SOCIAL-ECOLOGICAL SYSTEMS INSTITUTE
ANNUAL REPORT 2025

SESI
Social-Ecological Systems Institute

FACULTY OF SUSTAINABILITY
LEUPHANA UNIVERSITY OF LÜNEBURG
GERMANY

LEUPHANA
UNIVERSITÄT LÜNEBURG

FOREWORD

In 2025 the School of Sustainability celebrated the 15th anniversary of its founding (Leuphana was the first university in the German speaking world to establish a faculty of sustainability) and the Social-Ecological Systems Institute (SESI) celebrated its 5th anniversary. A particular strength to celebrate, in both the School and SESI, is the diversity of the people, perspectives and practices that are brought to bear in pursuit of solutions for the complex sustainability challenges facing humanity. At SESI that diversity is evident in the breadth of the research carried out within the institute and the range of academic backgrounds of researchers undertaking that research. In 2025 more that forty SESI researchers, from more than a dozen different countries, studied phenomena ranging from social-ecological restoration in Rwanda, through natures contributions to people in Tanzania, more-than-human-relations in Bolivia and exploring social-ecological sufficiency in Germany. In doing so we applied inter- and transdisciplinary (mixed) research methods drawn from social science, natural science and the humanities.

Nevertheless, within this diversity of research and researchers at SESI there remain and number of common threads that bind us together. These include: a focus on understanding the complex interdependencies and interrelations between the social and ecological facets of sustainability; the desire to generate socially relevant and context sensitive research that can contribute to the needed transition to a more sustainable future; and attempts to identify key dynamics and drivers of transformative change. Through these diverse activities SESI seeks to help shape crucial sustainability discourse both within the scientific community and civil society. In doing so we hope to play a small part in creating a better world, for the current generation of humans, those future generations of humans whose well-being our actions will fundamentally affect and for the multiplicity of other species with whom we share this beautiful planet.

This report is intended to provide some brief insights into SESI's diverse activities and achievements in 2025. We hope you enjoy it!

Dave Abson & Joern Fischer
Heads of the Social-Ecological Systems Institute

Photos by Berta Martín-López from the Kilimanjaro project.

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ABOUT THE SOCIAL-ECOLOGICAL SYSTEMS INSTITUTE (SESI)

The Social-Ecological Systems Institute (SESI) was founded in 2020. It is part of the School of Sustainability at Leuphana University of Lüneburg, Germany. The institute provides a space for like-minded faculty members at Leuphana who are particularly interested in links between social and ecological phenomena. SESI researchers come from many different parts of the world, and a substantial proportion of SESI's research takes place outside Germany, including in Africa and Latin America. SESI researchers are interested in the ecological sciences, the social sciences, and especially the linkages between the two.

The SESI logo was inspired both by an unfolding fern leaf and by the Celtic double spiral – which symbolises the balance between opposing forces (e.g. change and preservation; or collapse and renewal). Arguably, many social-ecological systems are now on an unsustainable trajectory because they have lost this balance.

Leuphana University's central building.

VISION AND MISSION

OUR VISION

We envision a fair world where the benefits generated within social-ecological systems are shared sustainably with other species, both within and across generations. Solutions to sustainability challenges are developed collaboratively across diverse scientific disciplines, knowledge systems, and social interests.

OUR MISSION

To realise our vision, we recognise the need for transformative change. In pursuit of such change, we:

- Use place-based social-ecological systems thinking to understand and resolve sustainability challenges such as biodiversity loss and environmental injustice
- Bring together insights and approaches from the natural sciences, social sciences and the humanities in genuinely collaborative endeavours
- Integrate experiences, practices, and understandings from diverse knowledge systems
- Embed tools for transformative change into social-ecological systems thinking via a leverage points perspective
- Develop and apply methods to bridge multiple scales and governance levels
- Provide spaces for people sharing our vision to meet and exchange ideas.

SESI: WHERE WE COME FROM AND WHAT WE WORK ON

The SESI team is a diverse community of researchers with intersecting paths from across the globe. Although based at Leuphana University, our institute is shaped by the many places we call home and the many regions in which our work is based (Figure 1). This international perspective is key to the complex and interconnected understanding of social-ecological systems that we hold.

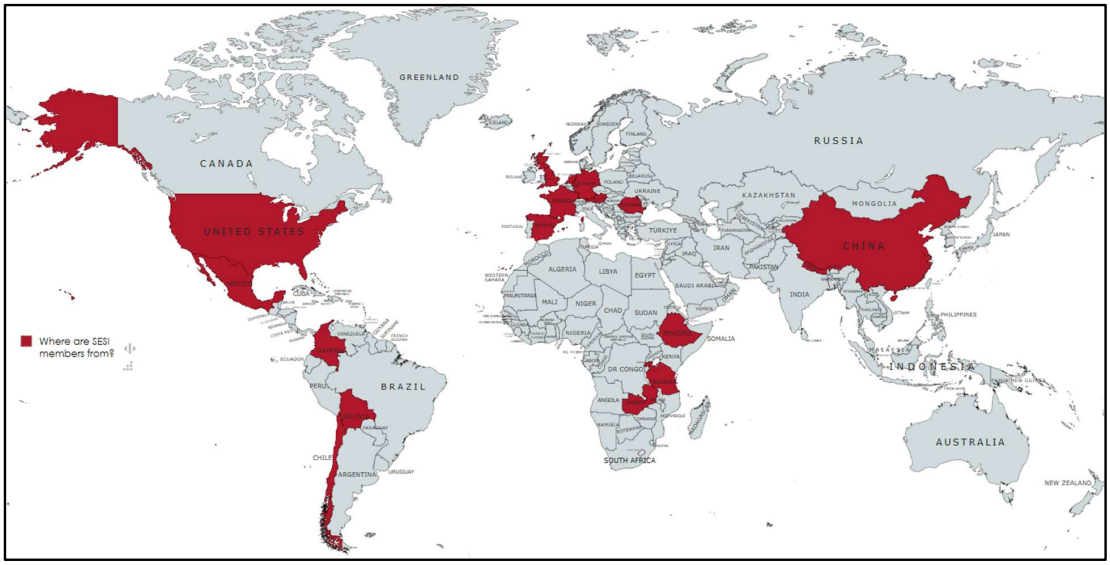
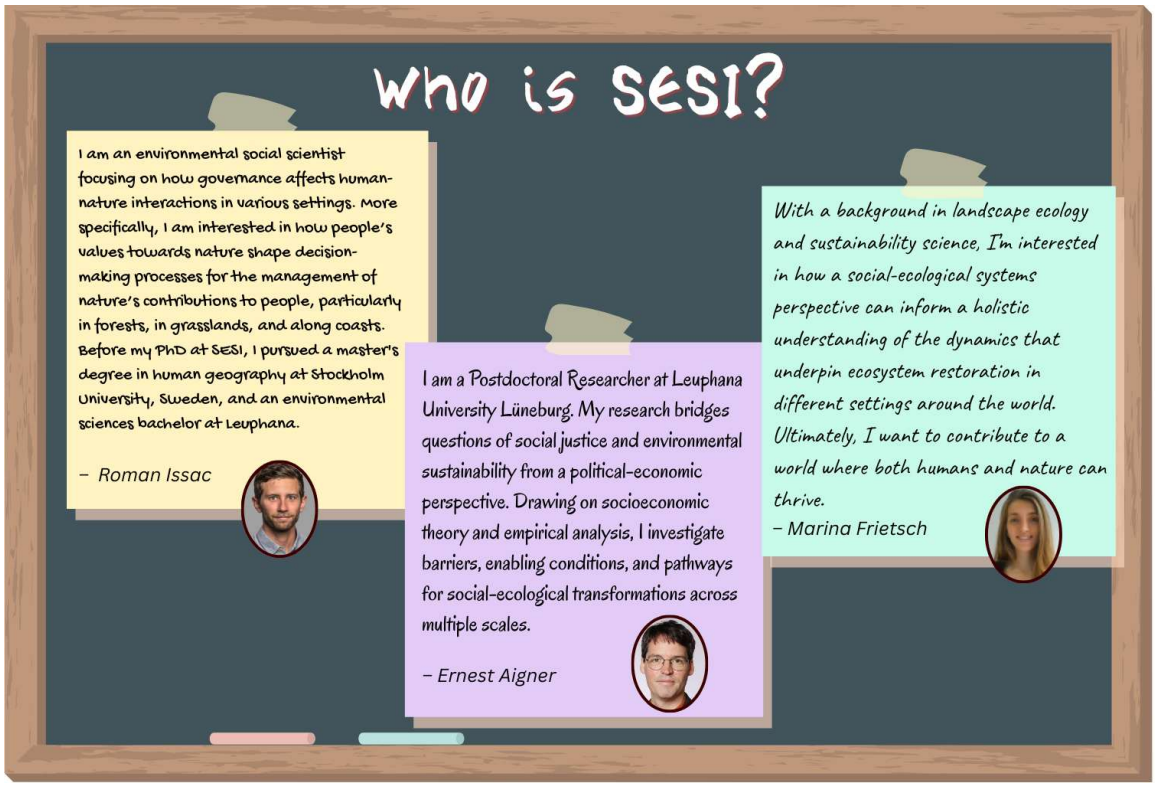


Figure 1. A world map shares a look into the home countries of our team. Created using MapChart.

SESI members bring expertise from the ecological sciences, social sciences, and many other disciplines. Together, we explore the vast dynamics between people and nature. The members of our team were asked to give just one word to represent their research focus. These words were used to create a word cloud giving insight into the diversity and interdisciplinarity of the SESI group (Figure 2).

Figure 2. A word cloud giving insight into the many interests SESI members focus on. Created using wordclouds.com.

Below are a few examples from individual researchers illustrating their engagement with various social-ecological challenges.



Who is SESI?

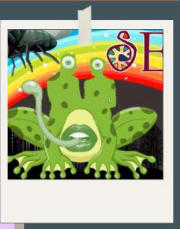
My work uses a social-ecological systems perspective and focuses on the landscape scale. I am interested in applying social-ecological systems thinking to ecosystem restoration. Increasingly, I am also beginning to focus on the concept of regeneration – I investigate to what extent regenerative systems thinking could help us to foster positive dynamics in social-ecological systems. Colleagues and I have recently published an article on this topic titled 'Resilience and regeneration for a world in crisis'. It is available through Ambio and linked in the references below.

– Joern Fischer

I focused on governance and institutions as the vague, yet diverse constellation of explicit and implicit rules, norms, values, and decision-making processes that structure and coordinate our lives. I was blessed with an opportunity that enabled me to explore and develop my expertise in international, explicit governance. Eager to understand the interpersonal and implicit institutions hindering and fostering sustainability, I investigated the plural values people ascribe to nature during my PhD. As my next step, I hope to be able to combine both expertise and concentrate on the intermediary level of communities and collective action for local agency that support sustainability in social-ecological systems.

– Lukas Kuhn

Who is SESI?



I am currently embarking on research on transformations towards sustainable and just futures. Arriving at this stage in my scientific career has entailed some twists, turns, and detours. I started my scientific career doing taxonomy of aquatic macroinvertebrates, and soon I moved to my PhD on the economic valuation of biodiversity. None of these topics fulfilled my soul, so I decided to start engaging with institutional theories, Indigenous and local knowledge systems, and critical feminist studies.

– Berta Martín-López

My research is currently focused on understanding the notion of sufficiency from a social-ecological perspective (e.g. sufficiency as both a social practice and biophysical constraint on consumption). My academic path started as a mechanical engineer, driven by a desire to satisfy my creative urge – "scientists investigate that which already is; engineers create that which has never been" (Albert Einstein). However, I came to realize that science is endlessly creative. Specifically, science can create new understandings that challenge dominant ways of thinking. This insight led me to the study sustainability science and concepts like sufficiency that seek to overturn problematic paradigms (like growth and efficiency) that are harming us and the precious planet we call home.

– Dave Abson

FOR FURTHER INFORMATION:

REFERENCES:

Fischer, J., Farny, S., Pacheco-Romero, M., & Folke, C. (2025). Resilience and regeneration for a world in crisis. Ambio. https://doi.org/10.1007/s13280-025-02287-6

TOOLS:

MapChart. (2025). *World map. Where are SESI members from?* MapChart. https://www.mapchart.net/world.html (Accessed Dec 2025).

WordClouds.com. (2025). *Word cloud generator*. https://www.wordclouds.com/
(Accessed Dec 2025).

RESEARCH HIGHLIGHTS

RESEARCH HIGHLIGHT: TWO DOCTORAL DISSERTATIONS COMPLETED THAT COLLECTIVELY ADVANCE SCHOLARLY UNDERSTANDING OF HUMAN–NATURE RELATIONSHIPS

John Sanya Julius and Milena Gross, both supervised by Prof. Berta Martín-López and Prof. Tuyeni Mwapmaba, completed their PhDs as part of subproject 3 (SP3) in the Kili-SES research unit. John's dissertation is entitled "Plurality within – Understanding the pluriverse of smallholders' relationships with nature on the slopes of Mount Kilimanjaro, Tanzania", and will be publicly available soon. Milena's dissertation is entitled "Balancing the plural voices at play – approaches of researchers to advancing an inclusive understanding of people-nature relationships" and can be accessed here. Figures 3, 4, and 5 show photos from John and Milena's defense days.

Figure 3. Photo at John Sanya's defense day. Nana Amoah, Jan Hanspach, Konrad Gray, Frank Shagega, Milena Gross, John Sanya, Dickson Mauki, Dominick Martin, Berta Martin-Lopez, Neema Kinabo, Roman Isack (photo credit: Anna Mayer).

The dissertations collectively advance the understanding of how people relate to nature, using the Nature's Contributions to People (NCP) and Plural Valuation frameworks, and implications for inclusive conservation. Both drew on the social-ecological system of Mount Kilimanjaro, Tanzania, which is not just a

tropical mountain but also the world's highest free-standing mountain (5,895 meters above sea level (masl)). This social-ecological system serves as an excellent platform to investigate people-nature relationships because it is characterized by, e.g., several distinct ecosystems that span across an elevational gradient of 5000 meters; biodiverse agroforestry systems farmed based on and cared for due to applying Indigenous and Local knowledge; a national park, one of Tanzania's premier nature-based destinations; and manifold opportunities for nature-based tourism; hosts various social actors, particularly subsistence-based farmers, nature conservationists, mountain tour guides, and tourists; supplies NCP that can meet the demand of different social actors; and nurtures diverse values.

Starting off with a systematic literature review, Gross et al. (2024) deepens the discussion of valuation frameworks and methods as institutions of scientific knowledge articulation, with a particular focus on value-articulating institutions. Through a systematic synthesis of empirical studies on tourists' values ascribed to nature in protected areas, the review advances knowledge on how research has approached tourists' values of nature in protected areas, while also signaling potential biases arising from a predominance of monetary valuation methods and single-actor perspectives in the available evidence.

Based on interviews with nature conservationists, tour guides, and tourists, Gross et al. (2025) advances the understanding of methods to identify context-specific NCP by framing them as institutions of scientific knowledge articulation and proposing a methodological approach that reduces the risk of knowledge omission by asking complementary interview questions. It further contributes to the theoretical development of the context-specific NCP perspective through empirical evidence, notably by identifying one context-specific NCP that cannot be mapped onto the generalizing NCP framework.

Next, Gross et al. (resubmitted after minor revisions) and Sanya et al. (2025a) reflect critically on the tendency to oversimplify or stereotype social actors based on their NCP preferences and value expressions. They shed light on the factors shaping social actors' NCP preferences and value expressions and discuss the need for a nuanced investigation of variations across and within social actors, thus highlighting the importance of attentiveness to a potential heterogeneity when analyzing people–nature relationships.

Figure 4. Photos at Milena Groß' defense day. Left: KiliSES group photo, left to right: Fabia Codalli, Milena Gross, Koggani Dickson, John Sanya, Dickson Mauki; (photo credit: Carole Flume). Right: John Sanya Julius and Milena Groß (photo credit: Vicky Temperton).

By revealing a distinct association between NCP preferences and differing degrees of value pluralism based on a survey with smallholders, nature conservationists, tour guides, and tourists, Gross et al. (2025b) underscores the need to leverage complementary frameworks to account for the multidimensionality of people–nature relationships. To recognize the distinct association between NCP preferences and differing degrees of value pluralism, they call for, without compromising biodiversity and ecosystem functioning, diversifying place-based conservation approaches in social-ecological systems with (a) protected area(s).

Sanya et al. (minor revisions, Sustainability Science) explore how smallholder farmers in Kilimanjaro benefit from, value, and emotionally connect with nature using the photovoice method. Content and multiple correspondence analyses identified three main associations between nature's contributions to people (NCP), values, and emotions. First, farmers near the national park expressed unpleasant emotions related to material and regulatory NCP, as well as intrinsic and relational values, such as stewardship and responsibility. Second, farmers in homegardens expressed pleasant emotions associated with non-material NCP and relational values such as cultural heritage and sense of place. Third, all farmers emphasized instrumental and relational values tied to social cohesion and social relations.

Sanya et al. (minor revisions; Agroforestry Systems) uncovers smallholders' motivations behind applying Indigenous and Local Knowledge (ILK) to manage

homegardens, showing how such practices extend beyond livelihood support to encompass relational facets with nature, and demonstrating how diverse knowledge systems, i.e., ILK, external, and scientific knowledge, can co-exist without undermining one another.

Figure 5. Photos of John Sanya's defense day. Left: John Sanya, Berta Martin-Lopez. Right: Milena Gross, John Sanya (photo credit: Dickson Mauki).

Taken together, SP3' insights carry important implications for inclusive conservation research, policy, and practice. They call for attentiveness to differences in NCP preferences and value expressions both within and across groups, and to the multidimensionality of people–nature relationships, operationalized, for example, through conservation-related benefit-sharing mechanisms that expand beyond instrumental thinking to value pluralism. They further suggest the need to design conservation strategies that focus on clusters of people united by shared NCP preferences rather than predefined social actor categories, thereby again challenging potential stereotypes and oversimplification. SP3' research underscores the need to diversify conservation strategies in ways that reflect varying NCP preferences and underlying values, ultimately promoting inclusivity across diverse and within groups of people. Ultimately, this research strengthens the call for braiding diverse knowledge systems in conservation, leveraging complementary frameworks, and developing place-based and socially just conservation strategies, without comprising biodiversity conservation and ecosystem functioning.

FOR FURTHER INFORMATION:

Visit our website: https://www.leuphana.de/en/institutes/sesi/research-projects/kili-ses.html

Publications:

Gross M, Mwampamba TH, Sanya J, Pearson J, Sesabo JK, Martin-Lopez B (resubmitted after minor revisions) Understanding preferences for nature's contributions to people between and within social actors sheds insights for inclusive conservation. People and Nature

Gross M, Pearson J, Arbieu U, et al (2023) Tourists' valuation of nature in protected areas: A systematic review. Ambio 52:1065–1084. https://doi.org/10.1007/s13280-023-01845-0

Gross M, Shepeleva D, Vogel F, Mwampamba TH, Arbieu U, Pearson J, Sesabo JK, Hofmann J, Codalli F, Martín-López B (2025a) The questions we ask matter: insights from place-based research on nature's contributions to people. Sustain Sci. https://doi.org/10.1007/s11625-025-01649-z

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Sanya, J, Gross M, Mwampamba TH, Pearson J, Sesabo JK, Riechers M, Kinabo NR, Krail V, Martín-López B (2025) Heterogeneity of demands for nature's contributions to people and nature's values by farmers: insights from the Kilimanjaro social-ecological system. E&S 30:art25. https://doi.org/10.5751/ES-15961-300225

Sanya, J, Pearson, J, Mwampamba, T.H, Sesabo, JK, and Martín-López, B (resubmitted after minor revisions) Interplays between nature's contributions to people, values of nature, and emotions expressed by smallholder farmers in Kilimanjaro, Tanzania: insights for inclusive conservation. Sustainability Science

Sanya, J, Gross, M, Mwampamba, TH, Krail, V, Pearson, J, Sesabo, JK and Martín-López, B (resubmitted after minor revisions) Diverse motivations underpinning the differential use of Indigenous and Local Knowledge in Chagga homegardens, Tanzania. Agroforestry Systems.

RESEARCH HIGHLIGHT: CONNECTING WITH NATURE THROUGH A TRIATHLON

Figure 6. Berta Martín-López, Anna Mayer, and Roman Isaac at the Olympic triathlon at Wukensee.

On 7 September, Berta Martín-López, Roman Isaac, and Anna Mayer took part in an Olympic triathlon at Wukensee, near Naturparkstadt Biesenthal in Brandenburg (Figure 6). They all started under the team name VaNaTe, short for "Unravelling the Relation between Values of Nature and Telecoupling", their project within the Biodiversity Exploratories.

Swimming in the clear waters of Wukensee, which lies just a stone's throw from the Schorfheide-Chorin Exploratorium, cycling 40 km through open grasslands, and running 10 km beneath the trees of the Brandenburg forests made them feel closely connected to the nature they know so well from their fieldwork in the Exploratories.

The event not only strengthened their team spirit but also deepened their appreciation of their relationship with nature – a fitting reflection of the VaNaTe project's research focus, which explores, among other things, the ways people value nature. After hours of swimming, cycling, and running, they also gained a new appreciation for the food that nature provides.

FOR FURTHER INFORMATION:

Visit our website: https://www.biodiversity-exploratories.de/en/projects/unravelling-the-relation-between-values-of-nature-and-telecoupling/

RESEARCH HIGHLIGHT: TRACING BIODIVERSITY LOSS THROUGH GLOBAL AGRICULTURAL VALUE CHAINS

Figure 7. BAMBOO project logo.

Biodiversity is declining at a rate unprecedented in human history and the agricultural sector is a major driver for biodiversity loss. Through mechanisms such as deforestation, pesticide use and the overuse of synthetic fertilizers, natural habitats are being fragmented, displaced and degraded. As several critical planetaries boundaries are being transgressed, many countries and regions have set conservation targets. The European Union's Green New Deal is an example of this. However, the policies outlined in these proposals typically focus on improving habitats on their own territory while disregarding international value chain dynamics. This can make policy efforts ineffective or even harmful, if environmental impacts are displaced to areas with less stringent regulations. To enable a view that takes into account the entire global trade system, agricultural value chains as well as their impacts on the environment are being modelled within the EU-Horizon project BAMBOO (Figure 7). Here, the environmentally extended Food and Agriculture Biomass Input-Output model "FABIO" is being developed further and connected to biodiversity impact factors to quantify the impacts of the agricultural system in a comprehensive, trade-linked way. Specifically, the model which currently encompasses 123 distinct agricultural products is being further disaggregated into 474 different products for 187 countries and the years 2010-2022, enabling an analysis at an unprecedented level of detail. Furthermore, in 2025, environmental extensions for nitrogen and phosphorous pollution were developed which will be linked to impact factors on biodiversity in 2026. These will serve as the basis for a paper which analyzes global trade patterns of livestock feed and their impact.

The BAMBOO project is led by industrial ecologist Prof. Dr. Francesca Verones (NTNU). At SESI, PhD student Olivia Hinz is working on the tasks described above. She is employed with Dr. Martin Bruckner (WU Vienna) who is leading WP3 of the project. At SESI she is supervised by Prof. Dr. David Abson.

FOR FURTHER INFORMATION:

Visit the project's website: https://bamboo-horizon.eu/index.html

RESEARCH HIGHLIGHT: MAINSTREAMING SOCIAL-ECOLOGICAL SUFFICIENCY (MASES)

Figure 8. MaSES project logo.

Global patterns of production and consumption are fundamentally unsustainable, threatening key planetary boundaries—earth system processes vital for the maintaining of ecological integrity and long-term human well-being. Strategies for averting this 'ecological overshoot' have largely focused on 'greening' production by reducing either the material intensity (efficiency), or the material throughput (consistency) of economic activity. However, neither of these approaches address what constitutes a sustainable scale of economic activity. In the MaSES project the novel notion of social-ecological sufficiency—a socially satisfactory standard of living within ecologically sustainable natural resource usage—represents a third vital strategy for shifting towards an economy within a 'safe operating space for humanity' (Figure 8).

Work package one of the MaSES project (led by Prod. Dr. David Abson and Wies Dijkstra) provides the theoretical foundations for conceptualizing social-ecological sufficiency in relation to a safe and just operating space for humanity. In this work package we have been focused on embedding the notion of social-ecological sufficiency within notions of justice. In particular, we highlight the over emphasis on the current discourse on sufficiency as a distributional justice concern, with too little attention to representative, procedural and capability aspects of justice especially in the operationalization of sufficiency in global models.

In addition, we have been exploring the characteristic tensions in the conceptualization of sufficiency. For example, is sufficiency and solely a means to sustainable consumption of a desirable end in its own right? Can sufficiency be determined by individuals or only via collective negotiations? Is there a point at which consumption can be considered sufficient, or does sufficiency exist

between some social foundation and ecological ceiling? What do different stances on these tensions mean of the understanding and use of sufficiency in the academic discourse? To this end, after several workshops with academics, we have recently launched an online survey to capture the diversity of views on sufficiency tensions within the academic community.

Work package two of the MaSES project (led by Dr. María Fernanda Godoy León and Diego Becerra) focuses on defining ecological sufficiency levels of human consumption. To achieve this, we utilize Environmentally Extended Input-Output Analysis (EEIOA) to systematically links economic activity to environmental stressors (like emissions and resource use), enabling us to calculate consumption-based environmental footprints. Early this year, we published a foundational paper for this work package entitled, "Mapping the intersection of planetary boundaries and environmentally extended input-output analysis: A systematic literature review" in the journal Sustainable Production and Consumption. This review explores research that integrates the Planetary Boundaries framework with EEIOA, allowing us to answer several key questions, including: What are the most common methodological choices used in studies combining PBs and EEIOA? And how has EEIOA informed policy decisions related to living within PBs?

Over the last year, our efforts have concentrated on two main research topics. The first explores (at the global level) the relationships between household and non-household consumption (e.g., government expenditure) on environmental footprints and different indicators of human wellbeing. For the second topic, we have been quantifying local ecological boundaries at the national level based, which is then used to estimate the share of these local capacities taken up by German household consumption.

Work package three of the MaSES Project (led by Dr. Ernest Aigner and Anne Kraudi) investigates perceptions and determinants of enough with respect to consumer goods and categories. In the last year our work has been focusing on a systematic literature review focusing on methods in sufficiency research, qualitative interviews to investigate diverse notions of enoughness and the reasoning underlying monetary enoughness levels, and on the developing the survey for sufficiency. Qualitative interviews with heterogenous group of participants show the diversity of perceptions of the notion of enoughness, some emphasising the role of ensuring minima, others pointing to upper limits. The influence of concerns for the environmental, social justice or individual freedom

in shaping notions of enoughness varies widely. Living conditions (e.g. living in a house or a flat, having low or high income) were also found to be determinants of enoughness levels.

The Development of a large scale, representative survey on monetary enoughness levels for Germany posed a particular challenge to our work in the last months. Survey tests, literature reviews and expert comments point to the difficulty in thinking beyond daily lives and making complex calculations in surveys. Refining the flow of the survey and give clear guidance to the participants have improved the survey substantially and we look forward to launching it in the coming year.

The MaSES project is funded via an ERC consolidator grant (ERC, MaSES, 101087573) and entirely based at SESI.

FOR FURTHER INFORMATION:

Visit the project's website:
https://www.leuphana.de/en/institutes/sesi/sustainable-resource-use/mases.html

Reference:
Godoy León, M.F., Bankert, A., Torralva Becerra, D., and Abson. D.J. (2025) Mapping the intersection of planetary boundaries and environmentally extended input-output analysis: A systematic literature review. Sustainable Production and Consumption 56:546-560. doi: https://doi.org/10.1016/j.spc.2025.04.015.

RESEARCH HIGHLIGHT: HOUSEHOLD GHG FOOTPRINTS AND AUSTRIAN CLIMATE POLICY: IDENTIFYING LEVERAGE POINTS FOR DEMAND-SIDE MITIGATION (FOCAL-POINTS)

Figure 9. Vienna at dusk

In order to achieve climate neutrality by 2040, all parts of society must change. Demand-side measures, i.e., those aimed at changing household consumption, are playing an increasingly important role in this process. However, there is little research on how climate policy measures affect household greenhouse gas emissions in the long term. The FOCAL-points project addresses this research gap and based on interdisciplinary and transdisciplinary studies, identifies leverage points for effective demand-side climate policy in Austria (Figure 9).

The project first creates two new empirical data sets by quantifying Austria's household-related greenhouse gas emissions for the period 1995-2020 and analyzing them in terms of different socio-economic characteristics. -economic characteristics, and secondly by conducting a policy analysis of demand-side climate policies and important public investment decisions in the same period, focusing on the transport and housing sectors. The results will then be discussed in a stakeholder process with practitioners and citizens in order to explore connections and entry points for transformative change. The concept of “leverage points” will then be used to identify best-practice examples of effective policy interventions and to find out where future demand-side climate protection must be applied in order to achieve climate neutrality for Austria by 2040.

The FOCAL-POINT project (KR21KB0K00001) is led by Simone Gingrich at BOKU and was funded by the Austrian Climate Energy Fund. At SESI Prof. Dr. David

Abson contributes to work on identifying leverage points for transformative change within the focal project.

FOR FURTHER INFORMATION:

Visit the project's website: https://boku.ac.at/focal-points

REFERENCE:

Hass, W., Abson, D.J., Haberl, H., Spittler, N., Wiedenhofer, D., and Dorninger. C. (2026) Reconceptualizing the role of socioeconomic material stocks in the leverage points framework to enable transformative change. Ecological Economics 239:108759. doi: https://doi.org/10.1016/j.ecolecon.2025.108759

RESEARCH HIGHLIGHT: HALFWAY THROUGH THE DFG RESEARCH UNIT ON ECOSYSTEM RESTORATION IN WESTERN RWANDA

The DFG Research Unit "A Social-Ecological Systems Approach to Inform Ecosystem Restoration in Rural Africa" brings together more than 20 researchers from different German and Austrian institutions. Together, we explore ecosystem restoration in western Rwanda from a social-ecological systems perspective to better understand the mechanisms involved in generating different restoration outcomes. Winter 2025 marks the two-year anniversary of the project. In the past two years, our team has conducted stakeholder workshops, interviewed households, counted trees, birds, and butterflies and carried out many more research activities in collaboration with our Rwandan colleagues.

In 2025, in addition to several rounds of data collection, we held two big events in Rwanda (Figure 10). In February, we invited restoration actors to a mini-conference on ecosystem restoration centered around three themes: biodiversity and landscape connectivity; food security, nutrition and livelihoods; and community involvement for ecosystem restoration. The nine talks by members of our team and by representatives of different Rwandan restoration initiatives were followed by panel discussions and questions from the audience. For students, we facilitated an interactive capacity building event at the University of Rwanda. Here, different members of the Research Unit gave presentations on their fields of expertise, ranging from sustainability science to food security and to living labs. In addition, students had the chance to participate in hands-on workshops on different innovative research methods and learn more about how to write a journal article.

Figure 10. In February 2025, we facilitated a mini-conference on ecosystem restoration and a capacity building event for students.

In October 2025, we conducted participatory scenario planning with restoration actors in Kigali and in five villages in western Rwanda (Figure 11). Participatory scenario planning complements other methods used to think about the future of a landscape (such as the Three Horizons framework which we also applied in Rwanda before) by exploring alternative futures – desirable or undesirable – that might develop over the coming decades. Together with a broad range of restoration actors, we explored drivers of change that are both difficult to predict and difficult to control to identify and discuss plausible future trajectories for the restoration landscapes in western Rwanda. The resulting draft scenarios will be refined by our research team and presented mid-February 2026 in Kigali.

Figure 11. In October 2025, we conducted participatory scenario planning workshops in Kigali and in five villages in western Rwanda.

In addition to place-based research on western Rwanda, our work also looks beyond the study area. For example, Dula Duguma successfully lead a paper outlining “five frontiers for the science and practice of ecosystem restoration in East African forest landscapes”. Using western Rwanda as a case study, the paper

identifies and contextualizes five critical frontiers for restoring East Africa's forest landscapes (Figure 12): (i) defining ecosystem restoration goals and elements of success; (ii) embedding ecosystem restoration in the promotion of multifunctional landscapes; (iii) enhancing food security, nutrition, and livelihoods through ecosystem restoration; (iv) engaging with values and nature's contributions to people in ecosystem restoration; and (v) governing ecosystem restoration for equity.

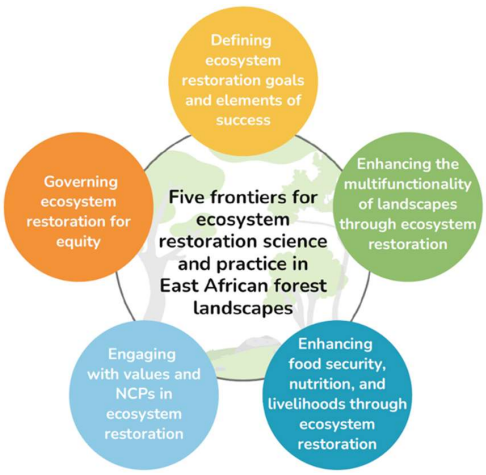

Figure 12. Five frontiers for social-ecological ecosystem restoration. Duguma et al. (2025).

For each of these frontiers, the paper highlights the state-of-the-art, outlines emerging research priorities, and offers recommendations for practice and policy to move ecosystem restoration ahead.

FOR FURTHER INFORMATION:

Visit our website: https://ecosystemrestoration.net/

REFERENCE:

Duguma, D. W., Löhr, K., Temperton, V. M., Apollinaire, W., Baumann, M., Kaplin, B. A., ... & Fischer, J. Five Frontiers for Science and Practice of Ecosystem Restoration in East African Forest Landscapes. *Integrative Conservation*.

FEATURED PAPERS

FEATURED PAPER: IDENTIFYING TRANSFORMATIVE POTENTIAL THROUGH 'CHAINS OF LEVERAGE'

Many of today's challenges—such as climate change, biodiversity loss, and inequality—are deeply embedded in complex systems that are difficult to change. Our research introduces a new approach to better understand and guide sustainability transformations: the 'chains of leverage' framework.

Because social-ecological systems are highly interconnected and constantly adapting, interventions can have unintended consequences. A small change in one part of the system may trigger a chain reaction, affecting other areas in unpredictable ways. Also, knowing where to intervene in a system is a very challenging endeavour. To navigate this complexity, our framework helps identify how changes at different levels of a system reinforce or conflict with each other, offering a roadmap for more effective interventions.

The framework follows four key steps:

1. Understand the system's core elements – Every system consists of different components, from surface-level rules and policies (parameters) to deeper structures like institutions (design) and underlying worldviews (intent).
2. Examine interactions and relationships – Changes at one level can trigger shifts in others. For example, new policies might strengthen or challenge existing social values, creating a ripple effect through the system.
3. Identify 'chains of leverage' – By mapping out how these elements interact, we can see whether changes work together (reinforcing sustainability) or against each other (creating obstacles). This includes examining power dynamics and governance structures, which shape how and where change happens.
4. Prioritise key interventions – Instead of relying on small, isolated changes, we pinpoint the most strategic leverage points where action can have the

greatest impact. This could include: (i) strengthening sustainable elements already in place, (ii) dismantling influential but unsustainable elements, (iii) reducing mismatches or inefficiencies in the system to create a sustainable chain of leverage.

The 'chains of leverage' framework helps decision-makers and researchers make smarter choices about how to shift systems toward sustainability. It highlights not just where to act, but how different actions interact, making it easier to avoid unintended consequences like policy resistance or rebound effects. Ultimately, this approach moves us beyond incremental change toward coordinated action that can create lasting and meaningful sustainability transformations.

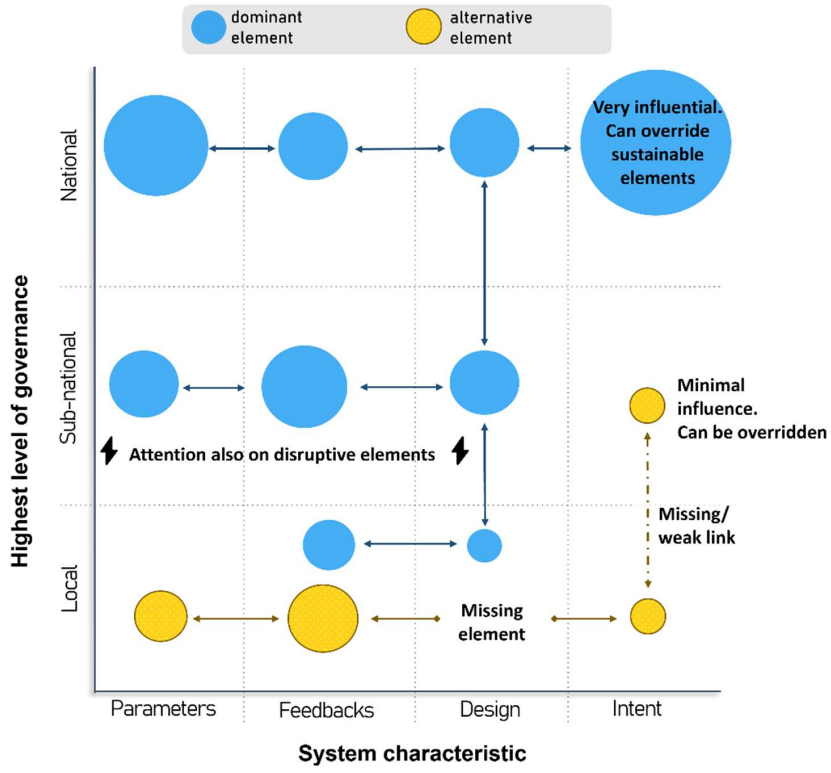

Figure 13. Graphical simplification of a generic system.

Figure 13 shows a graphical simplification of a generic system. Elements within the system can be categorised based on their main system characteristic (system parameters, feedbacks, designs or intents) and by their highest level of governance (here exemplary from local to national). The size of the circles

indicates the strength of the influence an element has on the system, i.e., the bigger the circle, the stronger the influence. Blue: dominant elements; Yellow: alternative elements. The lightning bolt ⚡ indicates disruptive elements that can occur across all system characteristics and levels of governance.

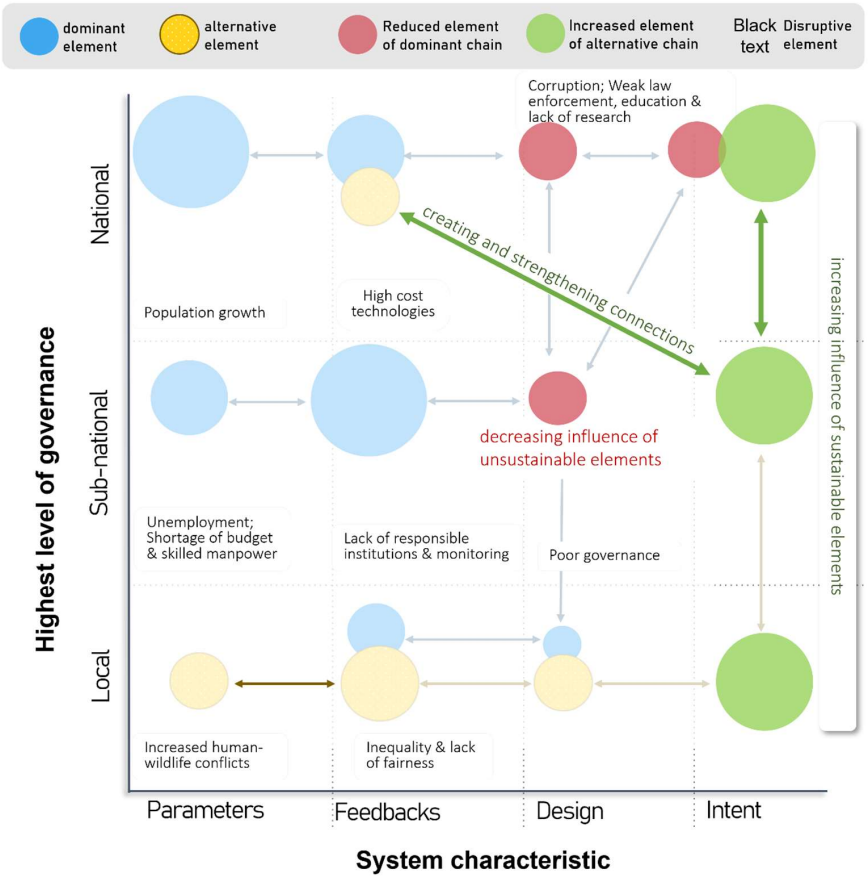

Figure 14. Two 'chains of leverage'.

If we take the 'chains of leverage' framework on previous work done by SESI on Ethiopian food systems (Jiren et al. 2021, 2023; Shumi et al. 2023) we can show identified leverage points. Figure 14 shows two 'chains of leverage': dominant (blue) and alternative (yellow, spotted) elements (circles) and interactions of elements (arrows). The size of the circles indicates strength of influence on the system (larger = stronger). Potential leverage points in the Ethiopian food system could be: bolstering the alternative chain by strengthening local and subnational system intents, upscaling the local and sub-national intent into the national sphere (green circles represent the increase of influence); strengthening the coherence/connection to existing sustainable national elements within this

alternative chain (green, bold arrows represent a strengthening or a creation of links between sustainable elements); decrease of the influence of unsustainable elements to deconstructing or disempowering the dominant, unsustainable chain (red circles represent the decrease of influence).

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FEATURED PAPER: MAPPING THE INTERSECTION OF PLANETARY BOUNDARIES AND ENVIRONMENTALLY EXTENDED INPUT-OUTPUT ANALYSIS: A SYSTEMATIC LITERATURE REVIEW

Since the development of the planetary boundaries (PBs) framework, efforts have been made to operationalise PBs at sub-global scales, from cities to continents. Many of these efforts employ Environmentally Extended Input-Output Analysis (EEIOA), which integrates environmental and material considerations into supply chain analyses. Despite the growing body of research combining PBs and EEIOA, the research is dispersed across various studies and disciplines, necessitating a systematic synthesis to consolidate findings, identify gaps, and guide future research. To address this need, we conducted a systematic literature review focusing on research that integrates the PB framework with EEIOA. The aim of the paper was to answer several key questions, including: What are the most common methodological choices used in studies combining PBs and EEIOA? How has EEIOA informed policy decisions related to living within PBs?

The methodological approaches to integrating the PBs framework with EEIOA have significantly evolved since the establishment of the PBs framework with a surge in research efforts combining these methodologies since 2018. Our review revealed four main methodological frameworks in the literature: “footprint v/s allocated PB”, “exceedance footprint”, “scenario analysis”, and “optimisation modelling”. Climate change emerged as the most extensively studied PB, followed by land-system change, freshwater use, nitrogen flows, and phosphorus flows. Policy guidance was central in 50 % of the studies, with 61 % following a responsibility narrative, 15 % human well-being, and 9 % examining socio-economic implications (Figure 15).

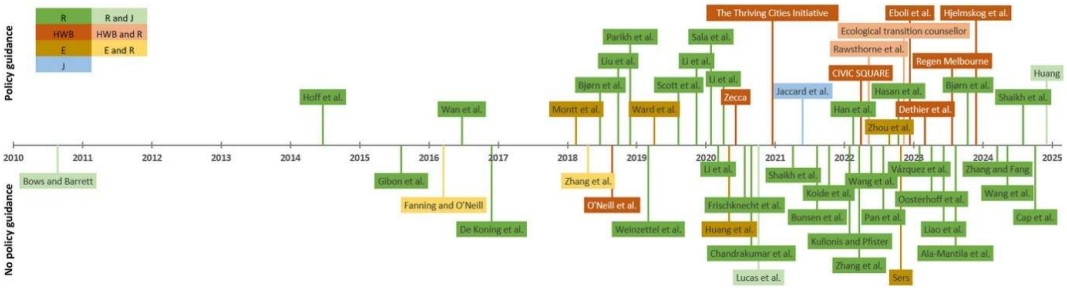

Figure 15. Studies organised chronologically by narrative, indicating whether they provide policy guidance. R: responsibility, J: justice, HWB: human well-being, E: economic.

This review provides critical insights into the intersection of PB and IOA, highlighting methodological trends and gaps. We found significant methodological heterogeneity, particularly in the choice of control variables, thresholds, allocation methods, and input-output databases. The choice of control variables and thresholds had the greatest influence on the results, followed by the allocation methods. By synthesizing findings, it advances the integration of these frameworks, supporting their application in sustainable consumption policies and broader environmental strategies.

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FEATURED PAPER: RECONCEPTUALIZING THE ROLE OF SOCIOECONOMIC MATERIAL STOCKS IN THE LEVERAGE POINTS FRAMEWORK TO ENABLE TRANSFORMATIVE CHANGE

Addressing the intensifying climate crisis and the transgression of multiple Planetary Boundaries requires a deep socio-ecological transformation. From the perspective of complex systems, the following question arises: Which leverage points need to be addressed to push socio-economic systems in a more sustainable direction?

This paper departs from Donella Meadows' notion of 'leverage points' – places a complex system "where a small shift in one thing can produce big changes in everything" (Meadows. 1999). While we agree that the leverage points heuristic proposed by Donella Meadows is useful, we herein argue that it would benefit from emphasizing the pivotal role of socioeconomic material stocks as enablers and inhibitors of transformative change. Currently, socioeconomic stocks are pigeonholed as a shallow leverage point. However, from a socio-metabolic perspective, existing stocks are key drivers of environmental pressures, which foster unsustainable individual behaviours and thus create path dependencies and lock-ins. Stocks can even shape the societal perception of challenges that often foster unsustainable responses. Hence, system-wide socio-ecological change hinges on fundamental changes in socioeconomic stocks (Figure 16).

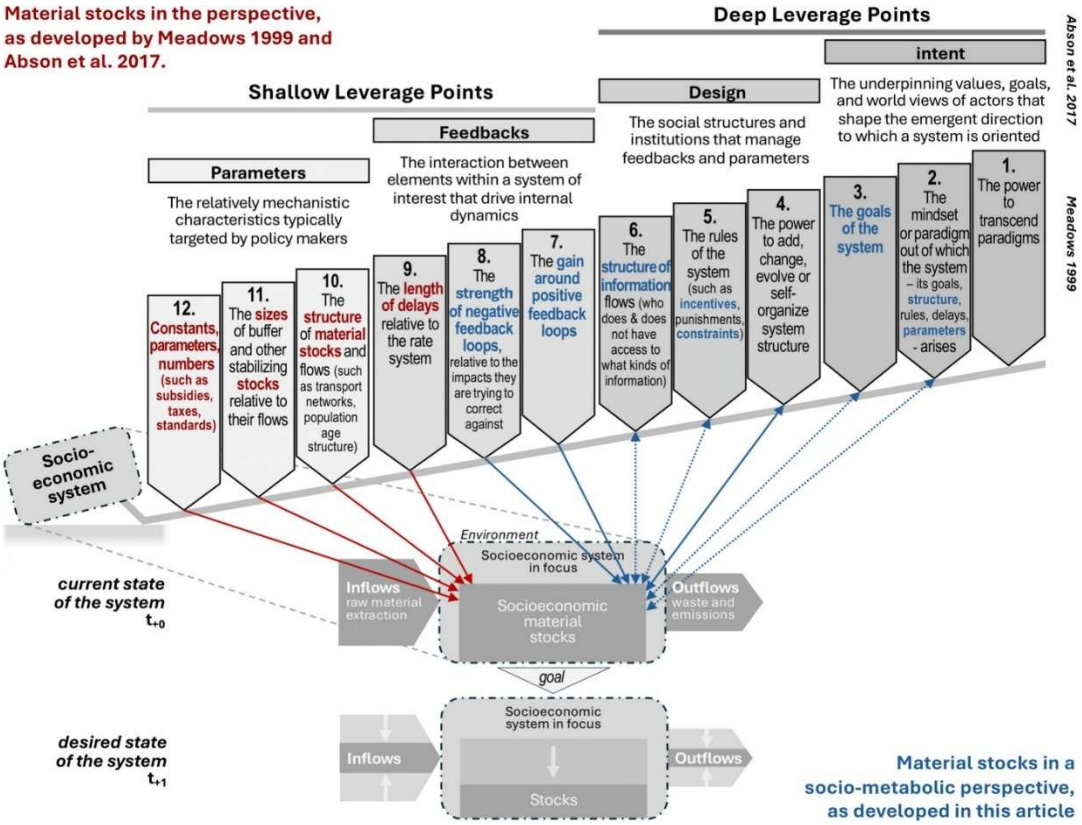

Figure 16. Leverage points and stocks, with extended connections to and from socioeconomic material stocks.

Transformative change requires a reconceptualization of stocks embracing their multidimensional and cross-cutting interconnectedness with the deeper leverage points around system feedback, design, and intent. Rather than looking for the one deep leverage point, we suggest that a well-coordinated intervention strategy needs to target multiple leverage points while systematically considering socioeconomic stocks as an inherent, critical system property to be altered.

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FEATURED PAPER: COFFEE AGROFORESTRY TO CONNECT PROTECTED AREAS

Around the world, protected areas are embedded within a landscape matrix of human activities, such as agriculture. Depending on what kind of agriculture is practiced, agricultural land can be a significant barrier to species movement. This can result in protected areas being isolated from one another, which, in turn, can threaten the long-term viability of the species that are meant to be protected.

An often-advocated solution to increase landscape connectivity is the creation of corridors. While this is a nice idea in principle, it can be difficult to implement in setting where local people depend on agricultural land use.

Both of these challenges – isolated protected areas, in combination with people who depend on agricultural land use – apply to the case of western Rwanda. The landscape here is among the most densely settled agricultural areas anywhere in Africa, and it is also where small but important remnants of Afromontane forest have been put under strict protection. Two of these remnant patches are Gishwati forest and Mukura forest – forest patches that boast a diverse flora and rare wildlife species, but that are isolated from one another by some 30 km of smallholder agricultural land.

In a recent paper, we explored the potential of coffee agroforestry to connect these remnants of native forest. Coffee agroforestry, if it uses a diverse mix of native trees in the overstorey, could potentially support high levels of biodiversity and thereby improve the connectivity between the protected forest remnants for a wide range of species. But unlike strictly protected land, coffee agroforestry can also benefit smallholder farmers economically. For this reason, we explored to what extent coffee might be a suitable cash crop for the highlands of western Rwanda in the future.

Our paper showed that because of a warming global climate, the mountainous area between Gishwati and Mukura forest patches actually will become increasingly suitable for growing coffee. Somewhat ironically, climate change has thus paved the way for a potentially exciting win-win scenario for biodiversity and local livelihoods. Our existing findings have not addressed livelihoods explicitly yet but have only focused on the climatic suitability of the landscape for coffee. Since the future climate looks to be suitable, it now makes sense to

investigate in more detail how exactly biodiversity and livelihoods may be influenced (and hopefully improved) through coffee agroforestry.

The paper is a local case study focusing on western Rwanda, but there, it has been met with much interest among local actors, who have been looking for feasible ways to connect Gishwati and Mukura for many years. Might coffee be (at least part of) the answer?

Perhaps the most fun fact about this paper is that its first author – Tom Reckmann – was merely a bachelor's student when he conducted this work. His Bachelor thesis turned out so nicely that his supervisor, Prof. Joern Fischer, encouraged him to work with a set of experienced co-authors to turn the thesis into a research article. Not only did this succeed (the publication details are shown below), but Tom also presented his work at the 6th World Congress on Agroforestry in Rwanda in October 2025 (Figure 17). Here, too, the work was met with much interest.

Figure 17. Tom Reckmann (left) with one of his co-authors, Dula Wakassa Duguma (right). Both presented research findings at the 6th World Congress on Agroforestry in Kigali, Rwanda.

In many ways, this paper demonstrates what we try to do in our institute in general: collaborate scientifically across cultures in ways that are relevant for sustainability practice and provide opportunities for the next generation.

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PUBLICATIONS

SESI publishes across a broad range of journals in ecology and the social sciences. The following list shows publications led or co-authored by **SESI members** in 2025.

1. **Aigner, E.,** Fischer, J., & **Kraudi, A.** (2025). Suffiziente Langzeitpflege: Institutionelle Ansatzpunkte in Deutschland. WSI-Mitteilungen, 78, 380–389. https://doi.org/10.5771/0342-300X-2025-5-380
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PEOPLE

Prof. Dr. David Abson, Professor of Sustainable Resource Use. I am an interdisciplinary scientist working at the intersection of the natural sciences and economics. I focus on land use change, ecosystem services, systems thinking and transformative changes in social-ecological systems.

Ernest Aigner, Postdoc Researcher. My research addresses the social and political facets of ecological economics. This includes studying structures for climate-friendly living; eco-social policies related to work, poverty and health; pluralism in economics; utopian commons and social sufficiency (enoughness) and its determinants.

Diego Torralva Becerra, PhD Candidate. My research focuses on examining ecological sufficiency based on the biophysical limits to earth system boundaries and their interrelation with consumption demand, applying Environmentally Extended Multi-Regional Input-Output analysis to better understand what sufficient levels of consumption could look like.

Camila Benavides-Frias, Research Associate and PhD student. I am an agro-ecologist. My research is part of a transdisciplinary project on biocultural diversity, I focus on agroecosystems functioning (integrating social and biological components) and linking it to sustainability topics such as food sovereignty.

Felipe Benra, Postdoctoral researcher. I am conservation scientist with a background in environmental engineering. I developed my PhD in mapping and modeling ecosystem services in southern Chile looking at distributive and inequality issues and policy

development. I am generally interested in sustainability sciences and restoration.

Dinkissa Benti, Postdoctoral researcher focused on biodiversity, agroforestry, indigenous knowledge, and conservation. Currently working on multispecies connectivity modeling and nature's non-material benefits in southwestern Ethiopia. Open to collaboration advancing conservation, ecological regeneration, and sustainable development across diverse socioecological systems.

Dr. Miguel A. Cebrián-Piqueras, Senior researcher. My research interests include community-based conservation, plural valuation, human-nature connectedness, and transdisciplinary approaches. I am currently working on a project that researches the applicability of transdisciplinary research to navigate diverse typologies of nature values to enhance social-ecological restoration.

Caroline Hélène Dabard, PhD student. My research focuses on small-scale innovations and their transformative potential in rural to peri-urban Biosphere Reserves. I thereby integrate content analysis, clustering techniques, network analysis and spatial perspectives on how, where and why sustainability innovation develop - and with which impact.

Wies Dijkstra, PhD student in the project 'Mainstreaming socialecological sufficiency'. My research is focused on sufficiency strategies, specifically looking at how different production- and consumption-based approaches can reduce pressure on the environment and ecosystems while ensuring a good life for all, now and in the future.

Dula Wakassa Duguma, Research Associate. My research focus is on land use change, biodiversity and ecosystem services in social-ecological systems in the Global South. Currently, I am working in an interdisciplinary research project in Ecosystem Restoration in Western Rwanda.

Ioana-Alexandra Pătru-Duşe, PhD student. She is an interdisciplinary researcher working at the intersection of ecology and social-political sciences. Her work examines governance processes and value systems shaping human–nature relationships, with a current focus on transdisciplinary research methods and knowledge integration.

Prof. Dr. Joern Fischer, Professor of Sustainable Landscapes. I have a background in landscape ecology and work at the intersection of social and ecological systems. I am particularly interested in biodiversity conservation, food security, and sustainable development in the Global South.

Marina Frietsch, Research Associate and PhD Student. I am a sustainability scientist with a background in landscape ecology and nature conservation. My work is based on social-ecological systems thinking and focuses on the restoration of degraded ecosystems.

Sarah Gottwald, Postdoctoral researcher. My background is in geography and landscape planning. My research focuses on the relation between senses of places and mobilities in borderscapes. I am interested in the application of participatory mapping methods.

Konrad Gray, PhD student. I am a sustainability scientist with an interdisciplinary background in human-nature relationships. My work deals with the social-ecological system of grassland restoration. In my PhD I want to explore different relationships and relational properties in a transdisciplinary approach to grassland restoration in the context of a real-world laboratory.

Milena Gross, Research Associate and PhD Student. I am a sustainability scientist aiming to unravel how people are connected with and value nature as well as how natures contribute to people's quality of life.

Dr. Jan Hanspach, Junior Research Group Leader. I have a background in ecology and conduct interdisciplinary work on biocultural diversity in the global south as well as on the integration of biodiversity conservation in farming landscapes. In 2021, I received the Leuphana Young Researcher Award.

Gudrun Harms. I am responsible for all secretarial and administrative work, financial processing, budget monitoring and the preparation of employment contract matters at the Social-Ecological Systems Institute.

Olivia Hinz, PhD student with Dave Abson and research associate at the Vienna University of Economics and Business. In my research I focus on quantifying impacts of the agricultural system on biodiversity and tracing them through global value chains.

Roman Isaac, Research Associate and PhD Student. I am interested in the role of governance in human-nature interactions. More specifically I focus on the multi-level governance of natural and anthropogenic capitals in the co-production of ecosystem services.

Dr. Amanda Jiménez Aceituno, Researcher. My research seeks to explore ways to operationalize transformations theory into analytical frameworks and participative and art-based methods that can improve sustainability practice. Currently I explore how co-designed processed can contribute to sustainable transformations of the food system in drylands.

Rhoda Nthena Kachali, Research Associate and PhD Student. I am particularly interested in the interface between people and nature and how a better understanding of these interactions can enhance protected area effectiveness and capabilities among people living in and around them.

John Sanya Julius, Research Associate and PhD Student. I am a social environmentalist interested in sustainability management and socio-ecological systems. I focus on understanding how human-nature interaction with existing Indigenous and Local Knowledge can influence the demand for and value of nature contribution's to people.

Anne Kraudi, PhD student. I am doing research on social sufficiency. Thereby, I am focusing on the question of what people perceive as enough. For this, I take an interdisciplinary perspective and draw on psycho-social models of behaviour to explore what influences people's different notions of enoughness.

Lukas Kuhn, Research Associate and PhD Student. I am a sustainability scientist with a special interest is understanding why people and groups of people do what they do. My research focusses on the diverse values and value compositions that motivate the sustainable use and restoration of grasslands in Germany.

Dr. David P. M. Lam (visiting scholar), Scientific Director of the project tdAcademy - Platform for transdisciplinary studies and research. I work on transdisciplinary research methods, processes to increase the impact of sustainability initiatives, and the role of indigenous and local knowledge in change processes.

María Fernanda Godoy León, Postdoctoral Researcher. My research focuses on assessing ecological sufficiency levels of consumption for Germany and the global community. The research employs input-output analysis and scenario development to evaluate the environmental impacts of consumption patterns and identify pathways towards sustainable consumption practices.

Dr. Aymara Victoria Llanque-Zonta, Research Associate and lecturer. I am interested in food justice and sustainability, with special emphasis on feminist and decolonial studies connected to sustainable consumption, co-production of knowledge with peasant and indigenous communities, transdisciplinary and transformations in science, politics and practice.

Prof. Dr. Jacqueline Loos, I research environmental justice in development and biodiversity conservation, applying a social-ecological understanding of protected areas to scrutinize interdependencies between governance arrangements, management effectiveness and social-ecological outcomes.

Prof. Dr. Berta Martín-López, Professor of International Sustainable Development and Planning. Her research is collaborative, interand transdisciplinary aiming to understand the role of values, knowledge, and institutions in supporting transformation pathways to sustainability.

Anna Mayer, Research Associate and PhD Student. My research focuses on how land managers' decisions are influenced by processes beyond their immediate region. By examining the resources that land managers rely on and tracing their origins, I aim to uncover patterns and dependencies that may influence land use decisions.

Verene Nyiramvuyekure, PhD student at the Institute of Ecology and the Socio-Ecological Systems Institute. My research focuses on the impact of ecosystem restoration intervention on biodiversity in the restored landscapes.

Molly Parker, Master's student in Sustainability (ecology and biodiversity) responsible for the SESI blog *Ideas for Sustainability*, compiling and editing the 2025 SESI Annual Report, and supporting SESI members in a South-South knowledge exchange project on ecosystem restoration.

Lucía Pérez Volkow, PhD student. I am part of a research team who aims to understand the transformative change potential in the Kilimanjaro Socioecological System.

Stefan Ortiz Przychodzka, Research Associate and PhD student. I am an Ecological Economist with experience in transdisciplinary research with peasant and indigenous communities. I work on topics related to biocultural diversity, agrarian change and social-environmental conflicts.

Dr. Manuel Pacheco-Romero, visiting scientist of SESI-Leuphana and postdoctoral researcher at University of Almería, Spain. My research focuses on applying a social-ecological approach to the assessment of ecosystem restoration. Recently, I am also interested in understanding how holistic landscape restoration processes can drive regenerative dynamics at multiple social-ecological domains.

Tom Reckmann, Research Associate, Master's Student. I have a background in environmental and sustainability studies with a focus on social-ecological systems and restoration. I am interested in landscape ecology and regenerative systems.

Dr. Maraja Riechers, Honorary Professor for the Faculty of Sustainability. I am a marine social scientist, researching leverage points for sustainability transformation, especially in the domain of human-nature relations, and ocean equity with research in the German Baltic Sea and in New Caledonia (South Pacific).

Felix Schaaf, Master's student. Responsible for the SESI website as well as the project website ecosystemrestoration.net through early 2025. I'm interested in transformative governance and law. Currently, I work on climate adaptation, water governance and sustainable agriculture.

Ping Sun, PhD student. My academic research interests are the application of environmental information technologies in landscape connectivity, biodiversity and biogeography research.

Prof. Dr. Vicky Temperton (secondary affiliation), Professor of Ecosystem Functions and Services. I have a background in experimental plant ecology and test ecological theories and knowledge for its potential to improve ecological restoration in a global change world.

Pramila Thapa, Research Associate. I am a sustainability scientist with previous training in inter- and transdisciplinary studies. My current research aims to synthesize the gradient of value interactions in farming and conservation settings across multiple countries.

Maria Wolters, Research Associate and PhD Student. I am a sustainability scientist with a background in Biology and strong interest in Psychology. I am researching regenerative dynamics in the context of holistic landscape restoration from the social-ecological systems perspective.

COURSES TAUGHT BY SESI

SESI members teach a diversity of subjects at the Bachelor, Master, and PhD level. These include:

- Basics of Inter- and transdisciplinarity
- Basics of Sustainable Development
- Colloquium Social-ecological system research
- Conservation Ecology
- Ecological Restoration for Sustainability
- Ecosystem functions and services
- Environmental Sciences - an Introduction
- Environmental Studies: Introduction to the Subject Area
- Fundamentals of Spatial Systems
- Fundamentals of Sustainability Economics
- Gastropolitics: From Plate to Planet
- Introduction to Biodiversity and Ecosystem Functions
- Introduction to Ecology - Field Exercise
- Introduction to Ecosystem Restoration and Social-Ecological Systems
- PhD Colloquium Institute of Ecology
- Practicing Research for Science and Society
- Qualitative and Quantitative Methods
- Reflecting Interdisciplinarity / restoration
- Research Forum I
- Research Forum II
- Resilience of Ecosystems & Social-Ecological Systems
- Restoration, conservation, social-ecological management and governance of the Island of Hiddensee
- Shaping the Future: Transdisciplinary Project
- Social-ecological systems approach to ecosystem restoration
- Sustainable urban transformation of a cross-border city - a social-ecological systems approach
- Sustainability and Space
  Sustainability Science
- The Economics of Biodiversity and Ecosystem Services
- Transforming Complex Systems

- "When we stand up, they have to negotiate with us" -South-North North-South proposals form local to global sustainable changes
- Writing a journal article

THESES COMPLETED IN 2025

The following theses were completed in 2025 after supervision or co-supervision by SESI members.

PHD THESES

- **Konrad Sylvester Gray: Exploring the Role of Values, Landscapes and Relationships for Social-Ecological Restoration: Insights from a Real-World Laboratory for Grassland Restoration in Germany**
  Human activities cause the ongoing decline of biodiversity. Especially threatened are grassland ecosystems, although they have thrived for millennia under human influence as part of cultural landscapes in Central Europe. Restoring species-rich grassland is perceived beneficial to halting and reversing unfavorable biodiversity trajectories in European cultural landscapes. To advance approaches that take human action into account for biodiversity research, social-ecological systems thinking contributed to the emergence of social-ecological restoration. Investigating the role of diverse values of nature, cultivating stewardship efforts, and fostering human-nature relationships is at the forefront of social-ecological systems research. Transdisciplinary research, especially real-world laboratories (RwLs), constitutes promising characteristics for combining research from different disciplines and conducting research with local actors on issues of societal relevance. While the prospect of transdisciplinary social-ecological restoration is promising, exploring the processes and effects of and the implications for dealing with diverse values, cultivating stewardship and understanding people's relationships with nature remain a novel research endeavor. Drawing on a real-world laboratory for social-ecological grassland restoration, I aim to (i) investigate how multi-layered values, knowledge of, and visions for grassland restoration can support engagement

in a social-ecological restoration project; (ii) better understand how people's perceptions of grassland and biodiversity in a social-ecological restoration project inform engagement and stewardship; and (iii) explore the influences of social-ecological restoration interventions on participants' perspectives regarding future generations as well as their personal, social, and environmental relationships to leverage transformative change. This cumulative dissertation consists of four chapters. Chapter I synthesizes the insights of Chapters II – IV, which address the research aims respectively (i – iii). Chapter II reveals value-based social-ecological restoration perspectives to embrace nuance layers for inclusive engagement. Chapter III discusses the relevance for addressing restoration at a landscape level as well as building on existing human-nature relationships in cultural landscapes to foster engagement and overcoming knowledge barriers to cultivate stewardship. Chapter IV depicts the potential of social-ecological restoration for transformative change by fostering personal reflections, connecting like-minded people, and increasing environmental awareness. Furthermore, the relevance of future perspectives to safeguard stewardship efforts is discussed. This dissertation synthesizes that the interconnectedness of values, landscapes, and relationships provide significant relevance of social-ecological restoration and depict potential for leveraging transformative change.Expanding social-ecological restoration to account for means of amplifying initiatives could advance social-ecological restoration to not only contribute to bending the curve for biodiversity loss but moreover paving a way forward towards regenerative practices.

— **Milena Groß: Balancing the plural voices at play – approaches of researchers to advancing an inclusive understanding of people-nature relationships**

Amidst the intertwined challenges of biodiversity loss and declining human well-being, people’s perspectives on nature vary widely based on how they relate to it. Therefore, it is important that conservation policies recognize how nature contributes to human well-being and the diverse values people

ascribe to it. Yet, policies often focus narrowly on economic values, neglecting the diversity of people-nature relationships and the varied groups of people who experience them.

In contrast, a growing body of scientific research has demonstrated the importance of accounting for diverse perspectives to address the above mentioned intertwined challenges. To support this, Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) introduced two frameworks: Nature's Contributions to People (NCP), reflecting what nature supports to well-being, and the plural valuation framework, which captures the varied reasons nature matters, i.e., their values.

Yet, scientific evidence itself remains biased toward monetary valuation, thereby overlooking critical non-monetary perspectives. The disregard for non-monetary perspectives becomes evident when socio-cultural methods, which can uncover these, are applied. The methods employed for data collection and analysis, i.e., how the diversity of people-nature relationships is studied, condition our understanding of people-nature relationships and shape the resulting evidence. Two additional methodological choices also affect scientific outcomes, namely the phenomenon and framework chosen (what dimension of people-nature relationships to study and through which framework) and the selection of research participants (who participates).

This thesis seeks to advance an inclusive understanding of people-nature relationships by examining how methodological choices shape this understanding, with the ultimate goal of informing inclusive conservation policies and practices. It is based on a study of four relevant social actor groups in Mount Kilimanjaro's social-ecological system in Tanzania, conducted as part of the Kilimanjaro Social-Ecological System (Kili-SES) Research Unit.

The thesis consists of five chapters, with Chapter I framing Chapters II–V. Chapter II synthesizes how research has approached capturing tourists' values ascribed to nature in protected areas so far. Chapters III-V use socio-cultural

approaches to yield empirical evidence on NCP and value perspectives of diverse actors in Kilimanjaro.

Chapter II highlights the role of valuation frameworks and methods in shaping scientific outcomes. The frequent application of monetary methods can explain the persistent bias toward monetary values. Further, the results also show that most studies focused on tourists solely, thereby not accounting for potentially differing value perspectives of other (local) social actors.

To confront these imbalances, Chapters III–V apply socio-cultural and diverse-actor approaches. Additionally, this requires closely examining the three methodological choices mentioned above. Chapters III–V are based on data on context-specific NCP expression (Chapter III), preferences for these context-specific NCP (Chapters IV and V), and expression of diverse values tailored to the Kilimanjaro context (Chapter V). This was achieved through the analysis of 130 semi-structured interviews and 623 surveys conducted with farmers, nature conservationists, tour guides, and tourists.

On a methodological level, this thesis demonstrates how researchers can deliberately make decisions throughout the research process to advance a more inclusive understanding of people-nature relationships. It (1) offers an approach that uses different question-framings within a single method to capture diverse perspectives. Even without changing the method, these question-framings can broaden interviewees' access to their diverse perspectives and thereby, this approach reduces the risk of knowledge omission (Chapter III); (2) reflects on two analysis approaches to avoid the risk of stereotyping social actors, ensuring inclusivity throughout the research process (Chapters IV and V); and (3) shows that combining the two IPBES frameworks can better account for the multidimensionality of people-nature relationships (Chapter V). Thereby, this thesis demonstrates the influential role of researchers' decisions in shaping scientific outcomes. This is an important empirical contribution of the thesis, given the dearth of studies on people-nature relationships that incorporate a critical methodological assessment and reflection.

This thesis has important implications for conservation policy and practice (Chapter V). To account for distinct preferences for context-specific NCP and nurture value pluralism, conservation strategies must not only focus on bending the curve of biodiversity loss but need also to be diversified to simultaneously foster the well-being of all people.

— **Lukas Kuhn: Interlinking value-articulating institutions for plural values in restoration**

The present intertwined social-ecological crises are mostly a values crisis. While there is no lack of values, decision- and policy making are predominantly based on a narrow, unsustainable set of values and fall short of accounting for the vast diversity and plurality of values. Values for nature are intertwined in human-nature relations, reflecting the complex ways in which people and nature co-depend, have co-evolved, and are deeply connected across cultures and political contexts. Restoration is a global policy reaction to address the intertwined social-ecological crises. Restoration policies have historically been oriented towards instrumental values, i.e. the value of nature for human use, or intrinsic values, i.e. the inherent right of nature to exist. While relational values, that is the multiple ways people relate to nature, have been observed in many settings as motivations for environmental protection, they have been lacking in political decisions. Factors influencing the expression, recognition, inclusion, legitimization, emphasis, and actualization of values have been conceptualized as value-articulating institutions. Despite much conceptual recognition, empirical evidence for value-articulating institutions is still rare. And importantly, the concept of value-articulating institutions has dominantly been associated with and investigated as a phenomenon of valuation methods. This dissertation seeks to fill this gap by investigating three different institutions, their influence on recognition of plural values in restoration, and their interlinkages: research, formal, and informal institutions. This dissertation consists of four chapters. Chapter I provides a theoretical framework for this dissertation by outlining how the following chapters (II-IV) are connected. Chapter II investigates

empirically how commonly use value-elicitation methods for plural valuation act as value-articulating institutions. Chapter III explores how informal institutions of social structures and relations influence value articulation of individuals' values into restoration. Chapter IV interrogates the values underpinning the EU Nature Restoration Law as a formal institution that will shape restoration in the EU for the foreseeable future and articulate which values are recognized, highlighted, and emphasized. Finally, Chapter I discusses how research, formal, and informal institutions are interconnected and in their current constellation perpetuate entrenched values. The findings of this dissertation provide empirical evidence of research, formal, and informal institutions acting as interlinked value-articulating institutions to perpetuate narrow, unsustainable nature's values in restoration. Formal institutions, in form of (inter-)national restoration policies, shape nature's values investigated in research as research traditionally understands itself to serve as policy advisory providing research in formats recognized in policy. Research informs local restoration through framing, monitoring, and decision support. Moreover, policy directly frames restoration based on instrumental values by recognizing, highlighting, and emphasizing them. Additionally, formal institutions frame informal institutions by shaping which social actors, knowledges, and values are legitimized to participate and be expressed in the context of restoration by providing discursive framing. Formal institutions of (inter-)national and local level further influence informal institutions and value articulation through formal processes, thereby setting which social actors (and their values) are included, which values are recognized and legitimized. Informal institutions finally influence value articulation through structures and relations in decision spaces and which values are expressed, heard, and articulated into restoration. The empirical proof of research, formal, and informal institutions acting as value-articulating institutions and the identification of their interlinkages hold several implications. Currently, interlinked value-articulating institutions on multiple levels hinder the large-scale uptake of

plural values into restoration. However, with the shifting role of research in fields like sustainability science and social-ecological systems research, value-articulating institutions can work towards the recognition of plural values in restoration by engaging with informal institutions and plural values to shape formal institutions in policy and locally. Finally, the insights on interlinked value-articulating institutions enable research to intently deconstruct, reconstruct, and reimagine institutions and their interlinkages to work towards the recognition of plural values in restoration.

— **Camila Monserrat Benavides Frias: Food comes from agroecosystems: the role of agriculture for the reproduction of life**

This thesis explores the ecological interdependences of humans and non-human species in agroecosystems, focusing on food as a central point of encounter between them. Anchored in the framework of Agroecology (AE), this thesis examines how farmers and non-humans co-construct life systems. To reach this aim, this work integrates empirical and theoretical approaches across three main research questions (Chapters). The first two Chapters are empirical and were carried in two Indigenous territories of the Chiquitanía region of Bolivia. The empirical research intended to better understand the interdependences between humans and bees, which were taken as a relevant "boundary object" to understand part of the complexity of relationships found in agroecosystems. In the first empirical Chapter (II), the Indigenous smallholder households were characterized by including variables on Bee Contemporary Knowledge (BCK), which revealed a nuanced heterogeneity that challenges simplistic divisions between traditional and agroindustrial farmer households. It also showed that BCK seems to be more associated with the maintenance traditional agricultural practices such as crop diversification and that, in contrast, people relying on jobs outside their community had lower BCK, as well as less access to land. The second empirical Chapter (III) investigated how different agricultural settings (agroindustrial versus traditional)

shape the flowering vegetation and resource use by the generalist stingless bee Tetragonisca fiebrigi (Latreille, 1811). The findings show that while overall floral richness was similar between agricultural settings, bees heavily relied on trees at both places. The results also show that the habitats with higher availability of resources for bees were home gardens for the agroindustrial setting and fallows for the traditional setting. Third, the theoretical Chapter (IV) assessed the integration of AE perspectives in Food Sovereignty (FS) research – a grassroots concept increasingly important in food-biodiversity research arenas – through a systematic literature review. Identifying a dominant focus on farming practices and social justice, this review showed that ecological topics such ecological processes (e.g. pollination, seed dispersion, nutrient cycles) are underrepresented in FS empirical research. Overall, the Chiquitanía case study revealed the importance of including local knowledge (e.g., BCK) for describing farmers, and traced back the relationships between land use, biodiversity, and culture (Chapter II). The empirical research also revealed the fundamental role of trees for bee diets, highlighting the importance of maintaining semi-natural vegetation in the agroecosystems (Chapter III). The theoretical Chapter IV demonstrated that incorporating ecological thinking into politically engaged frameworks such as FS could enhance sustainability transformations by addressing the systemic nature of food, and thus of the need of ecosystems health. Through a transdisciplinary and locally grounded research approach, this thesis unveils the need to understand the interdependencies of human and non-human foods in farming landscapes, and the fundamental role of traditional ecological knowledge to achieve life reproduction.

— **Stefan Ortiz-Pryzchodzka: Economies of honey at the agrarian commodity frontier**

At agrarian commodity frontiers, multiple life-forms intersect and produce different arrangements amidst the tensions of converging social-ecological crises. These crises are linked to rapid land-use changes due the deforestation of highly

biodiverse areas, the overexploitation of natural resources, and the expansion of monocrops of agricultural commodities. Yet, a lack of understanding of how people experience frontier dynamics risks overlooking the diversity of economic practices and values that produce different affections, reactions, and frictions involving more-than-human agencies, which do not simply wait to be used as resources for extractivism and capital accumulation. This these, drawing on the literatures on diverse economies, more-than-human assemblages, and world-ecology, investigate people's experiences of more-than-human entanglements in their everyday economic lives at Bolivia's most active agrarian commodity frontier, the Chiquitanía. The research combines qualitative methods allowing people to represent their experiences and values, including semi-structured and walking interviews, participatory mapping, focus groups and participant observation. The findings make a case for thinking of diverse economies as ethical and political actions influenced by more-than-human relations. Diverse economies unfold as a reminder of the limits of commodification, and the complex webs of relations and agencies that constitute economic lives.

— **John Sanya Julius: Plurality within: Understanding the pluriverse of smallholders' relationships with nature on the slopes of Mount Kilimanjaro, Tanzania**

Addressing the interconnected global social-ecological challenges requires profound transformations in institutions, values, and worldviews and should be centred on diverse perspectives on conservation and the relationship between people and nature. Existing claims that conservation has partially failed because it mainly focuses on a narrow set of nature's contributions to people (NCP), values of nature, emotional connections with nature, and knowledge systems. Despite an increasing body of literature on human-nature relationships, the internal heterogeneity of relationships is understudied. Overlooking internal heterogeneity in human-nature relationships may result in vague, over generalizations about how people relate with nature. More diverse frameworks

are intended for assessing human-nature relationships, including those introduced by the Intergovernmental Science-Policy Platform for Biodiversity and Ecosystem Services (IPBES). This dissertation aims to enhance our understanding of human-nature relationships by investigating the diverse relationships smallholders have with nature on the slopes of Mount Kilimanjaro, Tanzania, so as to inform inclusive conservation policies and practices. This dissertation consists of four chapters. Chapter I frames this dissertation by outlining the contribution of the following Chapters (II-IV) on understanding internal heterogeneity. Chapter II explores the NCP preference, the perception of the NCP supply trend over the last decade, and its expression of values of nature. This study found that smallholders primarily preferred material and regulating NCP: food, feed, and regulation of freshwater quality, whose supply is perceived as decreasing, i.e., "critical" NCP. Additionally, smallholders expressed the highest share of agreement on value statements representing intrinsic values (97.1%), relational values (94.8%), and instrumental values (94.1%). Moreover, NCP preferences and nature's values were explained by altitudinal and longitudinal gradients, the place of birth of respondents and their parents, and engagement in conservation activities. Values of nature were also influenced by age, education, and membership in any association. In Chapter III, this study applied the photovoice method to understand how smallholder farmers in Kilimanjaro benefit from, value, and emotionally connect with nature. This study found three types of associations between NCP, values of nature, and emotions, which are related to the geographical location of smallholders. In Chapter IV, the study focused on homegarden (i.e., an agroforestry system) to explore the motivation behind the application of Indigenous and Local Knowledge (ILK) by smallholders. I found that smallholders fit into three distinct clusters based on ILK applications. I also found that smallholders expressed various motivations beyond livelihood support, including an inherent moral responsibility in applying ILK for homegarden management. The findings of this dissertation highlight that, first, diverse approaches to

understanding human-nature relationships should consider factors beyond the socio-demographic. Second, the application of framework and methodological approaches influences the outcomes and evidence on human-nature relationship. Third, there is a need to recognize the heterogeneity within social actor groups and the plural approaches applied. These findings have implications for conservation policy and practice, particularly through consideration of context-specific NCP preferences, the nurturing of value pluralism, and braiding of knowledge systems for inclusive conservation, thereby enhancing the quality of life for people.

MASTER THESES

- Biodiversity Monitoring in Food Forests - State, Context and Implications
- Bridging Gaps in Targeting Criteria for a Payment for Ecosystems Services (PES) Program in southern Chile
- Exploring Human and Social Capital in Namibian Rangeland Systems: Feedback Loops and Implications for Farm Abandonment – A Commercial Farmers' Perspective
- From Degeneration to Regeneration: Understanding How Restoration Interventions Could Facilitate Social-Ecological Regeneration in Western Rwanda
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- Pathways towards the successful implementation of blue-green infrastructure at the municipal level
- Perception of transaction costs by agricultural enterprises in the implementation of collaborative bottom-up agri-environmental and climate measures.
- Social-ecological typology of landowners in working landscapes of Southern Chile
- Sufficiency in the Housing Sector: A Qualitative Exploration of Downsizing Practices in the Empty Nest Phase

BACHELOR THESES

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- A Post-hoc Assessment of Ecosystem Restoration Projects: Identifying Social-ecological Factors and Patterns for Success
- A Post Hoc Social-Ecological Assessment and Mapping of Regenerative Dynamics Emerging from Ecosystem Restoration Initiatives
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- Decoloniality in Sustainability Research: Assessing Opportunities for Implementing Approaches to Decoloniality at the Social-Ecological Systems Institute, Leuphana University of Lüneburg & the Individual Potential for Researchers to Contribute to their Advancement
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- Equitable Access to Urban Ecosystem Services: A Spatial Analysis within the Distributive equity framework in Bangalore
- Exploring Plant-Based Diet Interventions: A Literature-Based Analysis from a 'Leverage Points Perspective
- How does regenerative agriculture contribute to maintaining ecosystem services (nature contributions) and promoting linkages between biological and cultural diversity in the AlVelAl region in southern spain?
- Identifying Social-Ecological System Archetypes in a Polish-German Twin-City

- Learning from the SES framework: One Health reimagined
- Policy proposals for a degrowth-transition in agri-food systems and their compliance with principles for building resilience in Social-Ecological Systems
- Post hoc assessment of restoration success of European grasslands from an integrated social-ecological perspective
- Regenerative social-ecological dynamics arising from holistic restoration in the Altiplano Estepario landscape in Spain.
- Simulation-Based Assessment of Rule-Based Drainage Strategies Concerning Environmental Security, Wind Energy Use, Energy Efficiency, and Energy Costs of the Knock Drainage System in Emden
- Spatial Modelling of Tree-Based Ecosystem Services - a Case Study in Western Rwanda
- The experience of urban nature with Chronic Fatigue Syndrome
- Transformation from the inside-out: An inquiry of inner transformation processes of individuals living a sufficient lifestyle
- Urban Green Spaces and Biodiversity: Insights from Hafencity, Hamburg
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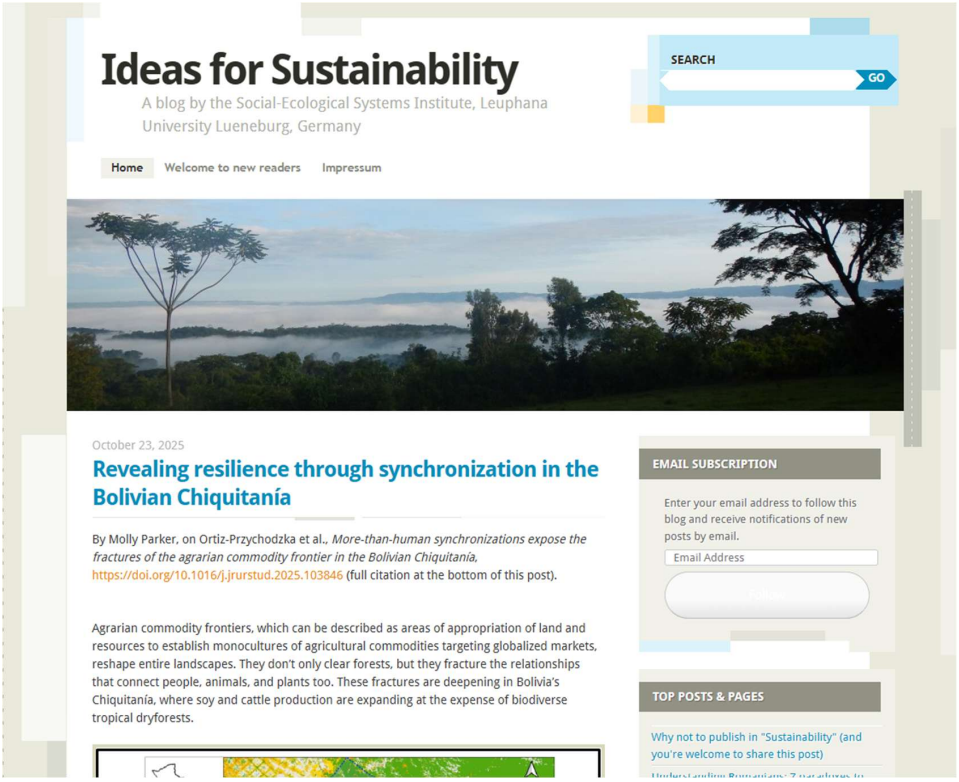
You can also follow our institute's news and publications on social media. Many of our papers are featured on our blog ideas4sustainability.wordpress.com soon after publication. Recorded talks by SESI members can be found on our YouTube channel Social Ecological Systems Institute SESI.

We thank Molly Parker for helping compile documentation throughout the year and editing this report. We thank all of SESI for the collection and contribution of the pieces and photos used to create this report.



A screenshot of the SESI blog.

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