The 6th International Research Workshop on

Archetype Analysis in Sustainability Research

June 7-9, 2023

at Lund University, Sweden (and hybrid)

Workshop program

Wednesday 7th of June

Time frame (CET)	Gustafscenen (Zoom-link)	VD-rummet (Zoom-link)	Ombudsmannarummet (Zoom-link)
9-10.00	**Registration** (Contact: Lina Eklund)		
Coffee			
10-12.00	**Orientation for new members** (Rimjhim Aggarwal, Regina Neudert, Diana Sietz, Christoph Oberlack, Klaus Eisenack)		
Lunch			
13.30 - 14.15	**Opening** (Facilitation: Nils Droste)		
Coffee	Kumospace-session: The Park of Archetypes		
14.45-16.15	**Pitch session I:** Conflict and sustainability	**Pitch session II:** Governance and management	**Pitch session III:** Land Use and sustainability
Break			
16.30-17.15	**Day 1: Wrap up** - summary, update for tomorrow (Facilitation: Nikos Alexandridis)		
Evening	Social activity and dinner at Herbivore 19:00	Bookmark	

Thursday 8th of June

Time frame (CET)	Gustafscenen (Zoom-link)	VD-rummet (Zoom-link)	Ombudsmannarummet (Zoom-link)
08.45-9.00	Kick off day 2		
9-10.30		**Paper session I:** Biophysical systems	**Paper session II:** Agricultural sectors
Coffee	Kumospace- session: The Park of Archetypes		
11-12.30	**Break out session I:** Open for ideas: Interactions	**Break out - session II:** Visual narratives I	**Break out- session III:** Dynamic archetypes I
Lunch			
13.30-15	**Break out- session IV:** Sustainable transition models	**Paper session III:** Local communities	**Paper session IV:** Synthesis
Coffee			
15.30-17	**Day 2: Wrap up** - summary, update for tomorrow		
18.30 - evening	Guided tour 18.30-19.30: Homes and their people + dinner 20.00 at Purgatorio		

Friday 9th of June

Time frame (CET)	Gustafscenen (Zoom-link)	VD-rummet (Zoom-link)	Ombudsmannarummet (Zoom-link)
9-10.30	**Break out - session V:** Open for ideas: Buzzwording Archetypes	**Break out- session VI:** Dynamic archetypes II	**Break out- session VII:** Visual narratives II
Coffee			
11-12.30	**Closing plenary** (Facilitation: Christoph Oberlack and Hanna Ekström)		
Lunch			

Book of Abstracts

Pitch session I: Conflict and sustainability

Thirsty Cities: Linking configurational analysis, case studies and game theory	Klaus Eisenack
Identifying archetypical patterns of the deforestation impact on local wellbeing	María Vallejos [online]
Archetypal Patterns in Decolonizing Environmental Education within Western Institutions	Bryant Serre, Johanna Dipple
Social-ecological shocks and their impact on rural people in tropical deforestation frontiers	Sofia Marinaro
Archetypes of Climate Change Threat to Peace and Security: insights from comparative case studies in Northern Kenya	Ndirangu Ngunjiri [online]

Thirsty Cities: Linking configurational analysis, case studies and game theory
Klaus Eisenack

The pitch presents a research design from a grant application which promised an archetype analysis on rural-urban conflicts in the water sector. In this sector, groups face decisions over the allocation of scarce resources to competing uses (drinking water, industry, energy production, and agriculture) that are prone to distributional conflicts. The sector is thus particularly insightful to study the relation between cooperation and asymmetric distributional implications. Globally, over 4 billion people are projected to live in water stressed river basins by 2050. Climate change and urbanization are intensifying competition and conflict over water, land, and energy. The grant application followed some design suggestions laid out in Eisenack, Villamayor-Tomas, Epstein et al. (2019, Design and Quality Criteria for Archetype Analysis, Ecology and Society 24 (3): 6). In particular, it aimed at (i) inductively identifying configurations of attributes in the GraD data base of water conflicts, (ii) studying selected conflicts in detail, and (iii) developing theoretical building blocks based on game theory. The archetype analysis is used to justify this whole set-up, but also to synthesize these three elements. Yet, it's not straightforward to see how this synthesis can be done within one project. Pairwise linkages between all elements need to scrutinized in a reasonable sequence. The pitch shortly presents the suggested research design, and invites for reflections for improved archetype analysis designs in the future.

Identifying archetypical patterns of the deforestation impact on local wellbeing
María Vallejos

Agriculture expansion in the Global South has a huge impact not only in the environment, but also in the wellbeing of local people. The increase in cropland and pastures at the expense of forests and other natural ecosystems in less developed countries has contributed to national economies through export taxes, but it is highly unclear if these benefits trickle down to the local level in areas where agricultural expansion happens. While some studies suggest that the arrival of capitalized actors generates benefits

that are distributed across society and eventually also lead to development for local people (e.g., job opportunities, infrastructure, or increasing social benefits), others argue that the agricultural expansion has increased hunger, poverty, unemployment, and rural migration. The aim of this work is to systematically explore the influence of deforestation on local wellbeing in the Argentinean Dry Chaco – a global deforestation hotspot. During the period of 1991–2020, this region saw a massive expansion of agribusiness. Using data from four National Population Censuses (1991-2001-2010-2020) at the department level, as well as deforestation time series from remote sensing, we analyse the links between land-use change and changes in local wellbeing. We will apply general and mixed linear regression models to explore these relations for different wellbeing parameters, and a rule-based classification to categorize types of relationships between deforestation and wellbeing. We hope this will enable us to identify archetypical cases of land-use change dynamics (e.g., specific deforestation frontier dynamics) that lead to specific wellbeing impacts, and thus to generate hypotheses about the underlying causes of these archetypes. The outcomes of this research will be useful to detect challenges and opportunities for fostering sustainable development in tropical dry forests.

Archetypal Patterns in Decolonizing Environmental Education within Western Institutions
Bryant Serre and Johanna Dipple

In North America, the 1970s were a pivotal decade of Western scientific ingenuity, which led to the remediation of the Laurentian Great Lakes, following profligate degradation by settlers. Among others, the Western education curriculum of the 1970s was stellar for its comprehensive inclusion of environmental education (EE) and how it fostered critical thinking, which ultimately led to local, regional, and national entities coming together to remediate, monitor, and preserve these precious water resources. Since the 2000s, there has been a renewed interest to improve EE in Canadian institutions, exemplified in the Bondar Commission (2007), the "Deepening Environmental Education in pre-Service Education Resource" (or DEEPER, 2013), and the Ontario Ministry of Education EE Curriculum for grades K-12 (in 2017). Disappointingly, EE is often relegated to junior-level science and social sciences classes. It has been 16 years since the Bondar Commission identified that teachers lack sufficient top-down educational support (e.g., from principals), the curricular resources, and broader community connections (e.g., science centres, nature field trip locations) to authentically include EE in their classrooms. In the Canadian education system, it has taken a long time to be understood that First Nations, Métis, and Inuit scientists and educators must be engaged, in equal partnership, for students to truly understand the natural environment around them, and subsequently act towards protecting it. Specifically to education research, both Indigenous and Western-led researchers and educators have investigated how to decolonize the EE curriculum, yielding success in the breadth of values all children learn, when all epistemologies are delivered equally. Nevertheless, a strong Indigenous voice is absent in an already minimal delivery of EE. In the select cases EE is implemented, the knowledge generated from these select school-led efforts and classroom-research is not shared with Western pre-service teachers. If decolonized EE could be implemented widely, there is proven potential to foster deep care and respect for the natural environments and lived histories of people among all students, giving way to an engaged and critical-thinking voting public not unlike the one which led the environmental revolution in the 70s. Thus, the proposed project will use archetype analysis to identify the opportunities for Western pre-service teachers to decolonize the delivery of the EE curriculum. Indeed, assembling common archetypes across Western educational institutions will

support Western pre-service teachers by giving them potential strategies to authentically approach implementation.

Social-ecological shocks and their impact on rural people in tropical deforestation frontiers
Sofia Marinaro

Tropical and subtropical dry forests harbour some of the largest undeveloped land reserves, yet experience the world's highest deforestation rates. Whereas much research has focussed on how land-use changes impacted biodiversity and ecosystem services, much less is known about the outcomes of deforestation on the livelihoods of the people inhabiting dry forests. The Dry Chaco, extending into Argentina, Bolivia and Paraguay, is a global hotspot of deforestation, but particularly weakly studied in terms of the social and economic outcomes of deforestation. In deforestation frontiers, contrast and conflicts among actors and genders are often amplified, with typically large imbalances in power, capital, and capacity. Thereby, when a sudden, unforeseen, and non-linear change (i.e. shock) takes place, it can deepen those differences. Key questions here then are how resilient land-use actors are, and whether shocks may influence livelihood outcomes and land-use practice' decisions. The region harbours a diverse portfolio of land-use actors carrying out diverse land-use practices. Also gender plays a role in the use, benefits, and decision-making on natural resources. Thereby, here we assess how actors link to the environment, and how environmental change feeds back on them through the lens of social-ecological systems. More specifically, we examine whether actor groups and genders differ in their vulnerability and adaptive capacity to social-ecological shocks. Here, we focus on four examples of different types of shocks, i) institutional (Argentinian forest zonation), ii) economic (Argentinian peso's drastic devaluation in 2022), iii) climatic (extreme drought 2022-2023), and iv) health shock (COVID19). For example, the COVID19 pandemic could have impacted rural women through an overweight of domestic tasks from the lockdown, and on peasant households through the inattention of the farm duties in cases of long sickness (since household duties are gendered divided). We use archetype approaches in two ways to address these questions. First, we condense the considerable heterogeneity and complexity in actors and their relations to the environment by defining and mapping a typology of land systems. Second, we use the Resilience Index for Measurement and Analysis (i.e. RIMA) developed by the FAO (2016) to quantify the resilience, by genders, of main land-use actors in the Dry Chaco to different social-ecological shocks. This permits to extract the socio-economic and cultural variables that contribute most to resilience. Finally, our analyses will yield archetypical combinations of shocks and resilience outcomes across actor groups and geographic situations.

Archetypes of Climate Change Threat to Peace and Security: insights from comparative case studies in Northern Kenya
Ndirangu Ngunjiri

Northern Kenya Counties (NKCs), more so climate change in transforming and redefining the way we think about security and peace, northern Kenya is highly vulnerable to climate change, including flooding, droughts and, most recently, a locust infestation. Archetype analysis with its focus on identifying climate change relations with peace and security. This is likely to tackle

on resource use problems in NKCs. This involves activities that connect between climate change and conflict and to increase understanding among policymakers, academics, and the general public. An archetype analysis was conducted based on primary data from 45 cases in NKCs. In total, 37 archetypical patterns were extracted, and the following implications were observed (1) projected climate change poses a serious threat to Kenya's national security; it acts as a threat multiplier for instability in some of the most volatile regions in Kenya. (2) Climate change-related shifts in rainfall patterns and increased frequency of droughts have led to resource scarcity and competition, exacerbating existing social and economic vulnerabilities. (3) Local authorities lack the resources, capacity, and coordination needed to effectively manage the impacts of climate change on communities. (4) Climate change-related environmental degradation has led to increased migration and displacement. Regarding policy recommendations, archetypical problems is interlinked in their actual case-study. These findings may benefit Northern Kenya Counties and other regions pursuing people dependent on natural resources for their livelihoods. Conflict-sensitive adaptation strategies are needed. Such strategies should take into account the potential unintended consequences of adaptation measures on conflict dynamics and prioritize the participation of marginalized communities in decision-making processes. International support is critical to addressing the climate change threat to peace and security in NKCs.

Key words: *Peace, Security, Kenya, Water, Environment, archetypes; natural resources; pasture; system archetypes*

Pitch session II: Governance and management

Project Archetypes: Exploring the Field Patterns of the European Research Area	Zane Sime [online]
Archetypical Patterns for Climate Adaptation Actions of Local Governments: Evidence from 293 Cities in China	Rongyu Wang
Archetypes of transformative change: finding evidence to navigate and upscale societal transformation.	Simon Vaňo [online]
Integrating social-ecological complexity into conservation planning: Archetyping land-use actors and activities in the world's tropical dry forests	Marie Pratzer
How does the financial system shape public environmental goods in Sweden? An archetypical study examining the underlying patterns of biodiversity conservation governance	Jesper Svensson

Project Archetypes: Exploring the Field Patterns of the European Research Area
Zane Sime

This paper builds on the sustainability research and resilience studies pursued within a broader enquiry into the EU science diplomacy towards the Southern neighbourhood. This practice-theory guided enquiry into Bourdieusian field dynamics of research collaboration explores the supranational incentives offered by the EU. Based on insights offered by the leading figures of projects funded by

Framework Programme 7 and Horizon 2020, this study examines how multilateral research ties contribute to post-Westphalian external action aspirations and structural power projection. Expert experiences of co-developing research-intensive solutions to address the most pressing environmental, socio-economic, and geopolitical challenges faced by the EU and its Southern neighbours offer new insights into the important role that science plays in advancing the EU's external action.

The paper outlines archetypes to offer more nuanced patterns to the field dynamics identified so far in the PhD thesis. Theoretically, the paper relies on a contemporary reading of Bourdieusian role of habitus and capital pursuits motivating agents in their routine operations across the framework field and its subfields. Methodologically, the study of archetypes follows the explaining-outcome process-tracing chosen for the PhD thesis. Regarding their functionality (Oberlack et al., 2019), archetypes are employed to identify a range of project models and how those shape empirical patterns of relational dynamics within the framework field of the European Research Area. Building on Eisenack et al. (2019), four project archetypes with distinct attributes are modelled to argue in a more systematised way how time-bound EU-funded relational ties across a project consortium shape the fluid and ever-changing patterns of multilateral collaboration and partnership structures across the European Research Area as a framework field. Discerning four project partnership archetypes helps go beyond the generalised observation of the European Research Area's in-built pan-European dynamics and supranational integrationist logic. Archetypes assist in tracing patterned relational interactions and how those connect the Southern neighbourhood to the European hubs and research cores.

Keywords: practice theory, archetypes, European Southern Neighbourhood Policy, EU Framework Programmes

Archetypical Patterns for Climate Adaptation Actions of Local Governments: Evidence from 293 Cities in China

Rongyu Wang

The extant literature focuses more on the patterns and the underlying drivers of climate adaptation at the local level in democratic or Western institutional settings. In practice, China, however, has proposed a seemingly ambitious blueprint for climate change mitigation that has carbon dioxide emissions peak by 2030 and achieves carbon neutrality by 2060, whereas its central government has not yet enacted a unified and decisive strategy for climate adaptation. Given the regionally decentralized authoritarian (RDA) regime, local governments in China take similarly dedicated mitigation actions while show greater diversity in adaptation actions. Thus, it comes to our research questions: why do local governments differ in climate adaptation actions? More specifically, what are the factors jointly contributing to diverse climate adaptation actions of local governments? To that end, this study intends to develop a theoretical framework for the interplay of natural, economic, political and social domains to conceptualize the underlying patterns for climate adaptation actions of local governments, based on which several hypotheses can be raised. For instance, 1) well-developed economy, sufficient fiscal capacity and widespread social awareness of climate change enable local governments to launch the policy of climate adaptation across their jurisdiction; 2) weaker adaptation capability of natural endowment enhances the willingness of local governments to institutionalize and propel climate adaptation to sustain socioeconomic development; 3) less developed economy, insufficient fiscal capacity and lacking social awareness of climate change discourage local governments from taking the policy of climate adaptation, and the local governments at most establish

model projects of climate adaptation to underscore the fulfillments for the political decisions of superior governments. To test these hypotheses, an archetype analysis is conducted with a large-N QCA approach to extract combinations of factors that lead to diverse local climate adaptation actions from 293 cities in China. Ultimately, it concludes with the policy implications for motivating climate adaptation actions at the local level, considering the combined effects of natural, economic, political and social factors. The highlights of this study include: 1) a systemism research paradigm is developed to explain diversity in climate adaptation actions of local governments; 2) the underlying patterns for local actions of climate adaptation are drawn from large-scale samples, providing relatively sound empirical evidence for behavioral motivations of local governments; 3) the above research paradigm and the findings thereafter potentially contribute to the subsequent investigation into and a better understanding of government-led climate adaptation in transitional countries that are distinct from democratic Western context.

Archetypes of transformative change: finding evidence to navigate and upscale societal transformation.
Simon Vaňo

The EU currently faces an urgent challenge of transforming societal functioning and governance[1] that allows for reaching synergic outcomes in the Nexus of biodiversity conservation, climate protection, water and food provision, energy security, transport and health. Thus, the EU Horizon project BIONEXT was launched to demonstrate the reasons for biodiversity loss and to make visible the interdependences within the biodiversity Nexus – its current and future linkages and drivers to initiate, accelerate and upscale biodiversity-relevant transformative change in society[2]. In this contribution, we present an archetype analysis[3] study applied within the project BIONEXT to identify recurrent patterns of transformative factors and processes, as well as enablers for and barriers to reaching desired outcomes[4], while ensuring synergic outcomes for the biodiversity Nexus across real-world case studies. The methodological procedure is as follows. (i) We built an exhaustive repository of case studies, selecting a sample (n = 40) showing signs of social or governance transformation and leading to synergic outcomes for the Nexus. (ii) We code and analyse these cases to disaggregate the embedded socio-ecological factors and processes and to uncover interactions between them. (iii) The analytical methods, such as qualitative dynamic modelling or model-centred meta-analysis, are deployed to identify the archetypal recurrent patterns and configurations in coded information from the cases. The selected methods allow direct investigation of causality between drivers and outcomes[5]. (iv) A database of "transformative change" showcases will be extracted, including cases where transformation has failed. The analysis results in clarifying archetypal building blocks of transformational processes, the

[1] EEA. 2019. The European environment —state and outlook 2020Knowledge for transition to a sustainable Europe Luxembourg: Publications Office of the European Union.
[2] Bulkeley, H., et al. 2020. Moving Towards Transformative Change for Biodiversity: Harnessing the Potential of the Post-2020 Global Biodiversity Framework. An EKLIPSE Expert Working Group report.
[3] Oberlack, C., et al. 2019. Archetype analysis in sustainability research: meanings, motivations, and evidence-based policy making. Ecology and Society 24(2):26.
[4] Magliocca, N. R.,et al. 2019. Archetypical pathways of direct and indirect land-use change caused by Cambodia's economic land concessions. Ecology and Society 24(2):25.
[5] Sietz, D., et al. 2019. Archetype analysis in sustainability research: methodological portfolio and analytical frontiers. Ecology and Society 24(3):34.

causes behind the barriers to their implementation, and archetypal enablers of transformation. This knowledge is vital for the transfer of insights to other contexts and will be used in a novel decision-support tool, developed to allow users explore archetypal building blocks of transformational processes and showcase their practical implementation. The outcomes will also inform EU policymakers and practitioners with competencies in the biodiversity Nexus and will feed into the IPBES science-policy assessments. As part of this contribution, we would like to propose several discussion topics touching upon the scale, scope, and purpose of the analysis: --What are the pros and cons of applying the following methods? (i) Qualitative dynamic modelling (e.g., [6] [7] [8] [9]), (ii) cluster analysis (e.g., [10] [11] [12] [13]) and (iii) model- or process-centred meta-analysis (e.g., [14]). --Should we opt for a mixed methods or a single method approach in our study? --What is the optimal case sample size? --A web application (decision support tool) is developed to facilitate simulation of decisions and transformative pathways. Archetypes will be used as the basic building blocks in this simulation which the application evaluates using MCDA (multicriteria decision analysis). Are there any similar experiences or projects with such efforts?

Integrating social-ecological complexity into conservation planning: Archetyping land-use actors and activities in the world's tropical dry forests
Marie Pratzer

The diversity of actors and activities on land is a major challenge for designing effective conservation interventions to safeguard biodiversity. Conservation science, like other scientific fields, has often not accounted for the complexity related to land use, partly due to a lack of methodologies to do so. More generally, it remains unclear how a middle-ground between oversimplification and case-specificity could look like. So far, two main shortcomings have prevented a deeper consideration of land-use complexity in conservation. On the one hand, global or large-scale conservation assessments rely heavily on simple land-cover proxies that do not appropriately represent the diversity of actors and activities on land and thus limit our ability to design targeted conservation interventions. On the other hand, local conservation assessments remain place-specific and thus hinder cross-regional

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[6] Sietz D., et al. 2006. Smallholder agriculture in northeast Brazil: assessing heterogeneous human-environmental dynamics. Regional Environmental Change 6:132-146.

[7] Egerer S., et al. 2021. A Leverage Points Analysis of a Qualitative System Dynamics Model for Climate Change Adaptation in Agriculture. Agricultural Systems.

[8] Bennich, T., et al. 2018. The Bio-Based Economy: Dynamics Governing Transition Pathways in the Swedish Forestry Sector. Sustainability. 10(4):976.

[9] Banson K. E., et al. 2016. Using system archetypes to identify drivers and barriers for sustainable agriculture in Africa: a case study in Ghana. Systems Research and Behavioral Science, 33(1), 79-99.

[10] Sietz, D., et al. 2011. Categorisation of typical vulnerability patterns in global drylands. Global Environmental Change 21(2):431-440.

[11] Kok, M., et al. 2016. A new method for analysing socio-ecological patterns of vulnerability. Regional Environmental Change 16(1):229-243.

[12] Rocha J. C., et al. 2019. Mapping social ecological systems archetypes. Environ Res Lett.

[13] Merino, V.M., et al. 2019. Archetypes of Climate Vulnerability: a Mixed-method Approach Applied in the Peruvian Andes, Climate and Development, 11:5, 418-434.

[14] Oberlack, C., 2017. Diagnosing institutional barriers and opportunities for adaptation to climate change. Mitigation and Adaptation Strategies for Global Change 22, 805–838.

comparison, knowledge transfer, and fail to inform planning that needs to be made across spatial scales. We here use a hierarchical, expert-knowledge-based archetypes approach to address these gaps. Specifically, we developed an actor-based land-system typology to represent land-use-related challenges and opportunities to conservation. We aimed at a level of abstraction that is appropriate to create a parsimonious typology that allows for comparison across cases, while still retaining descriptive detail for targeted conservation interventions. This presentation aims to share the methodology to design a hierarchical, scalable typology, building on regional and global expert knowledge, as well as our emerging typology itself. The latter consists of two levels: a generic top-down level that ensures broad applicability and cross-regional synthesis, and, nested within, a refined bottom-up level, allowing for regionalization and mapping. Both levels are based on expert assessments as a multicriteria assessment tool to derive the appropriate level of nuance that fits the requirements of region-specific conservation planning as well as cross-regional synthesis. Key challenges that we would like to discuss at the workshop relate to a) the use of expert-knowledge in under-researched and data-wise underrepresented sustainability issues, and b) the mapping, and specifically the overlap, of spatial representations of archetypes.

How does the financial system shape public environmental goods in Sweden? An archetypical study examining the underlying patterns of biodiversity conservation governance
Jesper Svensson

Non-state actors, such as financial markets and multistakeholder organization, increasingly shape environmental governance globally and locally. However, we still have a limited understanding of their investments and impacts over time and space. This is particularly the case for biodiversity governance, in terms of instrument design, and outcomes of different types of policy mixes. Thus, there is an opportunity to illuminate the conditions under which market-based strategies promote or undermine biodiversity and the mechanisms underlying those processes. This study seeks to address this research through its attention to how the financial system in Sweden affect land-use change and management in agriculture, forestry, and energy-sectors. The study seeks to understand: Which institutional and actor-configurations, and policy processes contribute to safeguard biodiversity in Sweden? The contribution is twofold: first, we develop an analytical framework guided by the Coupled Infrastructure Systems (CIS) framework along with the theory of collective action to understand the linkages between institutions, governance, and ecological systems faced with land-use changes. Thereby, different types of configurational archetypes can be derived from theory. The second contribution is empirical: we will compile and analyze and compile datasets on financial investments, as well as supporting documents to match investments to their organizational, institutional, and geographical settings in Sweden. We complement the quantitative dataset of financial flows along value chains with stakeholder interviews to shed light on the perceived drivers behind the funding, types of interventions and changes over time. By mapping the empirical data in the developed conceptual framework, we can populate the theoretical archetype space and analyze the prevalence of different archetypical configurations. This showcases a novel way to conduct a configurational archetype analysis. The study will thereby that reveal underlying patterns of biodiversity conservation, and exemplify the potential role of financial market actors and other non-state actors.

Pitch session III: Landuse and sustainability

Sustainability pathway archetypes in global drylands	Zuzana Harmackova
Archetype analysis to explore the implementation of sustainable agroecological practices	Diana Alfonso-Bécares [online]
Farming System Archetypes for modelling impacts of agricultural policies	Tomáš Václavík [online]
Social-ecological well-being in Land systems of The Alto Paraná Atlantic Forest, South America.	Ahuvit Trumper
Archetype methods to link land-use actors and threats to biodiversity	Tobias Kuemmerle
Understanding interactions between carnivores and livestock systems across the South American dry diagonal	Jamie Burton

Sustainability pathway archetypes in global drylands
Zuzana Harmackova

Identifying inclusive pathways to reaching sustainable and just futures is extremely challenging, particularly in areas like global drylands due to their increasing social and environmental pressures, rising inequalities and conflicts related to water availability[15][16][17]. In this contribution, we present preliminary results of the project "XPaths: Science in action – intersecting pathways to the SDGs across scales in the drylands" funded by the Swedish research foundation Formas, focusing on co-designing inclusive pathways towards the Sustainable Development Goals (SDGs) through a science-action research process in three critical dryland regions: Senegal, Brazil, and Spain. In each of the study regions, we organized several stakeholder dialogues across decision-making scales, from local to regional. Each of the dialogues focused on a different step in the sequence from identifying (A) current social-ecological concerns in dryland regions, (B) visions of a desirable futures and (C) the actions needed to weaken the status quo and transform to the envisioned future (the Three Horizons approach)[18][19]. The subsequent archetype analysis focused on the relationship between actors' vision of a just and sustainable future and actions identified by the actors as leading to their vision. In particular, actors' visions were defined by elements related to different SDGs and their justice dimension. On the

[15] FAO. 2019 Trees, forests and land use in drylands: the first global assessment. FAO Forestry Paper No. 184. Rome.

[16] Pousa, R et al 2019. Climate Change and Intense Irrigation Growth in Western Bahia, Brazil: The Urgent Need for Hydroclimatic Monitoring. Water, 11(5), 933.

[17] Woodhouse, P 2012 New investment, old challenges. Land deals and the water constraint in African agriculture. Journal of Peasant Studies, 39(3–4), 777–794.

[18] Aguiar, A.P.D., et al., 2020. Co-designing global target-seeking scenarios: A cross-scale participatory process for capturing multiple perspectives on pathways to sustainability. Global Environmental Change 65.

[19] Harmáčková, Z. V., et al., 2022. Linking multiple values of nature with future impacts: value-based participatory scenario development for sustainable landscape governance. Sustainability Science 17, 849–864.

side of actions, recurrent patterns were identified among actions with social, economic, environmental and governance-related impacts and their combinations[20]. As a part of a broader analysis, the archetypes of sustainability pathways have been linked to relevant societal actors and to potential leverage points to their implementation[21]. The results of the archetype analysis are planned to be utilized by Swedish and international development actors as a guidance on which combinations of pro-sustainability actions seem to be shared among global contexts and which appear to be specific to the conditions of different dryland countries. In relation to this pitch, we would like to propose the following discussion topics:

- *What are the different ways in which archetype analysis can be nested within a larger project structure?*
- *What are the approaches to archetype analysis available in the case of collecting data in data-poor contexts or in situations with other constraining factors (e.g. illiterate participants)?*
- *What is the experience of the archetype community so far with the transfer of the identified archetypes into practical guidance to practitioners and decision-makers?*

Archetype analysis to explore the implementation of sustainable agroecological practices
Diana Alfonso- Bécares

Although the drivers of sustainable practices and environmental motivations are commonly analyzed through the lens of behavioral analysis, we believe that the use of archetype analysis can help identify factors underlying these choices at the household level. In this case we define archetypes as notional households working as attractors and thus sharing a set of biophysical and socioeconomic characteristics and expressing different practices depending on their internal structure and their boundary conditions.

A methodology using land use and livelihood types has already been applied to characterize the different responses to a conservation policy in a rural community (Alfonso-Bécares et al., 2023). The identity of the livelihood types has been defined using the concept of metabolic profiles to study the factors that affect the individual households' choices of livelihood strategies (Alfonso-Bécares et al. submitted). We propose thus a combination of this type of analysis with a land time budget analysis (Pastore et al., 1999) where household are sorted in these previously defined types to help understand each household's social practices and therefore their willingness or reluctance to engage in sustainable farming and management activities.

The undertaking of the techniques and practices required by agroecology standards entails a change for the household in terms of invested time and land surface. To elicit the entanglement between these changes and the array of possibilities of involvement in agroecological practices, the differences between types are formalized: in this way we can identify the factors influencing the possibilities and constraints to agroecological conversion.
Apart from the internal characteristics of the households, there are also defining elements coming from upper hierarchical levels, since the characteristics of the boundary conditions would have an influence

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[20] Oberlack, C., 2017. Diagnosing institutional barriers and opportunities for adaptation to climate change. Mitigation and Adaptation Strategies for Global Change 22, 805–838.
[21] Abson, D.J., et al., 2017. Leverage points for sustainability transformation. Ambio 46, 30–39.

on how the households are distributed in archetypes. In this sense, a multiscale analysis can help define these boundary conditions. This methodology involves obtaining an important amount of information at different levels of analysis, but we believe can contribute to the identification of eventual compromises and interactions between social welfare, agricultural productivity, and sustainable practices. It allows to explore the links between the implementation of agroecological practices to possible structural obstacles and trade-offs and explore scenarios relating these practices to the social wellbeing of the stakeholders.

Farming System Archetypes for modelling impacts of agricultural policies
Tomáš Václavík

Nearly half of the land in Europe is used for agriculture, providing a range of ecosystem services and livelihoods for 10 million farmers. However, current models used to assess the impact of agricultural policies struggle to capture the complexity of farmers' decision-making, which can lead to incorrect predictions of policy outcomes. In this study, we apply archetype analysis, a key methodological approach in landscape research for organizing the complexity of social-ecological systems, to develop and test a generalized typology of farming systems. The Farming System Archetypes (FSAs) classify farms according to characteristics important for decision-making into units that are assumed to react similarly to policy change. Exemplified in five case studies across Europe, we map FSAs by geospatial relations of unique farm-level data on (1) farm specialization (a relative share of the standard crop and animal production – e.g. general cropping, horticulture, permanent crops, grazing livestock) and (2) economic size (the total value of standard production calculated from the area of individual crops and the number of animals at an agricultural holding). We test the usefulness of our typology by investigating the spatial correlation between FSAs and the adoption of agri-environmental schemes (AES), a typical example of agricultural policy. Specifically, we examine the degree to which AES adoption can be explained by archetypes of farming systems and whether additional farm characteristics and biophysical variables are needed to understand the local context that influences farmers' decisions on AES implementation.

Social-ecological well-being in Land systems of The Alto Paraná Atlantic Forest, South America.
Ahuvit Trumper

Identifying and Quantifying typologies of Social-ecological well-being (SEW) is key for detecting development needs and policy gaps. Often, the lack of social-ecological data at spatial scales relevant for policymaking hampers the inclusion of holistic measurements of well-being in indicators of sustainable development. The characterization of Social-ecological land systems (SELS), which integrates the multiple characteristics of regions, such as social configurations, environmental constraints, settlement patterns, or land-uses dynamics allows working with spatial regions and scales meaningful for regional/local planning efforts and at which the development of legitimate indicators are optimal. The integration of both, SELS and SEWs, contribute to understanding and filling gaps in sustainable development information in complex regions, but has hardly been done. For my research I focus on tropical forests, complex systems with high biocultural diversity but also extensive land uses, that are especially challenging to characterize. Moreover, I use a triple frontier as a natural experiment where to compare the influence of territorial planning on the regional SELS and SEW. In this

contribution, I would like to pitch my doctoral research proposal. First, I will identify and map Archetypes of SELS for the triple-frontier of the Alto Paraná Atlantic Forest (APAF), between Paraguay, Argentina, and Brazil. The SELS units will integrate information that is meaningful, coherent, legit, and comparable for the entire area. Specifically, I will include current and past spatial data, with tabular data to be spatialized, on environmental, economic, and social aspects, (the latter often missing in local-to-regional studies), in addition to interviews with experts and actor groups. The data will be clustered through the use of self-organizing maps (SOMs), an unsupervised technique, that groups observations based on their similarity and location, reducing the high dimensionality of the data, and resulting in a wall-to-wall SELS map for the triple frontier of the APAF. Second, I will model SEW individually for each of the SELS using representative variables in the economic, social, and environmental disciplines. I will use causal diagrams for selected municipalities with continuous coverage of the target variables. These will allow modeling the SEW and later extrapolating them to fill information gaps at SELS level. The result will lead to a wall-to-wall typology of SEW map per SELS, validated in field interviews. Finally, I will compare synergies and trade-offs of SEW variables per country and among the three countries, using Hasse diagrams, to contribute to filling information gaps.

Understanding interactions between carnivores and livestock systems across the South American dry diagonal

Jamie Burton

Livestock have played a huge role in the cultural, social, and ecological definition of tropical dry forests in South America. They have shaped how humans interact with biodiversity. As livestock expansion replaces – often violently – suitable habitat for endemic species, questions remain on what the broader implications for multispecies co-existence are. In this research, we explore these implications; those relevant to both livestock and conservation management. Biodiversity-wise, we focus on large carnivores (i.e., Jaguar Panthera onca and Puma Puma concolor), since they pose a friction between ranchers and conservation, by predating on livestock, and affecting livelihoods. Previous studies on the causes of predation have shown that the ecology of livestock and carnivores matters. The intricacies of a particular livestock system (e.g., the composition of livestock, the intensity of livestock production, and the biophysical attributes of a farm) influence a carnivore's perception of the environment and decision to predate on livestock. Understanding carnivores' interactions amongst expanding livestock systems can help with management decisions, but a systematic gaze in tropical dry forests is lacking. Followingly, we conduct an analysis of human-livestock-carnivore interactions at a regional scale – in the dry forest ecoregions of South America (e.g., the Argentine Chaco and Brazilian Cerrado). First, we glean the literature to understand the typical ecological, biophysical, demographic, and behavioural characteristics that lead to livestock depredation by large carnivores in South America. Second, we identify livestock systems in our study region using local trade and stocking data together with Bayesian Hierarchical Clustering. Doing so, we can estimate the composition of individual livestock (i.e., by age, gender, and species), and predict where intensification processes are concentrated. Finally, we use remote sensing to extract biophysical and land cover attributes for our study region. Combined, these data allow us to simulate how carnivores might interact with different livestock systems – varying in composition and intensity – at a regional scale. We explore the limitations and advantages of this probabilistic approach in making informed conservation decisions that are relevant to livestock owners and biodiversity.

Archetype methods to link land-use actors and threats to biodiversity
Tobias Kuemmerle

Addressing the biodiversity crisis critically depends on spatial data on land-use actors and how their activities translate into threats to biodiversity. Such data are often difficult to get, or entirely missing, particularly for those regions where pressure on biodiversity is highest. A barrier towards generating such data has been the huge complexity of land-use actors and activities, and how these potentially threaten species of conservation concern. Here, we use concepts and approaches rooted in archetype analysis to develop and map threat indicators. Focussing on the world's tropical dry forests generally, and the Argentinean and Bolivian Chaco and Chiquitania as case studies, we do this in three main steps. First, we developed an expert-elicited land system typology, where systems are defined based on key land-use actors and practices; designed using top-down elements to allow for cross-comparison, and bottom-up elements for appropriately considering regional contexts. Second, we link these land systems to portfolios of threat, that vary depending on species' traits. Finally, we develop a methodology to map these land systems which, when overlaid with species' distributions, allow for species-specific spatial threat indicators to be derived and included in conservation planning. More generally, we highlight how archetype analyses can foster a deeper understanding of the geography of threats, uncover where synergistic threats occur, and how the spatial footprints of threats vary over time. The key challenges that we would like to discuss at the workshop relate to the transferability and scalability of regionalized typologies of land systems and threat portfolios.

Paper session I: Biophysical systems

	Presenter	Discussant
Opportunities and challenges for integrating national observation networks into the construction of human-environment system archetypes	Matthew Williamson	Xander Huggins
Global groundwater system archetypes: a typology of social, ecological, and Earth system interactions with groundwater at the global scale	Xander Huggins	Sergio Wicki [online]
Archetypes of social-ecological-technological systems for managing ecological infrastructure	Sergio Wicki [online]	Matthew Williamson

Opportunities and challenges for integrating national observation networks into the construction of human-environment system archetypes
Matthew Williamson

Human-environment system (HES) archetypes integrate quantitative and qualitative data into typologies with common structural and compositional elements to investigate system dynamics that determine behaviors and outcomes. Although archetypes have proven to be a useful tool for balancing generality with contextual nuance, the integration of state-of-the-art remote sensing products which provide data at increased spatial grain, extent, and thematic resolution remains relatively rare. Similarly, long-term datasets amassed by national- and continental-scale observation networks (e.g.,

the United States National Ecological Observation Network, European Environment Information and Observation Network) are also rarely incorporated despite their ability to provide longer-term data on environmental dynamics at relatively high temporal resolution. Although the dramatic increase in the volume of spatially referenced data describing structure, composition, and dynamics of HES allows increasingly complex archetypes to be constructed, the potential for noisy or spurious classifications also increases. In particular, the sensitivity of archetypes to decisions about the scale (both thematic and spatial) and resolutions of data (including remote sensing, ecological, social) used in each analysis is uncertain. Further, mismatches in extent and resolution of datasets influence archetype typologies and analyses. We explore these challenges in the context of the United States National Ecological Observation Networks's (NEON) Aerial Observation Platform (AOP). NEON provides access to extensive ecological data and multi-spectral, multi-resolution remote sensing products for each of the field sites with data collected and curated for the next 30 years across a variety of social-ecological contexts. We describe how decisions about data inclusion; spatial, temporal, and thematic resolution, and temporal dynamics alter both the description and spatial configuration of resulting archetypes and the implications for the diagnosis of social-ecological challenges. We also introduce the Landscape Exchange Network for Socio-Environmental Systems (LENS), a US National Science Foundation-supported Research Coordination Network that promotes comparative research that analyzes the dynamics of complex adaptive systems and supports interdisciplinary collaborations for researchers interested in HES dynamics and sustainability.

Global groundwater system archetypes: a typology of social, ecological, and Earth system interactions with groundwater at the global scale
Xander Huggins

Global groundwater resources exhibit significant heterogeneity in their physical attributes (e.g., quantity, quality, and hydrogeological setting). The addition of regional differences in groundwater governance, agriculture, and groundwater-dependent ecosystems (among myriad other connected systems) suggest that the heterogeneity of groundwater connections in social-ecological systems may be even more pronounced. While several global classification systems have been produced for physical groundwater systems, there is no global typology of groundwater through a social-ecological systems framing.
We perceive the absence of such a classification system to undermine global groundwater sustainability initiatives. These initiatives are gaining momentum, evidenced through initiatives such as the Global Groundwater Statement (www.groundwaterstatement.org/). Our archetypes represent an effort to nudge the groundwater community away from global-scale studies that focus predominantly on physical groundwater systems and towards a social-ecological systems conceptualization of groundwater systems and sustainability. We do this by providing a global, geospatial data-driven typology of groundwater interactions with social, ecological, and Earth systems. The implications of the work extend beyond shifting mental models of hydrogeologists as the archetypes could prove useful for other research applications including the development of the next generation of hydrological models and could support interregional cooperation and networking.

We have produced a spatially-explicit, moderate resolution (5 arcminute) global map of groundwater system archetypes based on groundwater interactions with streamflow, ecosystems, climate, food systems and water governance. We derive archetypes using a recursive self-organising map (SOM)

algorithm, which has been shown to be an effective approach in exploratory archetype analysis where outcomes cannot be validated by existing system typologies. Bias of the co-authorship team's world views and disciplinary backgrounds undoubtedly affects the archetyping methods and approach presented here. However, in our view, the use of this recursive SOM approach does minimise some forms of subjectivity compared to other approaches for data-driven, spatially explicit archetype derivation.

Our preliminary results reveal nine global archetypes of groundwater interactions with social-ecological systems. These archetypes identify unique system configurations, reflecting unique qualities such as industrial agriculture, small landholder agriculture, under-serviced populations with limited groundwater management, extensive groundwater-dependent ecosystems, and deep groundwater systems with limited connections to social-ecological processes. All large aquifer systems of the world (i.e., WHYMAP aquifers) are characterised by multiple groundwater system archetypes, illustrating the need for context-appropriate approaches within these large aquifers.

We additionally provide an outlook on sustainable development opportunities and challenges for each groundwater system archetype. We do so by summarising global data sets that relate to the UN Sustainable Development Goals, which include crop yield gaps (SDG 2), groundwater storage trends (SDG 6), economic inequality (SDG 10), human modification of terrestrial lands (SDG 15), and likelihood for hydropolitical interaction (SDG 16).

In sum, our project provides a first-look at global groundwater resources through the framing of groundwater within social-ecological systems. As we harness the rapid growth in global data that document groundwater interactions in social, ecological, and Earth systems, we simultaneously provide a synthesis and snapshot of the global data space, which can be used to inform future data collection efforts.

Archetypes of social-ecological-technological systems for managing ecological infrastructure
Sergio Wicki

Topic
This paper presents an archetypisation framework for clustering different domains of social-ecological-technological systems (McPhearson et al., 2016) in order to identify management strategies for ecological infrastructure. The authors argue that a landscape approach (Sayer et al., 2013) is needed for the management of ecological infrastructure in order to plan for multifunctional spaces (Hölting et al., 2019), integrate different components of the ecological infrastructure, and better coordinate management strategies. We suggest archetype analysis to be used in combination with expert knowledge (Sietz et al., 2019), which can provide a valuable framework for identifying effective ecological infrastructure measures. The paper further states that linking archetypes to prioritization maps can aid in proactive decision-making and support science-policy dialogue for a sustainable development of ecological infrastructure.

Methods
The data used in the analysis is based on a systematic search procedure, focusing on the three domains of social-ecological-technical systems in Geneva, Switzerland. The data was used to inform

the design of an archetypisation-framework based on the work of Piemontese et al. (2022). We applied the framework on the data representing social-ecological-technological systems. The geospatial raster layers are grouped into three domains using K-means clustering algorithm followed by application of a spatial patterns clustering algorithm (Nowosad, 2021). The resulting archetypes are validated through stakeholder interviews. A stakeholder workshop in the format world café (Löhr et al., 2020) was hosted to discuss measures in each archetype needed to ensure a functioning ecological infrastructure in the future. The outcomes and insights are transferred to formulate recommendations and proposed management strategies, resulting in a profile and recommendations for each archetype.

Results
Using our archetypisation framework and the input data mentioned above, seven archetypes of social-ecological-technological systems were identified in the Canton of Geneva, Switzerland. The analysis of the archetypes revealed that social and technological domains tend to be synergistic, while the ecological domain appears to be in competition with the other two domains. A comparison of the archetypes in their scores of biodiversity, connectivity, and vegetation height uncovered major differences. The composition of habitats per archetype was also varying greatly between archetypes. We used this information in combination with the expertise of stakeholders to create a profile and propose a management strategy for each archetype.

Relevance
This work is relevant because it represents the first approach to define archetypes of social-ecological-technological systems. Additionally, the detailed delineation of archetypes using high-resolution raster datasets is novel to our knowledge. Beyond the scientific relevance, we believe that our insights provide useful information for decision-makers concerned with managing ecological infrastructure. We therefore hope to contribute to the science-policy dialogue towards a more integrated, inter-sectoral and sustainable development of ecological infrastructure leading to more comprehensive and coherent policies in the future.

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Paper session II: Agricultural sectors

	Presenter	Discussant
Social-ecological archetypes of smallholder coastal pond aquaculture development in Indonesia	Stefan Partelow	Marie Meyer-Jürshof
Mapping dynamic grassland system archetypes in Germany from 1992-2019	Richard Orozco [online] & Marie Meyer-Jürshof	Christoph Oberlack
With and beyond certification: archetypical strategies for sustainable development in coffee and cocoa sectors	Christoph Oberlack	Stefan Partelow

Social-ecological archetypes of smallholder coastal pond aquaculture development in Indonesia
Stefan Partelow (Ben Nagel)

Aquaculture is the fastest growing food sector globally, yet while it has the potential to address issues of food and livelihood security, it also brings with it sustainability challenges ranging from environmental degradation to privatization of coastal spaces and social inequity. Like other natural resource sectors, aquaculture depends on a diverse array of shared resources, grows resource users must work together to develop strategies to govern these commons and avoid collective action dilemmas in a growing and evolving sector. However, research applying a governance or commons framing to aquaculture remains scarce. In Indonesia, the central government has set major growth targets to expand aquaculture production across the country by 2030. The long-term sustainability of this growth requires institutions grounded in the heterogeneous social-ecological contexts of individual aquaculture cases. At the same time, researchers and policymakers need to identify areas of generalizability across these cases to inform management interventions. In the present ongoing study currently in the analysis phase, we analyze social-ecological patterns of coastal pond aquaculture development across Nusa Tenggara Barat province, Indonesia. Using a large-scale survey of over 80 fish farmer groups as our primary data collection instrument, we collected data on a range of social-ecological indicators theoretically grounded in potential for collective action and organized through the lens of Elinor Ostrom's social-ecological systems framework. Guided by the archetypes approach, we use a data-driven clustering analysis to identify spatial typologies of aquaculture cases in Nusa Tenggara Barat based on archetypical configurations of SES indicators. We interpret these typologies

through the lens of collective action theory, with the goal of creating actionable knowledge for local decision-makers to inform pathways to sustainable development of the sector.

Mapping dynamic grassland system archetypes in Germany from 1992-2019
Richard Orozco & Marie Meyer-Jürshof

Grassland is an important land use system in Europe covering more than a third of the European agricultural area. In addition to grass silage for animal fodder, it provides ecosystem services such as carbon sequestration, biodiversity enhancement and water resource protection. Yet, grassland systems have been decreasing due to abandonment, changing practices, and conversion to other land uses. This trend has severe consequences that threaten vital ecosystem services and can limit human well-being. Political decisions of European agricultural policy have played a significant role in this change. Nevertheless, the determinants of change and the development of grassland systems are heterogeneously distributed and still poorly understood. Given the great diversity of grassland systems in Europe and still in Germany with its heterogenous agriculture structure, designing appropriate policies requires a solid understanding of region-specific dynamics in order to adapt to changing environmental and socio-economic contexts.

Looking at Germany, we use data from the European Commission's Farm Accountancy Data Network (F.A.D.N.) to look at 17 identified indicators that provide information on the grassland situation. We use self-organizing maps an unsupervised machine learning algorithm, to produce spatial and thematic maps that illustrate recurring patterns in variables and processes of land use change. We describe land use changes between the years 1992 - 2019. We discuss our findings in relation to policy developments in the Common Agricultural Policy for Germany and explore the linkages between policy decisions and their impacts on land use in Germany. The focus is on the heterogeneous agricultural structure in Germany and the regional impacts of overarching policy decisions. Our results first show the evolution of farm types in Germany in relation to grasslands and reveal regional impacts of European agricultural policy. Furthermore, they can guide cross-sectoral decision-making processes for sustainable land use planning. This is promising given the call for more context-specific regionalised policy-making that supports both nature conservation and economic development.

The results of our archetype analysis can be used as a means to assist regional policy and decision-making processes dealing with sustainable land use.

With and beyond certification: archetypical strategies for sustainable development in coffee and cocoa sectors
Christoph Oberlack
(Authors: Christoph Oberlack, Samuel Bruelisauer, Gesabel Villar; CDE University of Bern)

Certification of voluntary sustainability standards have become a main strategy to enhance human well-being of producers, workers and communities involved in value chains of tropical agricultural crops such as coffee, cocoa, palm oil. Accumulating evidence however points to the limited and sometimes even adverse effects of certification schemes on well-being. Meanwhile, companies, producer organizations and other private sector organizations implement diverse strategies beyond certification

such as strategies of inclusive business or solidarity economy. These include innovative supply chain and business models and private governance arrangements. However, contemporary research analyses such strategies mostly in isolation. Consequently, the institutional diversity of sustainability strategies of the private sector in agricultural commodity sectors remains largely a black box. Therefore, the COMPASS project adopts comprehensive and comparative research approaches to understand how private-sector strategies for sustainable development in coffee and cocoa sectors differ in detail, and under what conditions a particular strategy is more or less adopted to enhance the well-being of producers.

This presentation aims to share emerging results that systematize the highly diverse strategies for sustainable development, focusing on the coffee and cocoa sectors of Switzerland and Peru. We adopt the archetypes approach to identify recurrent patterns amongst the governance instruments, supply chain and business models that companies, cooperatives and standard setters adopt. Empirically, we present results of a survey of n=120 organizations based in Peru and Switzerland that are involved in the production, processing, trading, selling, and certification of coffee and cacao and derived products.

The expected results demonstrate, first, that value chain actors combine different instruments into their portfolio which reflects their specific organizational mission and approach to sustainability. Certification, inclusive business and solidarity economy strategies are therefore neither pure alternative nor purely complementary strategies of sustainability governance. Second, a suite of archetypes disentangles the precise similarities and differences of inclusive business, solidarity economy and certification strategies in terms of governance instruments, supply chain and business models.

In conclusion, we hope this suite of archetypes will facilitate more precise understanding of the range of options, incentives and limitations that entrepreneurs and change agents along all stages of a value chain have to transform unsustainable practices in tropical agricultural sectors such as coffee and cocoa.

Paper session III: Local communities

	Presenter	Discussant
Archetypes of social learning for sustainable natural resources management: emerging models from the global north and the global north	Michelle Bonatti [online]	Joyce Doyle
Exploring the Characteristics of Black Gentrifiers in U.S. Cities: An Application of Archetype Analysis	Joyce Doyle and Sabine O'Hara	Matteo Roggero
Archetypes of climate mitigation in cities: configuring socioeconomic and institutional determinants	Matteo Roggero	Michelle Bonatti [online]

Archetypes of social learning for sustainable natural resources management: emerging models from the global north and the global north
Michelle Bonatti & Marcos Lana

Created during the 60s in the educational sciences, social learning (SL) has quickly evolved conceptually and been adopted by several different disciplines and subdisciplines. The rapid growth and diversification of social learning approaches have generated variations, inconsistencies, and in some cases, confusion about the meanings, potential, and limitations of SL for natural resource management.

Although SL conceptualization and implementation are flourishing in sustainability sciences, and its non-rigid conceptual fluidity is regarded as an advantage, research must advance the understanding of social learning phenomenon patterns on the ground (based on empirical data), contributing to the identification of its forms, particularly those that can address urgent Anthropocene socio-ecological problems.SL for sustainable natural resources management proposes the co-creation of knowledge as an equal process of integrating diverse knowledge sources in a process that goes beyond interlinking disciplines and social actors but creates knowledge systems.

This is a process found in different kinds of institutions, communities, and organizations, but their forms and functions appear to be quite diverse. This implies that questions about the various functions of social learning (how do they work?) and questions about conditions and structures (under what conditions?) must still be addressed. Therefore, the purpose of this research is to advance the SL theory by discovering fundamental patterns along which social learning in natural resource management differs by identifying SL archetypes. The methodology is based on a systematic literature review retrieved from 122 scientific articles. The content analysis and correlations were performed based on 10 categories of analysis: 1. the geopolitical location, 2. the type of participants; 3. learning scope/level, 4. Outcomes, 5. Relational capital generated 6. Conflicts, 7. SL mediation/methodology applied, 8. Resource availability during the SL process, 9. SL level (endogenous or exogenous process), 10. natural resources addressed with the SL process
The first results revealed two archetypes of social learning (SL Endogenous and SL Exogenous). The archetype SL Exogenous presents two subgroups (Tools and Processes). The results are related to where social learning occurs (global north or global south) and how venues/preconditions for social learning are placed (in power-imbalanced settings and societies). As a recommendation, it is proposed that the global south's endogenous social learning should be better potentialized as an instrument of development and a catalyst for deliberative processes for sustainable natural resource management.

Exploring the Characteristics of Black Gentrifiers in U.S. Cities: An Application of Archetype Analysis
Joyce Doyle and Sabine O'Hara

One of the results of the gentrification of U.S. cities is the displacement of long-term, lower-income residents and small businesses. As neighborhoods are redeveloped, and investments of higher-income residents and organizations move in, the racial, ethnic, and cultural characteristics of an existing community change. The criticism levied against gentrification is that it prevents historic residents from participating in the economic advancements within chronically underserved and marginalized

neighborhoods, thus scaring long-term residents and amplifying disparities. However, a silent subgroup of community members we call 'black gentrifiers' exists within these marginalized communities. To date, this group has not received much attention since the dominant narrative is that gentrification originates outside of marginalized neighborhoods. Some of the characteristics of 'black gentrifiers' include high educational attainments, high salaries, significant social capital, and dynamic ideologies that afford them different success outcomes than their lower-income neighbors within their communities. We propose an archetype analysis approach to identify the key characteristics of the 'black gentrifiers' in five U.S. cities and metropolitan areas that have experienced or are at the cusp of undergoing major gentrification events. Our selected cities fall within a range of geographic locations that reflect significant demographic shifts associated with migration patterns of 'black gentrifiers' from the northeast to the south of the United States. We begin our analysis by investigating publicly available documents that can provide clues about the characteristics of 'black gentrifiers' with the goal of identifying prominent patterns of behaviors and institutional characteristics associated with successful redevelopment outcomes in our selected cities. Gentrifying neighborhoods in our selected cities are Shaw, LeDroit Park, Columbia Heights, and Congress Heights in Washington DC; Fort Greene, Bedford-Stuyvesant, and Crown Heights in New York City, NY; North Kenwood-Oakland and Bronzeville in Chicago, Il; Point Breeze and Germantown in Philadelphia, PA; and West End and East Atlanta in Atlanta, GA. Once we have identified distinct archetypes of 'black gentrifiers,' we plan to apply our analysis to other U.S. communities that find themselves at the early stages of gentrification.

Archetypes of climate mitigation in cities: configuring socioeconomic and institutional determinants

Matteo Roggero

Cities have taken center stage in the fight against climate change. Research identified key conditions shaping how cities tackle climate change but hasn't yet addressed how such conditions interact in order to reduce emissions. The present paper contributes to filling this gap through a crisp-set Qualitative Comparative Analysis of 34 CDP-reporting cities across the globe, identifying combinations of institutional and socioeconomic factors that are systematically associated with emission reductions. Results show emission reductions both in presence and in absence of favorable socioeconomic conditions. Under favorable socioeconomic conditions, institutions seem central to the task of steering the capacities of the local business community and reaping scale benefits. Under unfavorable socioeconomic conditions, institutions seemingly play a key role in gathering resources, reaching out to broader networks on the international stage. Implications for policy and research are explored.

Paper session IV: Synthesis

	Presenter	Discussant
Taking stock of and advancing knowledge on interaction archetypes at the nexus between land, biodiversity, food and climate	Regina Neudert	Stefan Partelow
A meta-analysis of SES framework case studies: identifying dyad and triad archetypes	Stefan Partelow	Klaus Eisenack
Why local governments set climate targets: Effects of city size and political costs	Klaus Eisenack	Regina Neudert

Taking stock of and advancing knowledge on interaction archetypes at the nexus between land, biodiversity, food and climate
Regina Neudert

Global challenges related to land, biodiversity, food and climate interact in diverse ways depending on local conditions and the broader context in which they are embedded. This diversity challenges learning and integrated decision-making to sustainably transform the nexus, that is to say the interactions between these land-based challenges. Providing aggregated insights, archetype analysis has revealed recurrent patterns within the multitude of interactions, i.e. interaction archetypes that are essential to enhance the understanding of nexus relations. This paper synthesises the state of knowledge on interaction or nexus archetypes related to land, biodiversity, food and climate based on a systematic literature review. It focuses on the coverage of thematic aspects, regional distribution, social dimensions and methodologies. The results show that consideration of comprehensive land–biodiversity–food–climate interactions is rare. Furthermore, there are pronounced regional knowledge gaps, social dimensions are inadequately captured, and methodological shortcomings are evident. To enhance the investigation of interaction archetypes, we have framed a future research agenda providing directions to fully capture interactions across space and time, better use the potential of scenario archetypes and up-scale transformative actions. These advances will constructively contribute insights that help to achieve the ambitious objective to sustainably transform the nexus between land, biodiversity, food and climate.

A meta-analysis of SES framework case studies: identifying dyad and triad archetypes
Stefan Partelow

Case studies on collective action in social-ecological systems (SES) have tended to identify a broad range of variables which come in complex configurations. Can this complexity be better understood as compartmentalized groupings of smaller archetypal models? If so, are two and three independent variable groupings (dyads and triads) the optimal model size for building theories of social-ecological interaction? This would advance commons and SES theory beyond the listing of single independent-dependent variable relationships. We analyze interactions among independent variables and how they relate to positive or negative social or ecological outcomes. Our data comes from 71 SES outcome models generated from the qualitative coding of empirical case studies using the SES framework. We use hierarchical clustering, principal component analysis, and network analysis tools to identify the

frequency and recurrence of dyads and triads across clusters and outcome groups. The most frequent dyads and triads include Actor variables (Leadership, Norms/social capital, Knowledge of SES, Importance of resource) and Governance (Property rights, Operational rules, Collective choice rules) variables. We do not observe a relationship between model size or composition to model outcomes (i.e., positive social, positive ecological, negative social, negative ecological). There is little dyad and triad composition novelty as model complexity increases, supporting dyads and triads as a good starting point for understanding complex system models, theory building and moving beyond the "too many explanatory variables" problem in the study of SES and the commons. Meaning that more complex models are likely interacting groupings of smaller archetypes.

Why local governments set climate targets: Effects of city size and political costs
Klaus Eisenack

Topic: More and more cities worldwide set targets to mitigate greenhouse gas emissions within their jurisdiction, even if they are in countries without effective climate targets or policies in place (e.g. more than 1000 cities from all over the world now report their greenhouse gas emissions to the Carbon Disclosure Project). This is puzzling: When considering mitigation as contribution to a global public good, we might expect that such targets are just cheap talk or green washing – and have no effect. Yet, there are some indications that target-setting cities indeed achieve emission reductions. Meanwhile, empirical studies found variables correlated with city-level mitigation, but -- to put it mildly -- most evidence is mixed so far. In addition, only little is known about the mechanisms which drive urban climate action. I presume the diversity and idiosyncrasies of cities is part of this challenge. A universal explanation of the phenomenon might not be found because it does not exist.
Method: The paper develops a mathematical reduced-form model to address some of those gaps. It makes some assumptions which align with stylized facts from empirical research we already have. In particular, the model features effects of city size and distinguishes mitigation targets from achieved mitigation. The model is then used to deduce a set of implications which can be checked against further (or future) empirical findings.
Results: Since the deduced effects are ambiguous, the model actually classifies cities into types by the signs of the effects, along several dimensions. In an important dimension, one city type does not achieve its target, but mitigates more than a free-riding city. These relations reverse for another type. These two types are mutually exclusive. Other types determine which of the more vulnerable cities or which cities with lower abatement costs more likely set targets. Findings are contrasted with an alternative model where targets reduce abatement costs, producing some more city types, although some effects remain qualitatively the same.

Break out-session II: Visual narratives I

Convenors: Diana Sietz, Edmundo Barrios [online], Christian Levers[online], Nikolaos Alexandridis

Visual narratives have been proposed as a tool to describe plausible theories of transformative change towards sustainable agriculture and food systems addressing the science-policy-society interface. They present comprehensive storylines emphasising social-ecological interactions and interdependence between system components along plausible transition trajectories. However, the

multitude of social-ecological interactions, local stakeholders' expectations and global sustainability commitments challenge the development of visual narratives that can facilitate transformative change and specific transition trajectories. As a way forward, archetype analysis can provide insights into recurrent patterns in the interactions between agriculture, biodiversity, resource use decisions and governance, among others, and transformative potential. The synthesised knowledge provided by archetypes can help to develop entry points and transitions patterns for tailoring visual narratives and transformative pathways to recurrent characteristics of agrifood systems. This session aims to discuss emerging research and opportunities that archetype analysis provides for informing the design of visual narratives that can facilitate agrifood system transformations. The session will include short kick-off presentations (5 min each) that describe the development and examples of visual narratives, tailored transition pathways and related advances in archetype analysis. We invite short presentations exploring future potential to inspire work at the interface between visual narratives, transition pathways and archetype analysis. In this context, we particularly invite contributions addressing interactions between multiple system components including policy and decision-making spheres. We will then proceed with an open discussion to identify promising approaches, refinements and methods to invigorate synergies and collaborative follow-up activities linking archetype analysis, visual narratives and transitions to sustainable agrifood systems. Based on the discussion, we envisage to frame a perspective paper co-authored by the session conveners and participants.

Planed presenters: - Edmundo Barrios: o "Harnessing the potential of the 10 Elements of Agroecology to facilitate agrifood systems transformation – From visual narratives to integrated policy design, FAO 2023, https://doi.org/10.4060/cc4049en o "10 Elements of Agroecology: enabling transitions towards sustainable agriculture and food systems through visual narratives", Barrios et al. (2020) Ecosyst. People 16, 230–247, https://doi.org/10.1080/26395916.2020.1808705 - Diana Sietz: "Tailored pathways toward revived farmland biodiversity can inspire agroecological action and policy to transform agriculture", Sietz et al. (2022) Communications Earth and Environment 3:211, https://doi.org/10.1038/s43247-022-00527-1 - Nikos Alexandridis: "Archetype models carve paths for sustainable intensification of agriculture", Alexandridis et al. (2022) Ecological Applications 32:8, e2696, https://doi.org/10.1002/eap.2696 - Proposals via call for contribution

Break out session III: Dynamic Archetypes I

Convenors: Hanna Ekström, Nikos Alexandridis, Klaus Eisenack, Richard Orozco[online], Manuel Pacheco-Romero

It is still an open question how to best perform a dynamic archetype analysis (DAA), i.e. an archetype analysis that considers changes over time and the underlying drivers. Archetypes are often used in analysis of systems changing over time, however, it is still an open question how to address the dynamic aspects of archetypes. While the last workshops took up this desideratum in breakout sessions, and while we assembled a larger group which undertook experiments in DAA in the recent months, this work is not accomplished yet. However, we can now build on recent conceptual advances. DAA can address patterns of change (archetypal time paths), temporal building-blocks of stages (archetypes as snapshots), or building-blocks of dynamic mechanisms. We can also build on experience with a portfolio of quantitative methods e.g. cluster analysis, causal loop diagrams and

dynamic time warping. They were primarily tested by studying patterns in social-ecological systems (SES) or shared socio-economic pathways (SSPs). It will be a two-session breakout group. First, we present what has been done so far, and discuss our learnings. Second, we discuss how to proceed further. One ingredient will be to agree on suitable data sets (in particular longitudinal data on different cases) we want to publish on. We want to join forces from novel and past participants to push forward a possible milestone paper and/or research grant application.

Break out-session IV: Sustainable transition models

Convenors: Larry Gottschamer and Jeff Walters [online]

One promising sustainable transition research approach capable of bridging case-specific descriptive studies with generalized insights is quantitative and/or qualitative modeling. Modeling simplifies system complexity, provides clarity on attributes and the dynamics between them, as well as allowing for systematic testing of interventions. Policy makers have traditionally relied on quantitative linear or nonlinear programming, general equilibrium, or Integrative Assessment Models to better understand interlinked sectors such as energy, water, climate, and agriculture. These types of quantitative models are capable of simulating scenarios to better understand future behavior of non-linear socio-technical systems. However, these methods cannot fully capture dynamic feedbacks found in sustainable, socio-technical transitions. System dynamics (SD) is one methodology (among others) capable of including information and decision feedback loops, delays, and technological change. This allows a model to reproduce behavior more accurately by updating itself when information and decisions change the system under study. A model that captures system response to feedbacks and non-linearities presents a more realistic representation of socio-technical transition complexities. A wide diversity of SD models have been used to guide policy makers or provide understanding across sustainable transition sectors such as energy, biofuels, sanitation. Yet these models are case-specific and contextualized to specific geographies, technologies, economic considerations, and cultural landscapes. This leaves a knowledge gap on common dynamics underlying transition processes and emergent behaviors. To fill this gap, we conducted a cross-sectoral archetype analysis of five system dynamics sustainability transition models with the objective of finding common patterns. During this process we encountered critical knowledge gaps related to archetype analysis of sustainability transition models. One is the lack of a formal socio-technical system definition of included components. These are instrumental in defining attributes, and future studies applying archetype analysis to transition models would benefit from a formal definition of both components and attributes. Another is the level of abstraction employed to extract generalizable meanings from the modeling case studies. Abstracting model variables proved to be problematic, and future research would benefit from identifying best practices in this arena. We propose a themed break-out session to explore the application of archetype analysis to sustainability transition modeling approaches.

Specifically, we would like to address the following questions: • What are core components of socio-technical transitions? • What are best practices for abstracting sustainable transition model variables? • Do these practices differ across modeling methodologies? • If so, how?

Preprint of a small meta-analysis of system dynamic sustainable transition models available here: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4357815