aus der betriebswirtschaftlichen Notwendigkeit heraus nur die in Bezug auf Ertragswert, Forderung, Arbeitswirtschaftlichkeit wertvollsten Flachen auswahlen und die besonders schwer zu bewirtschaftenden Flachen auslassen wurden.

Ein weiteres Argument, welches die soziale und okologische Ebene verbindet, ist, dass jeder Betrieb uber seine Ausstattung in Flachen, Arbeitskraft, Tiere, Maschinen sowie Zielvorstellungen unterschiedliche Betriebsmodelle entwickelt und dadurch auf Landschaftsebene eine hohe sozial-okologische Strukturvielfalt entsteht. Auf Landschaftsebene wird diese Strukturvielfalt insgesamt als positiv gesehen, da dadurch unterschiedliche Ansatze ausprobiert und umgesetzt werden.

Demgegenuber wird von wenigen Betrieben angemerkt, dass durch die Erhaltung vieler kleiner Betriebe keine Wachstumschancen fur junge, motivierte Betriebsleiter entstehen, die ihre Betriebe gerne erweitern wurden. Diese sind davon uberzeugt, dass durch entsprechend groe und schlagkraftig aufgestellte Betriebe eine deutlich effizientere Bewirtschaftung der Flachen moglich ware. Die Ergebnisse dieser Untersuchung unterstutzen dies in Bezug auf die Wirtschaftlichkeit groerer Betriebe.

5.3. Manavorschlage zur Landwirtschaft der Zukunft

Die durch die Betriebe vorgeschlagenen Manahmen fur die zukunftsorientierte Entwicklung der Landwirtschaft (Tab. 5) entsprechen den entworfenen Leitlinien (Kap. 5.2) und rekurren auf den

identifizierten Herausforderungen (Kap. 5.1). Diese adressieren unterschiedliche Handlungsbereiche innerhalb des SÖS und reichen von Vorschlägen zu Vernetzung, Austausch und Lernen bis hin zum Umgang mit akuten Problemen. Die Umsetzung der Maßnahmen kann entweder durch die Betriebe selbst oder in Kooperation mit weiteren Akteursgruppen, bzw. eigenständig durch diese, erfolgen.

*Tabelle 5: Acht Maßnahmenvorschläge zur zukunftsfähigen Unterstützung der Landwirtschaft sowie Bezug zu den Resilienzprinzipien (RP). Die mit * versehenen Maßnahme kam durch die Bewertung der Maßnahmen durch die Betriebe hinzu.*

Handlungsbereich	Maßnahmenvorschlag	Bezug zu Resilienzprinzipien
Beratung und Ansprechpartner	Bessere Abstimmung zwischen Behörden sowie den weiteren Akteursgruppen. Zentrale Bereichsbeauftragte/ Gebietsmanager mit Bündelung von Kompetenzen aus den Bereichen Naturschutz- und Landwirtschaft. Umfassendere und verbindlichere Beratungsangebote.	Zugänglichkeit verbessern (RP2). Reduktion von Transaktionskosten durch klare Zuständigkeiten und kohärentes Auftreten der Akteursgruppen (RP1).
Wegkommen von Anbindehaltung	Praxistaugliche Entwicklung kostengünstiger und einfach umzusetzender Lösungen für Laufstallhaltung (gemeinschaftlich genutzte Ställe, Unterstände, Umbau bestehender Anbindeställe). Anpassung an kleine Betriebe.	Gemeinschaftsställe bieten Raum für Vernetzung, Kooperation und Austausch von Erfahrung sowie Wissen (RP6, RP2).
Herdenschutz und Wolf	Praxistaugliche Umsetzung des Herdenschutzes. Entwicklung weiterer Herdenschutzmaßnahmen. Kosten- und aufwandsreduzierte Umsetzung von Maßnahmen.	Entwicklung neuer Ansätze (RP5). Identifikation von Gefahren für das SÖS (RP3). Konflikte zulassen und Verständigung hierzu befördern (RP4).
Futterproduktion in Kooperation	Winterfutterproduktion in Kooperation (Zusammenschlüsse oder Dienstleistung). Unabhängig verwalteter Maschinenpark zum Verleih von Maschinen. Einsatz von Gebrauchtmaschinen.	Gemeinschaftliche Maschinennutzung bietet Raum für Kooperation und Austausch (RP6, RP2). Zudem können Kosten gespart werden (RP2)
Aus- und Weiterbildung	Angebot dezentraler und bedarfsgerechter Aus- und Weiterbildungsangebote. Einbeziehen unterschiedlicher Betriebsmodelle.	Erarbeitung und Verbreitung von Wissen (RP2, RP5). Austausch zwischen unterstützenden Akteursgruppen und Betrieben (RP6).
Vermarktungsinitiative	Initiierung einer umfassenden Vermarktungsstrategie (Wissen, Vernetzung, Organisation, Vermarktungsangebote, Auswirkungen auf Wertschöpfung, Schlachtmöglichkeit, Flächenausstattung).	Adressieren der gesamten Wertschöpfungskette (RP2). Stärkung der Bedeutung von tierischen Erzeugnissen, Diversifizierung (RP1).
Grünland-erhaltung	Ermöglichen von Düngung auf Grünland ohne Schädigung der Pflanzenvielfalt. Evidenzbasierte Begleitung von Düngung.	Monitoring und Steuern von Rückkopplungsschleifen (RP3). Vielfältige Betriebsmodelle ermöglichen (RP1). Horizontale und vertikale Verknüpfung des SÖS einbeziehen (RP4).
Vernetzung*	Arbeitskreis zur Entwicklung der Landwirtschaft. Gleichberechtigte Beteiligung der Betriebe, Verwaltung, Kommunen, Tourismus, Biosphärengebiet Schwarzwald.	Austausch und gegenseitiges Verständnis fördern (RP1, RP2). Einbeziehen relevanter Akteursgruppen des SÖS (RP6). Beitrag Austausch und Entscheidungsfindung auf mehreren Ebenen (RP7).

Zu jedem Maßnahmenvorschlag lässt sich eine Verbindung zu mindestens einem RP ziehen und darstellen, inwiefern dadurch resilienzsteigernde Wirkungen erzielt werden. Die Verankerung von RP in den Maßnahmenvorschlägen erscheint unterschiedlich ausgeprägt. Wiederkehrende RP sind

beispielsweise „Konnektivität steuern“ (P2) sowie „Partizipation erweitern“ (RP6), wohingegen „polyzentrische Governance fördern“ (RP7) nur im Rahmen eines Maßnahmenvorschlags angesprochen wird. Der die Resilienz betreffende Effekt geht direkt oder indirekt aus den Maßnahmen hervor. Während „Aus- und Weiterbildung“ sowie „Vernetzung“ auf inhärent resilienzsteigernde Elemente abzielen, entsteht die Verbindung zwischen RP und den Maßnahmen „Wegkommen von Anbindehaltung“ „Vermarktungsinitiative“ sowie „Herdenschutz und Wolf“ mittelbar durch Effekte, die von diesen zu erwartet sind.

5.4. Regionale Governance der Allmendweiden

Die vorgeschlagenen Maßnahmen sind eingebettet in einen Governance-Rahmen, der durch eine Vielzahl von regional agierenden Akteursgruppen gekennzeichnet ist. Wir fokussieren uns im Folgenden auf die Akteursgruppen, welche Unterstützungsangebote für die Landwirtschaft bieten oder die auf andere Weise in Verbindung mit der Landwirtschaft stehen und die durch die Betriebe als relevante Akteursgruppen genannt wurden.

Aus Tabelle 6 wird ersichtlich, dass die Unterstützungsangebote eine große Bandbreite aufweisen (Beratung, Förderung, Vernetzung, Interessenvertretung), teilweise redundant sind oder sich auch in ihrer Spezialisierung unterscheiden (unterschiedliche Beratungs- und Förderangebote) (RP1).

Tabelle 6: Regionale Akteure mit Unterstützungsangeboten für die Weidebewirtschaftung im GVV Schönau

Akteure	Institutionelle Einbettung	Reichweite	Unterstützung Landwirtschaft
Weidegemeinschaften	eigenständige Betriebe	jeweilige Allmendweiden	Gemeinschaftliche Bewirtschaftung von Allmendweiden, Austauschmöglichkeit, Ausleihen von Infrastruktur (teilweise)
Kommunen	Kommunen	Kommunen	(Häufig) Flächeneigentümer, Ansprechpartner, Verpachtung von Flächen, infrastrukturelle Unterstützung
Untere Naturschutzbehörde	Landratsamt Lörrach	Landkreis	Abschluss und Koordination Vertragsnaturschutz, investive Förderung mit Naturschutzbezug
Untere Landwirtschaftsbehörde	Landratsamt Lörrach	Landkreis	Beratung, Vorortkontrolle, investive Förderung
Landschaftserhaltungsverband	Verein auf Ebene des Landkreises	Mitgliedsgemeinden des Landkreises	Kontakt, Beratung und Umsetzung Schwerpunkt Naturschutz und Landschaftspflege
Übergebieliche Weideberatung	Landratsamt Lörrach, untere Landwirtschaftsbehörde	Berggebiet Südschwarzwald	Kontakt, Beratung und Umsetzung Schwerpunkt nachhaltige Grünlandbewirtschaftung
Höhere Naturschutzbehörde	Regierungspräsidium Freiburg	Regierungsbezirk Freiburg	Planung und Umsetzung von Pflegemaßnahmen in Naturschutzgebieten, investive Förderung mit Naturschutzbezug
Geschäftsstelle Biosphärengebiet Schwarzwald	Regierungspräsidium Freiburg	Biosphärengebiet Schwarzwald	Investive und konzeptionelle Förderung mit Naturschutzbezug,

Akteure	Institutionelle Einbettung	Reichweite	Unterstützung Landwirtschaft
			Diskussionsgruppen, Forschung, Regionalvermarktung, Netzwerk
Naturpark Südschwarzwald	Verein aus (Gebiets-) Körperschaften und Interessensvertretungen aus dem Südschwarzwald	Südschwarzwald	Konzeptionelle Förderung, Arbeitsgruppen, themenbezogene Einzelprojekte Forschung, Netzwerk

Die institutionelle Vielfalt des Untersuchungsgebiets ist auf Initiativen zur Unterstützung nachhaltiger Entwicklung in der Region (Naturpark, Biosphärengebiet) sowie auf den kulturhistorischen und ökologischen Wert der Allmendweiden zurückzuführen (Weidgemeinschaften, übergebieliche Weideberatung). Kennzeichnend ist, dass viele dieser Akteure Teil von Verwaltungen auf Ebene der Kommunen, des Landkreises oder Regierungsbezirks sind oder durch diese getragen werden. Die Strukturen sind untereinander vernetzt, sodass sich beispielsweise wechselseitig Vertretung in Gremien finden. Die Vernetzung der überkommunal agierenden Akteursgruppen mit den rein lokal agierenden Akteursgruppen (Weidgemeinschaften, Kommunen) ist unterschiedlich stark ausgeprägt. Dies trifft auch auf die Verbindungen zwischen diesen Strukturen insgesamt und den landwirtschaftlichen Betrieben zu. Vielfach kommt die Vernetzung durch ein spezielles Anliegen des Betriebs oder Unterstützungsangebot der Akteursgruppen zu Stande. Einige Betriebe finden sich als „Vertreter der Landwirtschaft“ in übergeordneten Gremien wieder.

Die institutionelle und unterstützende Vielfalt wird durch landwirtschaftliche Betriebe unterschiedlich bewertet. Wiederkehrende Kritik richtet sich auf (1) intransparente sowie mehrfachbelegte Zuständigkeiten sowie Unterstützungsangebote, (2) die Vielzahl derjenigen, die bei Anliegen und Gremien zu beteiligen sind, (3) langwierige und komplizierte Entscheidungsprozesse. Als positiv wird hingegen wahrgenommen, dass (1) die Akteure ein großes Interesse zur Unterstützung zeigen, (2) aufgrund der Vielzahl von Angeboten passende Unterstützung geleistet werden kann und (3) einzelne Mitarbeitende der Akteure Vertrauenspersonen sind.

6. Diskussion und Ausblick

6.1. Welche Chancen bietet die sozial-ökologische Resilienz als Analyserahmen?

Die Herausforderungen für die Erhaltung der Landwirtschaft als Gestalterin der Kulturlandschaft im Südschwarzwald sind vielschichtig und komplex. Ein Beitrag sozial-ökologischer Forschung ist es, praxisnahe Analyserahmen für inter- sowie transdisziplinär zu bearbeitende Fragestellungen bereitzustellen sowie Erkenntnisse hervorzubringen, auf denen Adaptations- sowie Transformationsprozesse aufbauen können (Horcea-Milcu et al., 2020). Die Perspektive der sozial-ökologischen Resilienz kann auf verschiedenen Ebenen Anwendung finden, von betrieblicher Ebene (Darnhofer et al., 2010) über Vereinigungen und überbetriebliche Gemeinschaften (Prager, 2012) bis

hin zu Landschaften (Cumming et al., 2013). Die in dieser Untersuchung gewählte Betrachtung der landwirtschaftlichen Betriebe als zentrale Akteure des SÖS ermöglicht es, ineinandergreifende Herausforderungen darzustellen sowie Maßnahmenvorschläge in Bezug auf ihre Resilienzsteigernden Potenziale einzuordnen. Hieraus wird ersichtlich, dass Leitlinien sowie Vorschläge der landwirtschaftlichen Betriebe mit Potenzial zur Erhaltung sowie Steigerung von Resilienz zu bewerten sind. Auf der Ebene der internationalen Politikgestaltung wird das Konzept der Resilienz immer häufiger aufgegriffen, da es als wichtiges Element der Nachhaltigkeitsagenda gilt (Berkes, 2017). Dies findet bisher aber noch nicht ausreichend Berücksichtigung in der Ausgestaltung von Resilienzsteigernden Maßnahmen auf nationaler und regionaler Ebenen – was aber dringend notwendig wäre, um vorhandene Potenziale auszuschöpfen. So bietet die Ausdehnung und Kontextualisierung von Resilienz die Möglichkeit, dominante Einstellungen und Denkmuster von Landbewirtschaftenden und Entscheidungstragenden aufzubrechen, in dem explizit der Fokus auf Bereiche gelegt wird, die häufig unberücksichtigt bleiben. So kann Resilienz dazu beitragen, ein Kulturlandschaftsmanagement zu befördern, das Prozesse des Wandels proaktiv und strategisch in den Blick nimmt, anstatt lediglich kurzfristig auf Probleme und Störungen zu reagieren (Luthe & Wyss, 2015).

Die durch die Betriebe vorgeschlagenen Maßnahmen beeinflussen die sozial-ökologische Resilienz auf unterschiedlichen Ebenen. Für einige Maßnahme ergeben sich Resilienzsteigernde Potenziale als nachgeordnete Effekte einer mehrgliedrigen Wirkungskette. Ein Beispiel hierfür ist das Wegkommen von der Anbindehaltung von Rindern. Diese Maßnahme stellt eine wesentliche Voraussetzung für die Zukunftsfähigkeit der Betriebe dar, da ein gesetzliches Verbot abzusehen ist und der Handel zudem einen großen Druck ausübt. Die Maßnahme an sich (Wegkommen der Anbindehaltung) wirkt sich allerdings nicht direkt auf die Resilienz der Betriebe aus, sondern nur als Ergebnis einer (größeren) Kompatibilität mit gesetzlichen Bestimmungen und Verbrauchererwartungen. In diesem Sinne können hingegen durch praktische Maßnahmen indirekte Resilienzsteigernde Auswirkungen ausgelöst werden. So werden die notwendigen Alternativen zur Anbindehaltung unmittelbar zu einer Diskussion von zum Beispiel Gemeinschaftsställen oder anderen alternativen Einstallmöglichkeiten (RP2) führen und somit Lernprozesse (RP5) und Austausch (RP2) anstoßen. Als Ergebnis könnte am Ende nicht nur eine zukunftsfähige Anpassung der Rinderhaltung gelingen, sondern ebenso erreicht werden, dass mehrere Akteure gemeinsam Verantwortung für das sozial-ökologische System der Allmendweiden übernehmen (RP3). Eine Möglichkeit, die Umsetzung von Maßnahmen zu priorisieren und damit praxistauglich zu gestalten, könnte darin bestehen, diese entsprechend der Anzahl der darin berücksichtigten Resilienzprinzipien zu sortieren.

6.2. Welche Perspektive eröffnet die sozial-ökologische Resilienz für die Praxis der Allmendweiden im Südschwarzwald?

Die Ergebnisse dieser Untersuchungen weisen auf Herausforderungen, Ziele sowie Maßnahmenempfehlungen hin, die aus Sicht landwirtschaftlicher Betriebe für die zukunftsfähige Entwicklung der Landwirtschaft ausschlaggebend sind. Hierbei kennzeichnend ist die Verknüpfung von ökologischen und sozialen Aspekten, welche inhärent für die Land(wirt)schaft im GVV Schönau sind. Damit geht sozial-ökologische Resilienzforschung in der Verknüpfung einen Schritt weiter als typische andere angewandten Forschungen. So weisen Barbisch et al. (2021) in ihrer Simulation zur Erhaltung einer Allmendweide im GVV Schönau auf die wechselseitigen Einflüsse von Besatzstärke und Herdenzusammensetzung aus Rindern und Ziegen sowie der Notwendigkeit zu dynamischen Anpassungen dieser an den Klimawandel hin. Kiefer et al. (2020) zeigen, wie die Wertschöpfungskette von Bio-Weiderindfleisch durch das Ineinandergreifen von Politik und Verwaltung, Produzierenden und Handel rentabel gestaltet werden kann. Aus der Perspektive unserer Untersuchung sollten soziale Aspekte (Einstellungen, Motivation, Netzwerke, Dynamiken) sowie die Governance stärkere Berücksichtigung im Management von Kulturlandschaften finden. Demnach sollten Entscheidungstragende nicht lediglich die auf Ökologie, Ökonomie oder Produktion bezogenen Ziele der Landwirtschaft ins Zentrum stellen, sondern vielmehr die Frage, wie das SÖS insgesamt unterstützt werden kann, um diese Ziele integrativ zu erreichen. Die sich in dieser Studie ergebende „zweigleisige“ Leitlinie, vorrangig kleinteilige Betriebsstrukturen zu erhalten, aber gleichzeitig auch größere Betriebe in ihrer wichtigen Rolle anzuerkennen und zu fördern, wird durch die Resilienzperspektive gestützt (Spears et al., 2015). Hieraus ergibt sich die Empfehlung, unterschiedlich ausgestaltete Betriebsmodelle zu ermöglichen und in diesem Zuge Unterstützungsangebote bereitzustellen und anzupassen, welche die Innovations- und Anpassungsfähigkeit der Landwirtschaft im Hinblick auf die bestehenden Herausforderungen stärken (Darnhofer et al., 2010). In Anbetracht der vielgliedrigen und für die Landwirtschaft bedeutsamen regionalen Governance könnte die Integration der Perspektive dieser regionalen Akteure zur Zukunft der Land(wirt)schaft zusätzliche Erkenntnisse liefern, um Ansätze für eine kohärente, partizipative und resilienzbewusste regionale Governance zu konkretisieren.

Eine praxisbezogene Schwäche von sozial-ökologischer Resilienz als normatives Leitbild für Land(wirt)schaft ist, dass diese schwer eindeutig zu bestimmen oder gar zu quantifizieren ist (Cabell & Oelofse, 2012; Plieninger et al., 2014). Im Mittelpunkt dieses Ansatzes steht ein fortlaufender Anpassungsprozess, kein einmal zu erreichender Zielzustand. Der Einsatz von sozialen, ökologischen oder ökonomischen Indikatoren der Resilienz eignet sich zur Veranschaulichung, zum Vergleich und zum Monitoring von Entwicklung (UNU-IAS et al., 2014), ist jedoch weniger zielführend, um direkte Maßnahmen abzuleiten. Es ist eine Herausforderung, konkrete resilienzsteigernde Maßnahmen aus

dem konzeptionellen Rahmen abzuleiten, da diese komplexe Sachverhalte berücksichtigen müssen (Park & Bieling, 2021) und nicht vorweg definierten Zielen folgen. Darüber hinaus birgt die Zielsetzung einer resilienten Land(wirt)schaft die Gefahr, den landwirtschaftlichen Betrieben sowie den weiteren regionalen Akteuren die Hauptverantwortung für die Kulturlandschaftserhaltung zuzuschreiben. So könnte durch die Fokussierung auf regionaler Resilienz die Aufmerksamkeit von der Notwendigkeit weglenkt werden, Störungen auf der überregionalen Ebene konstruktiv zu begegnen. Eine resiliente Landwirtschaft und regionale Governance nehmen zwar eine bedeutende Rolle ein, sie müssen aber komplementär und nicht fakultativ zu Anpassungen der überregionalen Rahmenbedingungen verstanden werden (Ashkenazy et al., 2018). Beispielsweise sind hier Land, Bund und EU gefragt, die Gemeinsame Agrarpolitik so auszugestalten, dass bestehende Inkohärenzen zwischen Agrar-, Naturschutz- und Forstpolitik beseitigt werden (Schoof et al., 2019).

6.3. Polyzentrische Governance als Kernelement eines resilienten Kulturlandschaftsmanagements?

Dieser Gedanke steht im Mittelpunkt des so genannten polyzentrischen Governance-Ansatzes, also der Verknüpfung unterschiedlicher Ebenen (z.B. in administrativer Hinsicht) und Handlungsbereiche (z.B. Landwirtschaft, Tourismus) der Entscheidungsfindung und -steuerung. Dieser als RP7 gefasste Ansatz stellt einen Kern-Beitrag der Resilienzperspektive zur Konzeption und Implementierung eines zukunftsgerichteten Kulturlandschaftsmanagements für den Südschwarzwald dar. Die empirischen Ergebnisse unserer Studie zeigen, dass der vernetzende Aspekt sich zwar in regionaler Governance und Maßnahmenvorschläge wiederfindet, hierbei jedoch außerlandwirtschaftliche Sektoren sowie überregionale Entscheidungsebenen wenig berücksichtigt werden. Auch hängen Effekte für eine größere Resilienz nicht (nur) an der Anzahl der einbezogenen Akteure, sondern vielmehr an der Tiefe und Qualität der Zusammenarbeit und des Austauschs – wichtig ist, dass der Governance-Rahmen hier eine entsprechende Ausgestaltung ermöglicht und fördert (Galaz et al., 2012). Daher sind Akteure, die lösungsorientiert und dynamisch agieren können oder sektorübergreifende Perspektiven ermöglichen, von besonderer Bedeutung. Die Landschaftserhaltungsverbände nehmen als Brückenorganisationen eine solche Rolle für die Verbindung von Landwirtschaft und Naturschutz wahr (Park & Bieling, 2021), der Naturpark sowie das Biosphärengebiet erweitern dies um die Aspekte der Regionalentwicklung und Bildung. Allerdings sollte die Governance das gesamte Spektrum an Akteuren berücksichtigen, welche von den Ökosystemleistungen der Land(wirt)schaft profitieren (Schoon et al., 2015). Im Südschwarzwald sowie in vielen europäischen (Mittel-)Gebirgslandschaften sind hier in erster Linie der Tourismus und die lokale Bevölkerung zu nennen, für die vor allem das Landschaftsbild, lokalen Erholungsmöglichkeiten und auch eine Identifikation mit der Region im Sinne von Heimat von großer Bedeutung sind (Krebs, 2014). Diese Akteursgruppen übernehmen bisher eine geringe Verantwortung

im Bereich des Kulturlandschaftsmanagements im Untersuchungsgebiet. Eine solche Verantwortung wird jedoch durch die lokalen landwirtschaftlichen Betriebe und Akteure bisher auch wenig bis gar nicht eingefordert. Dennoch gibt es in der Region bereits einzelne Initiativen, die zu einer gerechten Verteilung von individuellem Aufwand und allgemeinem Nutzen führen möchten. Die unmittelbar westlich an den GVV Schönau angrenzende Gemeinde Münstertal leitet seit Beginn der 2000er Jahre einen Teil der Einnahmen aus der erhobenen Kurtaxe an ziegenhaltende Betriebe weiter und schafft somit einen finanziellen Ausgleich für die Landschaftserhaltung (Liesen & Coch, 2015). Zudem finden in einigen Gemeinden des Biosphärengebiets Schwarzwald regelmäßige „Landschaftspflege-Tage“ statt, bei denen Freiwillige aus der Bevölkerung die Betriebe bei der Weidpflege unterstützen (Bieling & Konold, 2014). Eine weitere Besonderheit im Südschwarzwald, die an die Gemeinschaftsaufgabe der Allmenden anknüpft, sind die auf ehrenamtlichem Engagement beruhende Landschaftspflegevereine. In diesen beteiligen sich meist Anwohnende direkt an der Landschaftserhaltung durch Ziegenbeweidung (Brossette et al., in Druck). Im Südschwarzwald noch nicht verbreitet, aber ein gutes Beispiel dafür, wie auch Akteure aus der Wirtschaft eingebunden werden können, findet sich im Biosphärenreservat Rhön. Hier tragen regionale Unternehmen zur manuellen Bekämpfung einer invasiven Lupinenart bei (persönliche Mitteilung, Torsten Kirchner). Diese Initiativen gehen aus unterschiedlichen Initiativen der Kooperation öffentlicher oder zivilgesellschaftlicher Akteure und der Landwirtschaft zurück. Im Südschwarzwald bieten das Biosphärengebiet und der Naturpark mögliche Plattformen, um diese Aufgaben zu übernehmen und so die sozial-ökologische Resilienz der Land(wirt)schaft zu erhöhen.

7. Fazit für die Praxis

- Die Erhaltung der Allmendweiden sowie der damit einhergehenden Ökosystemleistungen sind in hohem Maße von der Landwirtschaft abhängig. Der Analyserahmen der sozial-ökologischen Resilienz verdeutlicht, dass landwirtschaftliche Betriebe eine zentrale Rolle für die Entwicklung zukunftsfähiger Lösungsansätze spielen, weil diese sowohl sozial als auch ökologische die Kulturlandschaft prägen und mit dieser verwurzelt sind.
- Die derzeit durch landwirtschaftliche Betriebe vorgeschlagenen Maßnahmen können sich positiv auf die Resilienz der Landwirtschaft im Biosphärengebiet Schwarzwald auswirken. Effekte sind hauptsächlich in den Bereichen Vernetzung, Lernen sowie Erweitern der Partizipation zu erwarten. Die sozial-ökologische Resilienz verdeutlicht, dass diese Maßnahmen nicht (nur) unmittelbare Effekte erzielen, sondern dass längere Wirkungsketten im Fokus der Praxis sein sollen, die im Sinne von „Langsamen Variablen“ längerfristige und tiefgreifende Effekte erreichen können.

- Über diese betrieblich vorgeschlagenen Maßnahmen hinausgehend ist für die Erhaltung der Allmendweiden ein polyzentrischer Governance-Ansatz zu stärken: (1) Maßnahmen sollten auf das Gesamtsystem ausgerichtet werden und insbesondere die Vernetzung zwischen unterschiedlichen Handlungsbereichen und Entscheidungsebenen stärken. (2) Die Angebote für die Betriebe aus der regionalen Governance sollten neben einer finanziellen Unterstützung auch ergebnisoffene und vernetzende Beratung beinhalten, die über die rein ökologischen oder produktionstechnischen Aspekte hinausgehen. (3) Weitere regionale und überregionale Akteursgruppen sollten in die Verantwortung genommen und in das Kulturlandschaftsmanagement eingebunden werden.

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PART IV – Article III

Title: Connecting resonance theory with social-ecological thinking: conceptualizing self-world relationships in the context of sustainability transformations

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Abstract

- 1) Relationships and interactions between humans and their environment play an important role for sustainability transformations. Their conceptualization, however, remains a big challenge in current social-ecological research. We propose resonance theory by the German sociologist Hartmut Rosa as a fruitful framework to advance social-ecological thinking. Resonance theory investigates the quality of the relationships between self and world and scrutinizes their relevance for transformations.
- 2) To illustrate the potentials of resonance theory, we use a vignette approach to cases of landscape stewardship in the Black Forest Biosphere Reserve in Germany.
- 3) In distinguishing between self and world and highlighting the role of relationships, resonance theory brings ontological and epistemological clarity, while overcoming a strict dichotomy between social and ecological. We find that resonance theory provides a much-needed framework to describe how system-wide transformations emerge from interactions and out of relationships at the individual level.
- 4) We argue that resonance theory contributes to social-ecological systems thinking by adding the notion of uncontrollability in transformations and shifting the debate on agency towards relationships.
- 5) Synthesis and applications: This paper demonstrates that meaningfulness of relational paradigms for real-world transformations in theory and practice.

1. Relationships in sustainability transformations

In the light of multiple sustainability challenges and interwoven social, economic and ecological crises (Lehmann et al., 2021; Persson et al., 2022), the debate on comprehensive transformations at individual, systems and global levels has gained momentum in science (Charli-Joseph et al., 2018; Steffen et al., 2018), politics (IPBES, 2019; United Nations, 2015) and society. In the field of sustainability science, social-ecological systems (SES) approaches consider sustainability issues as the interplay of social, economic, technological and ecologic elements and seek inter- and transdisciplinary understandings (Horcea-Milcu et al., 2020; Preiser et al., 2018; Westley et al., 2013). Processes of change in complex adaptive SES do not follow distinct patterns but are multifaceted and beyond

complete human understanding and control (Chambers et al., 2022; Hahn & Nykvist, 2017; Moore et al., 2014).

Despite the analytical and practical merits of social-ecological approaches in the last two decades, there is a need to better comprehend the processes leading to transformations (Blythe et al., 2018; Horcea-Milcu et al., 2020; IPBES, 2022; Pereira et al., 2020). In this respect, scholars highlight that SES thinking should make “hidden” qualities of these systems, such as motivations, values, norms, power relations or paradigms more explicit (Abson et al., 2017; Bieling et al., 2020; Chan et al., 2016; Charli-Joseph et al., 2018). The current debate seeks to improve the understanding of the relevance of social and social-ecological relationships for sustainability transformations and to propose conceptual clarity. “Leverage points” (Abson et al., 2017; Fischer & Riechers, 2019; Meadows, 1999), “embodied” (Raymond et al., 2018) and “relational” approaches (Jax et al., 2018; West et al., 2020) provide theoretical grounding. However, while acknowledging the conceptual advances these approaches imply, we see a gap in literature with regards to how relational approaches contribute to real-world sustainability issues.

This article investigates conceptualizations of transformations through self-world relationships and uses insights of resonance theory to infuse SES thinking. Resonance theory, established by the work of the German sociologist Hartmut Rosa considers the quality of relationships essential for transformations (Rosa, 2019). Characteristics of resonance, and consequently of transformations, are unpredictability and uncontrollability. Resonance theory has received acclaim in sociology, social-economy and popular science in the German speaking community (Rosa, 2022) but relatively little in sustainability sciences (Sommer, 2019) and within international scholarship (Keohane & Haugaard, 2020; Taylor, 2021). Recent papers by Artmann (2023) and Müller et al. (Müller et al., 2023) introduced resonance theory to provide valuable forms of knowledge in the context of social-ecological crises. We extend these considerations by exploring analytical and practical insights of resonance theory for SES thinking and transformations. This article illustrates resonance-based perspectives on social-ecological transformations, thereby adding to the conceptualization of self-world relationships in SES. To this end, we look at initiatives of landscape stewardship in the Black Forest Biosphere Reserve, Germany (Bieling & Plieninger, 2017; West et al., 2018). Landscape stewardship, a concept that links social, ecological and relational dimensions, enquires the motivations and initiatives that pursue sustainability at the level of cultural landscapes (Bieling et al., 2020; West et al., 2018). We make use of landscape stewardship to bridge the theoretical debates on transformations and relationships with requirements on the ground.

We ask the following research questions:

- How does resonance theory conceptualize self-world relationships, as compared to SES thinking?
- How does transformative change link to self-world relationships?
- What role does agency play for sustainability transformations in a resonance theory perspective?

To address these questions, we present our results in two sections, following the material and methods section. In section 3, we scrutinize conceptualizations of relationships in SES-thinking and contrast them to resonance theory. Furthermore, we present the axis of resonance as a typology to investigate relationships. In section 4, we apply aspects of resonance theory relevant to the debate on relationships in SES to vignette cases of landscape stewardship in the Black Forest Biosphere Reserve. In section 5, we bring together conceptual and empirical findings to explore how resonance theory contributes to the debate on sustainability transformations.

2. Material and Methods

The conceptual work in this article is based upon an analysis of relationships in SES and resonance literature. Given the comprehensive and interdisciplinary scope of literature on SES, we conducted a review of peer-reviewed literature on relationships and transformation in SES. In a first step, we searched for the key words “interaction”, “relation”, and “relationship” in the context of SES on the search engine Google Scholar. We gave special attention to publications engaging with relational approaches and care. To this end, we made use of the corresponding references and “cited by” features provided by Google Scholar and Scopus. Literature review, analysis and writing were conducted iteratively until conceptual considerations had been exhaustively addressed. In order to capture recent debates in SES literature, publication dates were used as a criterion to sort literature. The field of resonance theory is relatively clearly delineated and here we considered publications relating to resonance in a sustainability context. In addition to this, we incorporated literature that forms the basis for transformations in resonance theory. We made use of an iterative approach in reviewing and analysing literature, starting with a focus on relationships followed by transformations. The empirical part of this paper follows a vignette approach (Barter & Renold, 1999). Vignettes are examples of cases that allow one to substantiate theoretical and conceptual considerations (Knierim et al., 2021). The choice and presentation of the vignettes illustrates conceptual findings on self-world relationships. All cases represent initiatives of landscape stewardship in the UNESCO Black Forest Biosphere Reserve but differ in terms of their transformative scale and the quality of relationship they entertain within the SES. As “learning laboratories for sustainable development” (Ishwaran et al., 2008, p. 118), Biosphere Reserves take up an exemplary role to conciliate social and ecological dimensions of sustainability, in particular human-nature relationships (Negev et al., 2019; Schultz et al., 2018). The

vignettes' presentation relies on the authors' in-depth knowledge and lived experience within the area. Both conduct research in inter- and transdisciplinary sustainability research in the Biosphere Reserve (literature has been taken out for review process to enable double-blind review, literature will be added after peer-review) and live adjacent to it. The main author (initials will be added after peer review) works for the reserve's office with a focus on sustainable grazing. Additionally, we made use of grey literature (newspaper articles, websites, and reports) and personal correspondence to illustrate the vignette cases. For all vignettes included here, interlocutors consented in writing to be included in this study. Drafts of vignette cases' presentations were sent to interlocutors for feedback, so that they could acknowledge, alter or confirm the description and interpretation given in this publication.

3. The role of relationships for transformations in SES

3.1. Challenges for relationships in SES thinking

SES thinking and frameworks stem from the very recognition that interactions of and processes from humans and their environment are essential for analysing sustainability challenges but also for enabling transformations (Berkes et al., 2003; Levin et al., 2013; Riechers et al., 2021). Differences in SES literature exist in terms of the framings of these realms, how entities are categorized, as well as whether authors rather focus on social or ecological aspects (Anderies et al., 2004; Binder et al., 2013, 2013). There are, however, two aspects to SES conceptualisations that are recurrent in and for transformation literature: (1) the diversity of interactions and relations existing between and within social and ecological realms as being central for social-ecological transformations (Schlüter et al., 2019), (2) the claim of human and nature as being inextricably interconnected (Liu et al., 2007).

Despite the conceptual and practical merits of SES thinking, there is an emerging debate concerning the capacity of "classic" SES frameworks to inform sustainability-directed transformations. These concerns include how theoretical and analytical aspirations are brought together in SES thinking (West et al., 2020), whether it tends to consider the quality of relations inadequately (Raymond et al., 2018), or whether it is deterministic about processes of transformations (Chambers et al., 2022; Moore et al., 2014). The emergent debates on "leverage points" (Abson et al., 2017; Fischer & Riechers, 2019; Pérez-Ramírez et al., 2021; Riechers et al., 2022), "relational" (Walsh et al., 2021; West et al., 2018, 2020), "embodied" approaches (Artmann et al., 2021; Manheim & Spackman, 2022; Raymond et al., 2018) or "care" (Enqvist et al., 2018; Jackson & Palmer, 2015; Puig de la Bellacasa, 2017; Singh, 2015) follow a different impetus and have distinct perspectives on social-ecological processes. However, they coincide in advocating for a better consideration of the quality of interactions and relationships in SES thinking. Following West et al. (2020), we use the term "relational turn" in referring to this rich strand of emergent social-ecological literature and to scrutinize existing deficits in classical SES frameworks.

A fundamental critique of the relational turn within SES concepts addresses their theoretical grounding and methodology. By aiming at a broad integration of human and non-human entities and phenomena, they lack ontological (i.e. beliefs about the nature of reality) and epistemological (i.e. theories to represent reality) lucidity (Abson et al., 2017; Raymond et al., 2021; West et al., 2020). Explicit ontologies of SES, such as “intertwined” (Folke et al., 2016; Preiser et al., 2021) or “inextricable” (Martín-López et al., 2017) contradict with analytical proceedings that tend to separate between the social and the ecological spheres (Binder et al., 2013; Hinkel et al., 2015). The relational turn transcends this division by paying attention to the diverse relationships between humans and nature (Hertz et al., 2020; Mancilla García et al., 2020). It claims to adhere to a non-dualistic approach towards human-nature connectedness, which is key for sustainability transformations in science and practice. Corresponding literature advocates a focus on “the web of relations which exist between mind, body, culture and the environment” (Raymond, Giusti, and Barthel 2018, 791) and calls for better reflection of practices such as care or mindfulness to collapse socially constructed distinctions between human and nature (Singh 2015; Puig de la Bellacasa 2017; Deleuze and Guattari 1987).

Derived from this, another deficit concerns the indistinct terminology to describe and analyse processes within SES. In the literature, we found that notions such as “interactions”, “relations” or “relationships” are often used synonymously, but can imply varied and context-specific qualities of association or affection between focal entities (de Vos et al., 2019). While “interaction” describes reciprocal action or influence free of value, “relation” or “relationship” imply a qualitative attribution of influence, e.g. positive (affiliative) or negative (antagonistic). Consequently, “relation” and “relationship” hold a normative component. Whether this wording is restricted, per se, to processes comprising human agency or, per alia, permitting non-human agency depends on the underlying ontologies. A distinction between “relation” (the manner in which things are associated) and “relationship” (the condition of being associated) in their deployment in SES is, due to converging meaning, more subtle. Here, we do neither want to claim hidden meanings in the vocabulary, nor an improper use of words in in SES research. Instead, we refer to the idea that the words we use to describe interactions and relations can be helpful in better understanding what we are actually referring to (Hertz et al., 2020).

In fact, the relational turn argues that the meaning of cognitive and emotional experiences such as emotions (Slaby, 2016), the connectedness of mind, body and culture (Raymond et al., 2018), or power structures (Boonstra, 2016) are still underexplored and need further development in SES thinking. SES frameworks acknowledge the importance of cognitive and affective aspects, such as relationships, in social-ecological processes but integrate them insufficiently in SES frameworks (Gray et al., 2019; Jones et al., 2016; Masterson et al., 2017). For this reason, we seek to give specific attention to the qualitative processes that make up relationships within SES.

The aspects mentioned so far lead the relational turn to identify a deficit in conceptualisations of transformations in SES frameworks (Charli-Joseph et al., 2018; West et al., 2020). SES-frameworks have a tendency to elicit frame conditions that enable or favour transformations (Chambers et al., 2022), assuming that that transformations are deliberate but non-linear in their course (Goldstein et al., 2010; Moore et al., 2014). Questions of how system-wide transformations emerge from interactions and out of relationships at the individual level is of theoretical and practical relevance. O'Brien and Sygna (2013) posit that transformations occur in three interdependent spheres: (1) the personal, in which individual believes or values are shaped; (2) the political, in which political power shapes legal, economic and socio-cultural systems; and (3) the practical, where outcomes of transformations translate in changes of strategies and practices. Correspondingly, van Wijk et al. (2019) describe three cycles in social innovation: (1) the micro cycle, in which emotions and reflexivity enable agency; (2) the meso cycle, in which processes of negotiations and co-creation embed innovations in the context of the SES; (3) the macro cycle, in which innovations become part of broader societal institutions. These considerations are in accordance with conceptions of radiating and interlocked transformations, i.e. where those at the individual level precede those at the system level (Biggs et al., 2010; Eakin et al., 2019). The relational turn argues that there is a requirement for better conceptualizing and integrating these perspectives and show how the processes from individual to systems' level are linked (Blythe et al., 2018; Charli-Joseph et al., 2018; Hahn & Nykvist, 2017).

The relational turn has introduced two important arguments on leverage points and agency, that we briefly seek to introduce here.

First of all, the current debate on leverage points illustrates the stance of governance in SES. Based on Meadow's (1999) essay, the leverage points perspective (Abson et al., 2017; Meadows, 1999) postulates a hierarchy of possible interventions according to their transformative potential in SES. As an example, interventions aiming at changing mechanistic characteristics and feedbacks within a system are considered less effective than those targeting social structures or underlying values. Thus, the leverage points perspective argues for a better consideration of relational aspects in practical governance of SES (Fischer & Riechers, 2019; Riechers et al., 2022)

Secondly, the relational turn challenges assumptions of agency as central for sustainability transformations. SES thinking conventionally reserves the ability to bring about change to the social (sub-)systems (Binder et al., 2013; Davidson, 2010). The relational turn challenges these assumptions (Stone-Jovicich, 2015; West et al., 2018). By dissolving the clear distinction between human and nature, agency is extended beyond the human realm. Non-human entities, such as animals, plants or physical conditions are acknowledged to initiate transformations as well (Latour, 2007; Puig de la Bellacasa, 2017; Singh, 2015).

Notwithstanding the theoretical lucidity of the current debate on ontology, epistemology and agency it is far less clear how the relational turn translates into empirical analysis of complex social-ecological systems. For this reason, we introduce resonance theory with the goal to exemplify and apply considerations of transformations held in SES thinking.

3.2. Resonance theory

In his 2019 book “Resonance : a sociology of the relationship to the world”, Hartmut Rosa investigates the social and environmental conditions that enable or hinder meaningful relationships between self and world (Rosa, 2019). Following a Critical Theory tradition, resonance theory questions dominant socio-political power structures, which lead to alienation and thus drive the current sustainability crises (Brand & Wissen, 2018; Rosa, 2015; Taylor, 2021). Rosa’s conception of resonance as a specific mode of relationship to the world (cf. Box 1) allows a twofold understanding of resonance. As an analytical tool, resonance theory seeks to describe a ubiquitous human need: to develop subjectivity and intersubjectivity through the establishment of responsive and meaningful (i.e. resonant) relationships. As normative concept, resonance becomes a criterion for a good life (Rosa, 2019).

Resonance theory operates within the subject-object duality to conceptualize self-world-relationships. Following Charles Taylor (1989, 2007) and phenomenological thinking, Rosa posits that subject and world constitute one another. “What and how a subject is can only be defined against the backdrop of a world in which it is placed and to which it finds itself related; in this sense, one’s relation to oneself cannot be separated from one’s relation to the world. Subjects thus do not stand opposite to the world, but rather find themselves always already in a world with which they are interconnected and interwoven” (Rosa, 2019, p. 33). World, in this perspective, is an open term that includes human and non-human entities that operate outside the sphere of the self.

It is the very ontological recognition of self and world as different but interdependent entities that allows focusing on the quality of relationships. This recognition translates into a coherent epistemology, in which resonant relationships are conceptualized as bridging the gap between self and world.. Resonance theory acknowledges that resonance cannot be established deliberately. However, Rosa shows, that “contextual, institutional and cultural conditions of action and encounter” (2019, p. 381) mediate our relationship. Striving for socio-political conditions favourable to resonant self-world relationships, constitutes the normative impetus of resonance theory.

Resonance describes tangible self-world relationships in which subject and world are mutually affected and transformed. The term is borrowed from physics, describing vibrations between receptive subjects and objects. According to Rosa (2020:398) the following elements define resonant relationships (adapted by the authors of Article III).

1. *Af←fection*: A subject (or an entity more general) feels 'called upon' and is touched, moved or gripped by something or someone 'out there', as part of the world he or she encounters.
2. *E→motion* or *Self-Efficacy*: The subject responds to this affection in a self-efficacious mode of reaching out and touching or influencing the object or entity encountered.
3. *Transformation*: In this dynamic, two-way process of encounter, both sides – self and world – are transformed to some extent. Hence, resonance is not about the affirmation of identity, but rather about its transformation.
4. *Uncontrollability* (German: *Unverfügbarkeit*): Resonance in this sense is essentially open ended, i.e. uncontrollable and unpredictable in two respects: Firstly, it is constitutionally impossible to predict or deliberately establish its occurrence, and secondly, if it happens, it is impossible to predict or control the outcome or result of the unfolding transformation.
5. *Mutuality*: Resonance can be established only in mutually accommodating resonant spaces, i.e. of the appropriate temporal, spatial, social, physical and psychical conditions. (In Rosa's view, this point should be considered a precondition, rather than an element of resonance).

Considering these principles, resonance is irrespective of the emotional content that relationships feature. This implies that resonant relationships are not necessarily harmonic or consonant per se. In fact, resonance often requires friction, difference or alienation in order to become tangible. This requires that both subject and world need to be self-consistent "so as to each speak in their own voice", while remaining permeable "to be affected or reached by each other" (Rosa 2019:174). As such, modes of relationship that contain the unknown or exhibit sadness also have the potential of bearing resonance. In a similar way, resonance can become apparent through confrontations with the mute and alienated.

Box 1: Definition of Resonance. Adapted from Rosa (2019; 2020, 398).

Another inherent aspect of resonance theory concerns the affective and evaluative processes along which social processes align, potentially providing advancements for the conceptualisation of social-ecological transformations. Taylor's concept of "strong" and "weak" evaluation (Taylor, 1976, 1989), human behaviour is a constant balancing of "what we ought" and "what we want" to do. In this sense, strong evaluations serve as moral principles of what constitutes a good in life and of what we aspire to, whereas weak evaluations consist of our short-term needs. In practical life, our moral compass and our desirous do not always align. For resonance, however, it is characteristic that strong and weak evaluations are in line. As humans seek to accomplish this alignment, important questions for resonance theory include: how strong evaluations evolve and change over time and what this implies for our ability to develop meaningful self-world relationships. In fact, Taylor (1976) argues that strong evaluations are not chosen but acquired by social practices throughout the course of life. Such practices include widespread societal drivers such as personal accomplishment, growth, but also to take care of the environment (Meyfroidt, 2013; Puig de la Bellacasa, 2017; Rosa, 2015). Resonance theory's perspective contributes to the debate on sustainability transformations by arguing that changes within the web of strong evaluations occur foremost through "strong experiences of resonance" (Rosa, 2020, p. 409) rather than through critical reflection.

The dimensions in which self-world relationships are continuously being established depends on the quality of the object, to which the self relates. Consequently, Rosa suggests analysing and pursuing resonance along the “axes of resonance”, i.e. three spheres that differ with respect to the quality of relationships: “horizontal” for social relationships, “diagonal” for relationships to the world of things, “vertical” for relationships to the whole (cf. Table 1).

Table1: Axes of Resonance. Adapted from Rosa (Rosa, 2019).

Axes of Resonance	Exemplification of Resonance Axis
Horizontal – social relationships	Family Friendship Politics
Diagonal – relationships to the world of things	Objects Work School Sports Consumption
Vertical – relationships to the whole	Religion Nature Art History

Rosa further substantiates these considerations in his conception of transformations, which addresses both self and world through their established relationships (cf. Box 1). By pointing to sociological work on religion (Durkheim, 2008; Latour, 2009), the political debate (Habermas, 1984) and music (Goebel, 2021), Rosa exemplifies how situational experiences of resonance spread from the individual to the collective. Following Durkheim’s framing of “collective effervescence” (Durkheim, 2008), Rosa points to moments in which “the attention and emotions of those who participate in it come together and mutually reinforce each other” (Rosa, 2019, p. 197). This is exemplified in Durkheim’s (2008) analysis of religious rituals as manifestations of the power of the collective (2008). The congregation gathers in order to connect with a higher power (vertical resonance), selected objects are credited with transcending powers (diagonal resonance) and collective consciousness is sustained (horizontal resonance) (Rosa, 2019).

4. Empirical insights

4.1. Vignette cases in the Black Forest Biosphere Reserve

The Black Forest biosphere covers an area of 632km² in the southern part of the eponymous mountain range in south-west Germany. As a Biosphere Reserve, the area is committed to the UN sustainability agenda and is ambitious in promoting transformations (Brockamp et al., 2016; Reed, 2019). A

prominent feature and assignment of the Black Forest is mosaic landscape with varied patterns of grasslands and forests. Pastures are in common property. Next to their cultural and touristic meaning for the region, pastures are a biodiversity hotspot (Bieling & Konold, 2014). These functions can only be sustained through continued adapted grazing (Bieling & Konold, 2014). However, extensive grazing is unprofitable (Black Forest Biosphere Reserve Office, 2021). The number of farmsteads has decreased by half in the last 40 years but remains predominantly small-scale (Statistics Office of Baden-Württemberg, 2021). Various initiatives exist to address the social-ecological challenges the Biosphere Reserve is facing. Cases 1 to 4 (cf. Boxes 2-5) present a subset of these initiatives of landscape stewardship to illustrate possible contributions of the resonance perspective on SES thinking along the axes of resonance, self-world transformations, uncontrollability and the leverage points perspective. Table 2 provides an overview of the vignette cases.

Table 2: Vignette cases: Resonance perspective on initiatives of landscape stewardship in the Black Forest Biosphere Reserve.

Cases	Dominant axis of resonance	Exemplification of relationship	Considerations in SES thinking
1. "Weidgemeinschaften" - traditional grazing collectives (Box 2)	Horizontal	Traditional collective landscape stewardship	Transformations of self and world (O'Brien & Sygna, 2013)
2. "Geiße Buure Atzenbach" - reinventing collective grazing (Box 3)	Horizontal	Emerging collective landscape stewardship	Uncontrollability of transformations (Folke et al., 2010; Moore et al., 2014)
3. "Kulinärische Hinterwälder Wochen" - tasting the landscape (Box 4)	Diagonal	Commodifying cultural landscape	Leverage points perspective (Abson et al., 2017; Riechers et al., 2021)
"Theater in den Bergen" - an artistic perspective (Box 5)	Vertical	Appealing to existential sphere of cultural landscape	Transformations of self and world (O'Brien & Sygna, 2013)

4.2. Axes of resonance

Resonant relationships within a group of people, or for people with animals, plants, at cultural landscape, pasture products or nature as a whole characterize the proposed vignettes of the Black Forest Biosphere Reserve. An analysis of these relationships along the axes of resonance allows one to identify the connectedness within this SES. Horizontal resonance is evident in initiatives of collective landscape stewardship. Maintenance of long-established relationships (cf. Box 2) and the formation of new ones (cf. Box 3) within the local community rely on the social and ecological importance of the cultural landscape and, at the same time, sustain it. Diagonal resonance stands out in the commodification of the cultural landscape in foodstuff (cf. Box 4). The range of landscape-experiences extends from contemplation to taste and appropriation. The artistic approach to landscape sustenance (cf. Box 5) makes vertical resonance tangible. Comprising a legacy of relationships between people and

nature, the Black Forest landscape is not only scenery but also an integral part of dramaturgic performances that potentially appeal to the participants' existential sphere.

Small-scale farmers traditionally federate in common pasture organizations (“Weidegemeinschaften” in German) to collectively graze the sweeping pastures of the Black Forest Biosphere Reserve. Functions and roles of pasture organizations have co-evolved with socio-economic changes in the last decades. While a main task was to prevent over-exploitation until the middle of the 20th century, the role shifted towards maintaining pasture activities. Changes in the agricultural policy after 2002 necessitated formal re-organizations of pasture organizations to be eligible for financial support.

Members' commitment to common pasture organizations nowadays is due to the conviction that demanding landscape stewardship activities can be best accomplished collectively. Many families have contributed over generations within the same pasture organizations. While some have dropped out after having given up farming, only a few remaining common pasture organizations incorporated new members or merged with neighbouring organizations. Organizations specifically engage in landscape stewardship in joint work activities, such as clearing encroachment, renovation of infrastructure, or herd management. Members also contribute individually to the community, e.g. in checking on cattle. This allows for flexibility for all members. Thus, pasture organizations maintain and transform the creation of inter- and transgenerational connectedness of farmers, pastures and cattle.



Box 2: Case 1 – “Weidegemeinschaften” - traditional grazing collectives. The picture depicts a typical landscape image of the Black Forest Biosphere Reserve and the Hinterwälder cattle. Grazing is a requirement to sustain this landscape. Picture: Florian Brossette.

4.3. Process of transformations

Landscape stewardship initiatives feature empirical indication of how transformations of the self extend to the world. The vignette of landscape-based theatre (cf. Box 5) exemplifies the potential of collective resonance. In the setup of performances, in which local amateurs perform as artists walking together with the audience through the landscape, the distinct separation between audience and actors collapses. The audience is invited to actively engage with the play rather than to remain passive observants. Artists, audience and the cultural landscape participate in the becoming of aesthetic events that appeal to strong evaluations in the sustainability context. Thus, context-specific situations emerge where resonant relationships among landscape, artists and the audience are made possible.

In contrast to this, the commercialization initiative (cf. Box 4) builds on the combination of gustatory (bodily) and informational (cognitive) stimuli to enable resonance. In the vignettes of practical landscape stewardship (cf. Box 2 and 3), it is the meaning that the cultural landscape and grazing practices hold which induces individual and collective commitment. Through practices of collective stewardship, long-lasting relationships are renewed and new ones emerge. As individual benefits of grazing are small compared to the societal gain, these activities are conditional on meaningful relationships.

The continuation of landscape stewardship in the locality Atzenbach has become a challenge due to the diminishing number of farmers. Furthermore, a too high workload forced the last farmer to reduce the size of his pastureland in May 2022. As this change was discussed within the community, locals sought solutions to sustain grazing. Within a couple of months, a group of people came together and decided to collectively engage in landscape stewardship. Inspired by other grazing initiatives in the Black Forest Biosphere Reserve, the group in Atzenbach seeks to commonly take care of a goat herd as of 2023. An association called “Geiße Buure Atzenbach” (in the local dialect for “goat peasants Atzenbach”) was formed in autumn 2022. Nine members from different age groups and with varying pasture experience decided to join the association. Another 40 people joined the association as passive members, providing financial and moral support.

The Geiße Buure not only seek to jointly maintain the landscape, but also to transform the perception of landscape stewardship within the region. They view this initiative to sustain the cultural landscape as a shared engagement of pleasure rather than an individual burden. In order to reach a broader public awareness, they plan further activities like social media campaigns, excursions for children or sponsorships of goats.



Box 3: Case 2 - “Geiße Buure Atzenbach” - reinventing collective grazing. The picture depicts a gathering of association members in the goat barn in winter 2023. Picture: Sarah Trinler.

4.4. Uncontrollability of transformations

Landscape stewardship initiatives bear no guarantee for resonance. In fact, the number of people engaging in landscape stewardship decreased in the last century concomitant to declining farm numbers despite the social and ecological significance of farming. The emergence of landscape initiative supports the theoretical claim that resonance (and consequently transformations) is

uncontrollable and unpredictable. Both modern common grazing (cf. Box 3) and commercialization weeks (cf. Box 4) are due to the involvement of different people and fitting social-ecological conditions. The establishment of a grazing association in Atzenbach is the consequence of spontaneous encounters and the ability to bring together a large enough number of participants. The process neither has been planned nor was its current outcome foreseeable. Likewise, it remains to be seen, if the initiatives will succeed in maintaining the Black Forest cultural landscape.

The “Hinterwälder Rind” is an endemic cattle breed in the Black Forest Biosphere Reserve. It co-evolved with the social-ecological system over time. Compared to other cattle breeds, Hinterwälder are rather small, sturdy and make do with nutrient-poor fodder. As a dual-purpose breed, Hinterwälder match the requirements of subsistence farming, supplying families with milk and meat. However, they are less productive. As a consequence, the number of Hinterwälder cattle has decreased dramatically in the 20th century.

The Hinterwälder cattle is valued for its social-ecological meaning within parts of the farming community. The Biosphere Reserve office has requested to contribute to the preservation of the breed. Following discussions with farmers, meat processors, food retailing and the gastronomy, a commercialization initiative “Kulinarische Hinterwälder Wochen” (“culinary Hinterwälder weeks” in English) was launched in 2019. Since then, during two weeks in autumn, local restaurants propose Hinterwälder dishes on their menu. Slaughter prices exceed the regular market prices. The Biosphere Reserve offices takes care of organization, marketing, training and quality management, setting minimum prices, and enabling low-stress slaughtering. Farmers, restaurateurs and Biosphere Reserve officials equally contribute to calling the public’s attention to the social-ecological importance of regional grazing in a way that reaches more people every year. Information is provided through excursions, booklets, online and in teaching material.



Box 4: Case 3 - „Kulinarische Hinterwälder Wochen“ - tasting the landscape. The picture shows a tasting event for initiative in the biggest city, Freiburg. Restaurateurs, farmers and the Biosphere Reserve explain the connection between the cattle and the cultural landscape. Picture Barbara Schneider.

4.5. Leverage points perspective

Other than hands-on contributions to landscape stewardship, the vignettes presented here aim at transforming underlying characteristics of the Black Forest SES. Following the insights of the leverage perspectives, effective and long-term sustainability transformations are achieved by changes in intent, goals and paradigms that constitute a system. The vignette case of the commercialization weeks of

Hinterwälder cattle (cf. Box 4) illustrates how practical interventions and changes in mindset go hand in hand through resonance. Both farmers and restaurateurs capitalize on the marketing initiative. By reaching out to restaurant visitors, the initiative strengthens the awareness of the importance of landscape sustenance and appreciation for farmer's products. The commodity meat is assigned with social-ecological meaning that enables resonant relationships between farmers, restaurateurs, visitors and the landscape. As the initiative aligns weak (i.e. exquisite meat, enjoying landscape) and strong evaluations (i.e. preserving SES), it could be an option to change the underlying paradigms of the Black Forest Biosphere Reserve.

Since 2011, the theatre-ensemble "Theater in den Bergen" ("Theatre in the mountains" in English) proposes open-air performances. Every year, new plays are created and performed, usually on common pastureland of the municipality Hög-Ehrsberg in the Black Forest Biosphere Reserve. During the performances, artists and audience walk through the landscape as the play evolves. Landscape features such as hedgerows, emblematic trees or certain views serve as both scenic backdrops and content illustrators for the plays' topics. Thematically, Theater in den Bergen addresses sustainability issues of relevance both at the local and at the broader level. While navigating comical and serious elements and bringing them together into a storyline that engages with people's realities, the plays appeal to the audiences' capacity to bring about change. In a 2019 play on the topic of insect mortality, different insects were used as stereotypes to illustrate detrimental relationships between humans and their environment. For 2023, the initiative plans to explore the human relationship to water, following a severe drought in the past summer.

Theater in den Bergen offers different possibilities for public engagement. Next to professional actresses and actors, amateurs of different age-groups participate in the plays. Spectators integrate into the play as they are part of the scenery. The distinction between artists, spectators and the landscape slowly dissolves as the play unfolds and progresses. Both young and elderly locals truly value Theater in den Bergen, which has resulted in repeated sold out performances.



Box 5: Case 4 - "Theater in den Bergen" – an artistic perspective. The picture shows a typical scene during a performance. Folding stools allow the audience to follow changes in scenery and to change their own perspective. Picture: Kristoff Meller.

5. Resonance theory in sustainability transformations

5.1. Conceptualizing self-world relationships

SES thinking and resonance theory alike provide analytical perspectives in the context of sustainability transformations. While resonance emphasizes the quality of self-world relationships, SES perspectives incorporate diverse interactions to illustrate emergent phenomena (Moore et al., 2014; Olsson et al., 2004; Walker et al., 2004). As SES thinking allows for eclectic frameworks and methods, theoretical groundings vary and remain at times ambiguous. The relational turn has addressed the shortcoming of classic SES thinking to inadequately consider human-nature relationships (Fischer & Riechers, 2019; Maas et al., 2022; Pérez-Ramírez et al., 2021). Furthermore, the relational turn seeks to overcome the epistemological versus the ontological divide identified in SES frameworks by adopting a non-dualistic stance: assuming that humans inherently are nature and vice versa (Raymond et al., 2018; West et al., 2021). As such, the relational turn suggests to analyse “the web of relations which exist between mind, body, culture and the environment” (Raymond et al., 2018, p. 791) and to focus on practices such as care or mindfulness to collapse socially constructed distinctions between human and nature (Deleuze & Guattari, 1987; Puig de la Bellacasa, 2017; Singh, 2015).

Following Rosa (2019), we are concerned that positing the unity of human and nature as well as self and world leads to conceptions that struggle to address real world problems in the context of sustainability transformations. First, because self-cognition occurs against the backdrop of the world; second, because distinguishing between entities is necessary to bring about change.

These considerations of Resonance theory overcome the dichotomy present in classic SES frameworks by highlighting the idea of relationships for and within transformations, while maintaining the need to distinguish self and other for enabling transformations (Artmann, 2023). In focussing both theory and analysis on the quality of relationships between self and world or human and nature along distinct axes, resonance theory provides an analytical framework that enunciates assumptions inherent of SES thinking. The axes of resonance direct a specific analysis in which self and world relate to one another. The awareness of whether experiences of resonance extend to the social, material or existential realm informs about possible starting points for facilitating sustainability transformations. This goes without saying that narrowing down relationships to one axis of resonance falls short in the face of the complexity of interactions. In the vignette cases of landscape stewardship, all initiatives rely on social connections (horizontal axis), engage with objects they aim to appropriate, affect or take care of (diagonal axis), and seek existential meaning in the cultural landscape (vertical axis). Exploring the diversity and mutual composition of emotionally charged relationships along one or several axes of resonance remains a challenge for resonance theory that needs further empirical applications (Rosa, 2020).

5.2. Transformations of self to the world

SES thinking and resonance theory agree upon the central role that interactions, relations or relationships take on in enabling, navigating and stabilizing transformations (or its new, transformed, state). However, the perspectives of SES thinking and resonance theory differ with respect to their emergence, process or the role that different parts of SES play. One major distinction concerns the perception of how transformations come about. In SES, transformations are thought of as originating in deliberate action (initiated by people looking for change) or forced upon (imposed by changing natural or socio-economic conditions) (Folke et al., 2010). The acknowledgment of (complex adaptive) systems thinking (Kotschy et al., 2015; Schlüter et al., 2019) immanent to SES thinking is causative for conceptions of transformations: different levels (local to global) (Smith & Raven, 2012) and realms (social, social-ecological) (Schlüter et al., 2019) of transformations; interrelations and cascades of transformations (Folke et al., 2010); and cross-scale transformations (Westley & Antadze, 2010).

In contrast, resonance theory considers transformations inherent to the experience of resonance (cf. Box 1), in a way that resonance precedes transformative outcomes. Transformations, as the processes in which the relationship and encounter between self and world allow for mutual change, are essentially uncontrollable and unpredictable (Artmann, 2023; Müller et al., 2023). Instead, Rosa (2019) points to the relevance of socio-cultural conditions that charge and enable axes of resonance to bear their transformative potential.

These perspectives are not fundamentally incompatible, in particular when acknowledging the broad conceptual background and practical impetus of SES thinking. Resonance theory's point of origin is the transformations of selves, while SES thinking inherently focusses on systemic transformations. The former informs about the initiating processes leading to the latter (Eakin et al., 2019; O'Brien & Sygna, 2013). In fact, the focus of resonance on the quality of relationships makes the indistinct assumption of SES thinking of self-world transformations explicit. Exemplifications of self-world transformations on a relationship-based approach refer to vertical resonance, i.e. relationships that appeal to our existential sphere (Durkheim, 2008; Goebel, 2021; Latour, 2009; Rosa, 2020). Moments of collective effervescence, in the sense of shared experiences of resonance, arise when strong social-ecological relationships and collective activities lead to feelings of being deeply touched or called-upon (Rosa, 2019). This is further supported by Rosa's reasoning that it is strong experiences of resonance that can transform our strong evaluations, i.e. the moral roadmap of what is considered desirable individually and collectively (Rosa, 2020; Taylor, 1989). Under this perspective, resonance theory and experiences illustrate what the leverage perspective refers to as "deep leverage" (Fischer & Riechers, 2019).

From an empirical perspective, all vignette cases of landscape stewardship presented in this article exhibit evidence of self-world transformations. The extent of world that becomes part of transformational changes, i.e. the extension from an individual to a group of people or the SES at large.

Reviewing further case studies on collective transformations in SES from a resonance axes' perspective could help to refine the integration of resonance theory into SES thinking.

5.3. Embracing uncontrollability

A key aspect of resonance theory is the acknowledgement of transformative processes as uncontrollable and unpredictable. Rosa (2020, p. 413) uses the German term "Unverfügbarkeit" to point to the impossibility of predicting the occurrence and outcome of resonance as a key aspect of transformations. Rather than calling for action and control to address sustainability issues, resonance requires porosity and self-consistency to be mutually affected. We argue that this call for open self-world relationships is currently underrepresented in sustainability transformations thinking.

This uncommon perspective opens the debate on the role of institutions and governance for transformations. While SES scholars highlight the role institutional settings play in implementing transformations (Moore et al., 2014; Westley et al., 2013), resonance theory sees the role of institutions to enable or favour resonant self-world relationships (Artmann, 2023; Rosa, 2019). Integrating this view does not mean to downplay the importance of institutions. Instead, it points to resonant relationships existing in spheres of self-world connections that remain hidden to or out of the scope of institutional arrangements (Müller et al., 2023). To illustrate this in the context of our case study, the Biosphere Reserve's office provides an institutional framework to favour sustainability transformations by federating different actors around the commercialization of the Hinterwälder cattle. However, the relationships that evolve within this setup towards transformations are outside the reach of institutional control.

Acknowledging the uncontrollable character of transformations provides insights into the debate on agency within SES. Unlike SES thinking, resonance theory, per se, is not concerned with human agency but conceives differences between self and world or human and non-human entities through the quality of relationships established. In this sense, sustainability transformations occur when changes in the world are mediated through the experience of resonance. Questions of causality and responsibility, present in SES thinking, thus becomes one of "responsibility" (Rosa, 2020, p. 411) between self and world. If landscape stewardship rather relies on people's intrinsic dedication or if it emerges through encounters with the landscape, landscape products or theatre events has limited relevance for the Black Forest cultural landscape. Instead, the key argument of resonance theory is that the reflexive encounters of self and world (both human and non-human) precondition transformations towards sustainability. This suggests a shift in the perspective from agency to the quality of temporally evolving relationships.

6. Conclusion and outlook

SES thinking and resonance alike are concerned with sustainability transformations in theory and practice. Resonance theory informs of the quality of self-world relationships relevant for the systemic perspective of SES thinking. By providing ontological and epistemological clarity, resonance reconciles the critique of the relational turn with classic SES thinking. Moreover, by conceptualizing the process of self-world transformations and stressing on the notion of uncontrollability, resonance provides new perspectives for SES thinking. As such, it resolves the debate on agency by moving it towards the quality of relationships. Although resonance theory focusses at the level of self and world, we argue that the approach is transferable to the systems' perspective. For this, further work is needed to show how contextual, institutional and cultural conditions that foster or inhibit resonance can be integrated into relational paradigms.

With respect to resonance theory's suitability for bringing together scientific, political and societal powers, we affirm West et al.'s (2020) concern to explore and articulate potential contributions of resonance to the sustainability crises. There is a particular need to empirically investigate resonance along the axes of resonance in cases of sustainability transformations. The vignette cases of landscape stewardship in the Black Forest Biosphere Reserve served to illustrate the relational diversity that touches upon distinct types of relationships such as social relationships or relationships to the landscape. However, it omits the interconnectedness between these axes that contribute to change. Also, power-relations, strongly recognized in SES thinking (Boonstra, 2016; Lahsen & Turnhout, 2021) and resonance (Fuchs, 2020; Rosa, 2020) are ill-portrayed. Prevailing assumptions on the origins of transformations in SES literature largely rely on ex-post investigations, as is the case in this article. Ethnographic approaches that focus on the process of emerging resonance could provide insights into self-world transformations that are much needed in science but also in practice.

During the course of working on this paper, we became aware that resonance theory might have theoretical and practical implications for sustainability transformations that we could not cover in our research approach. Resonance is not a mere theoretical construct but also a mental and embodied experience. Resonance can be felt as being touched, moved or called upon. Firstly, this aspect could be considered as a means but also an ends of sustainability research, as moments of understanding are often characterised by resonance. This could also mean to reflect upon how material and methods employed relate to another for eliciting resonant relationships of those contributing to or benefiting from research. Secondly of all, resonance theory bears the potential of serving as a boundary object (Star & Griesemer, 1989). Boundary objects are concepts and approaches that exhibit discursive power to transcend science, such as ecosystem services or resilience (Abson et al., 2014; F. S. Brand & Jax, 2007). The importance of lived experiences, such as resonance, is acknowledged within SES literature (Meyfroidt, 2013; West et al., 2020), but also in psychology (Hunecke, 2018) and education (Rieckman,

2018). Promoting resonance beyond its theoretical scope towards a culturally embedded discourse might lever sustainability transformations.

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