

# Chapter 1

## A Knowledge-Based European Perspective on Sustainable Land Management: Conceptual Approach and Overview of Chapters



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**Abstract** This introductory chapter, written by the editors, provides an overview of their conceptual approach, the book’s line of argumentation, and an insight into the different chapters of the book “Sustainable Land Management in a European Context—a co-design approach”. The synopsis highlights the various approaches and possible applications of a co-design approach.

**Keywords** Sustainable land management · Land governance · Co-design · Co-production of knowledge · Transdisciplinarity

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## 1.1 New Conceptual Approaches for New Challenges

Urban and rural landscapes are constantly undergoing processes of change. Humankind has been influencing the natural environment on earth for centuries, resulting in different types of land use. In the nineteenth and twentieth centuries, radical changes in land use (Lambin et al. 2001; Hersperger and Bürgi 2009; Niewöhner et al. 2016; Jepsen et al. 2015; Plieninger et al. 2016) were brought about by the “agricultural revolution” and the “industrial revolution”, which presented new opportunities for mobility and urban development.

Today, international challenges such as climate change, loss of biodiversity, soil degradation and food security or megatrends such as globalisation processes fuel discussions about the current land use system and land use policies, as well as future options. Significant changes have occurred, e.g. natural land has been transformed. In addition, qualitative aspects such as the loss of ecosystem services in combination with land degradation is an inconvenient truth.

International bodies such as the United Nations’ Intergovernmental Panel on Climate Change (IPCC 2019) and the Intergovernmental Panel on Biodiversity and Ecosystem Services (IPBES 2018) specified changes in land use as one of the key aspects in debates about sustainability, culminating in the adoption of the Sustainable Development Goals (SDG) by the United Nations.

Several SDGs include relevant objectives in the policy field of land use. Not only SDG 15 (Life on Land) covers a wide range of recommendations—SDG 3 (Good Health and Well-Being), SDG 6 (Clean Water and Sanitation), SDG 9 (Industry, Innovation, and Infrastructure), SDG 11 (Sustainable Cities and Communities) and SDG 13 (Climate Action) also address further important aspects by highlighting a need for change across sectors. Implementation of these objectives is seen at the regional and local level, requiring changes of governance processes (Weith et al. 2019).

Looking specifically at cities and urbanised areas, HABITAT III focuses on resilient and sustainable cities and human settlements. Emphasis is placed on integrated urban and territorial development and new forms of urban governance to prevent urban sprawl and a further depletion of natural resources. In addition, there is a need for a balanced approach to the development of urban and rural areas, which are interdependent. This will indirectly promote the reduction of greenhouse gas emissions and air pollution (Liu et al. 2013). In a nutshell, there is a scientific and societal need to discuss options and solutions for land use change.

Land use is a complex human-nature interaction, generating diverse cultural landscapes influenced to a greater or lesser extent by humankind. In particular, land used for urban areas and infrastructure puts pressure on ecosystem services due to continued soil sealing and the fragmentation of landscapes following continuous land conversion. Consequences occur not only at the local or regional scale—they are globally interconnected. Consequently, human action accelerates global change, which in turn has an impact on humankind. Although various partial models have been developed for different types of land use (e.g. Siedentop et al. 2009; Siedentop

and Fina 2010; Weber and Höferl 2009; Plieninger et al. 2016; EEA 2017), there is no accepted model that provides a comprehensive explanation of land use change. One important factor for land use change is interaction between population and economic dynamics (cf. Storper and Scott 2009). On a global scale, the population is increasing, particularly in economically prosperous regions and in metropolitan areas (UN 2014), putting pressure on the land by using space for settlement activities. In Europe—the spatial focus of our book—75% of the population live in urban areas, which is expected to increase to over 80% by 2020 (EEA 2017: 29). Due to urban–rural linkages, rural areas are likewise affected by this development. Land use and environmental impacts therefore depend not only on the size of the population, but also on its spatial distribution (Zasada 2011).

The persistent gap between the sustainability goals and spatial developments that are noncompliant with those goals raises questions about methods of governance to ensure compatibility with the goals. At first glance, the land use system in Europe, including Germany, seems to be organised within sophisticated land use policy frameworks, comprising land use planning and impact analysis tools. This assumption also seems to reinforce the fact that, against the backdrop of the aforementioned, the annual land use change rate is low relative to the total amount of land (EEA 2017).

However, land use is influenced by a complex interaction of more or less coordinated governance patterns, referring to a variety of sectoral administrative and disciplinary activities. Quite often, there is no integration of these complex factors. Although functional perspectives are required, territorial and sectoral powers dominate (Hooghe and Marks 2003; Blatter 2004; Sikor et al. 2013). In 2002, Young mentioned deficits with respect to fit, interplay and scale that hamper the successful implementation of sustainable land use strategies, e.g. in settlement development. He explained governance mismatches as drivers of land use conflicts by referring to incongruity between ecosystems and institutional arrangements (fit), a lack of adequate interaction between institutions (interplay), as well as a lack of interrelations between temporal and spatial scales.

As yet, there is no integrated approach to land use governance that provides applicable inter-sectoral governance to handle multi-stakeholder interrelations. In particular, current land use decisions are based on an insufficient poly-rational understanding of actors' positions (Davy 2012, 85), as well as deficits in knowledge provision (Salet 2014; Frantzeskaki and Kabisch 2015; Giebels et al. 2016). This includes knowledge gaps, also related to the complexity in land use governance, which is characterised by high levels of uncertainty (unpredictable developments and interrelations), disagreement (conflicting aims and demands) and distributed capacities (multi-actor landscape) (cf. Hummelbrunner and Jones 2013, 2).

In conclusion, contemporary land use governance systems are characterised by gaps, mismatches, or other dysfunctionalities that lead to the promotion of unsustainable land use. Above all, integrative land use regulations are lacking, particularly at the EU level. This deficit can be traced back to path dependencies (Getimis et al. 2014), based on closed disciplinary debates in science that are continued and reflected by sectoral perspectives in land use governance.

It therefore appears necessary to broaden the understanding of the system that influences land use by elucidating the interrelationships between different land use sectors, integrating diverse knowledge bases, and intermediating between stakeholders' various action patterns (Ison et al. 2013). Besides the need for a better understanding of land use systems, there is also a need for concrete future action.

We argue that this requires new governance approaches that integrate different knowledge types and perspectives, and that develop new socio-technical solutions in a continuous process to narrow the persistent gaps and contribute to more sustainable land use.

The concept of sustainable land management (SLM) is being increasingly discussed against this backdrop. "Land management" refers primarily to the procedural dimension of land use and land development for coordinating spatial, sectoral and temporal aspects in multi-level governance processes (see Engelke and Vancutsem 2010: 70). Central aspects include the integration of multi-stakeholder perspectives by linking ecological, socio-economic and political aspects as well as intertemporal dimensions (Hurni 2000; Schwilch et al. 2012). Management includes reconfigurations of the set of instruments as well as "technological, political and legal measures and activities" (Haber et al. 2010, 378–379). Land management takes into account interactions among different land use types and land-related sectors, explicitly incorporating rural and urban demands as well as economic, social and ecosystem functions of land. It is suggested as a framework to provide system-oriented solutions for dealing with land use conflicts (Repp and Weith 2015). In this regard, land management is strongly linked to debates on environmental and landscape governance (EEA 2017).

Understanding and managing land resources on a landscape level calls for systemic knowledge of the diverse actor groups that influence land use, and a coherent approach towards possible sustainable futures and adequate measures. This cannot be provided by science alone because normative aspects play a decisive role. It is therefore crucial for sustainable land management to integrate and utilise different perspectives and knowledge types from academia and practice. To that effect, we advocate a conception of SLM that refers to ongoing debates on new "modes" of knowledge production, reflecting the demand of real-world problem orientation, actor orientation and implementation (Zscheischler and Rogga 2015). In this context, co-design processes can be considered as a central instrument of SLM with different applications and purposes: starting at the co-design of just and acceptable processes, through the co-production of knowledge to the co-design of socially robust orientations and solutions (Moser 2016; Mauser et al. 2013).

Based on the challenges, state and drivers of land use trends in Europe described above, the central question is how to produce and handle new knowledge about land management to create innovative and actionable solutions towards sustainability. One special focus of this book is therefore co-design- processes and the co-production of knowledge to foster new modes of land use governance.

The book is organised following the "co-design and co-creation" concept as proposed by Mauser et al. (2013) as part of the sustainability discourse. It deals with

the role and significance of different actors and their inclusion in (political) planning processes, emphasised for more than a decade in institutionalist approaches (cf. Ostrom 2011). Particular attention is paid to the knowledge stocks of these actors, including their experience-based knowledge (co-production of knowledge). This knowledge is not only used for a better understanding of problems and starting situations, but also to prepare and implement decision processes. Thus, implementation orientation plays a special role. All this takes place in the highly complex context of spatial and landscape development organised in a multi-level system (Reimer et al. 2014).

Co-design processes are increasingly assessed in science with regard to their effects in decision-making processes. It is assumed that co-design processes can raise acceptance because of their integrational and participative nature (Busse and Siebert 2018) and can support the development and implementation of social innovations. That is why they play an important role in the discussion about change and transition processes (Tschakert et al. 2016). At the same time, they are associated with developing action possibilities for stakeholders and increasing the resilience of decisions. In consequence, co-design approaches are much more than “simple” participation processes, which have been known for a long time and in some cases are applied in a formalised way (e.g. Arnstein 1969). They also go beyond the mere application of learning loops or transdisciplinary concepts.

We therefore stress the early and ongoing involvement of a broad variety of actors in solution-oriented processes that take up the role as knowledge providers alongside academic and technical experts. Ideally, the process consists of three steps: the analysis of the state and drivers of change; the co-design and co-production of knowledge; and the co-evolution and co-dissemination of that knowledge. We argue that the comprehensive approach to sustainable land management should follow this concept, and take up these three steps.

To conclude, the book is based on the assumption that successful—and hence sustainable—land management (SLM) requires routines of knowledge co-production to put sustainable land use into practice. It thus refers to ongoing debates on new “modes” of science, which stress problem orientation, action, and negotiation of research activities—as it is highlighted in the following chapters.

## 1.2 Overview of the Main Parts and the Single Chapters

The book starts with a foreword and this introductory overview. The main body is subdivided accordingly into three main parts:

- “Land use: state and drivers in Europe”,
  - “Co-production of knowledge”, and
  - “Co-evolution: New system solutions and governance”.
- The book closes with a concluding and summarising “Outlook”.

The chapters in **part one** focus on the development of different forms of land use as a result of the interplay between societal demands on land and physical-ecological conditions. Society is in a situation of ongoing changes and developments. Important framing factors are the social and economic system, population development and economic driving forces, urbanisation and spatial interrelations. These factors influence the development of regions and landscapes with their infrastructure, agriculture in its respective intensity, forestry in form and extent, the use of resources and raw materials as well as the preservation of specific landscapes and their characteristics. The chapters in part one highlight these interlinkages and provide overviews and current states and drivers of land use change, as well as describing any lack of knowledge.

The chapter on *Landscape change in Europe* by García-Martín, Quintas-Soriano, Torralba, Wolpert and Plieninger provides a first introductory overview of the evolution and change of landscapes throughout history. In this emerging research field on landscape change in Europe, the authors explain why these changes happen, and what they fully entail. They embed the evolution of landscapes in an understanding of complex social-ecological systems and the drivers behind them. In consequence, they gain a better understanding of complex, dynamic and interlinked change processes that are characterised inter alia by environmental degradation and increased land use conflicts. While considering these challenges, the authors provide guidance for co-designed sustainable landscape management. The results are based on a combination of quantitative analysis with participatory approaches on the one hand, and diverse spatial and temporal scales on the other to achieve a comprehensive understanding of past changes and future trajectories.

From an economic point of view, land is a limited and scarce natural resource that faces competing and rising demands. These demands refer to different types of land use, such as agriculture, nature and natural resource protection, industrial areas, human settlements and infrastructure. Land use conflicts have evolved and are driven by various factors. Based on a previous study, Kirschke et al. focus on the economic aspects of sustainable land management in the chapter about *New trends and drivers for agricultural land use in Germany*. This chapter provides an overview of the main economic drivers of land use change in Europe, bringing together theoretical approaches from regional economics, economic geography, agricultural economics, environmental and resource economics, and infrastructure planning. New developments in agricultural land use in Germany are analysed based on general land use trends. Indicators for agricultural land use changes that create conflicts include rising land prices, deteriorating environmental conditions and changing land use structures. The authors describe major drivers behind this development, which basically reflect market forces and new policy frameworks such as the Renewable Energy Act (REA) and particularities related to German reunification.

Besides economic pressure, demographic change is described as one of the central factors of human influence on land use change. But does demographic change really contribute directly to land use change? Do changes in population size and composition directly affect changes in land use? Hoffmann reflects in his chapter on *Demographic change and land use* the questions of (a) whether and to what degree clear

correlations between demographic change and observable land use changes could be found in the existing literature, and (b) what the result of the literature review means for regional studies and regional development policies. The chapter contributes to a more evidence-based view of the topic, helping to avoid misleading simplifications and even myths on interlinkages that often influence concepts, values and decisions in politics and policies shaping land use.

Urbanisation is seen as one of the major driving forces of today's land use systems. This phenomenon involves the usually irreversible conversion of mainly agricultural land. Urban land use change can occur in quite different forms in terms of spatial layout, building density and speed of change, to name but a few aspects. The global dimension of urbanisation and related land use change is now on the agenda of policy-makers and researchers worldwide. To provide an overview of these complex processes, Nuissl and Siedentop endeavour in their chapter on *Urbanisation and land use change* to achieve conceptual clarification, highlighting drivers and impacts. They provide a systematic overview of influencing instruments and strategies for coping with urban land use change.

In contrast to the urbanisation focus of the previous chapter, Doernberg and Weith seek to expand the view towards an urban–rural interrelations perspective. Urban and rural regions are no longer seen as distinct places, but as functionally connected in the context of the sustainable use of land-related resources, quite often with blurring boundaries. In recent years, both scientific and societal discourses have given new impetus to this thematic debate. At the same time, it becomes quite obvious that there are currently no conceptual approaches available that are comprehensive in terms of content, and can capture the complexity of regional urban–rural interrelationships. In consequence, concepts are missing to provide practical support for regional planning and regional development policies. The chapter on *Urban–rural interrelations* outlines the existing approaches, and highlights opportunities for developing new concepts, especially by defining requirements of new concepts to overcome the shortcomings of models currently in place in science and practice.

The chapters in **part two** “Co-production of knowledge” explain and discuss explicit ways of knowledge co-production and co-dissemination to foster sustainable land management. In recent years, new ways of integrative knowledge generation have been developed and applied to find new solutions to complex real-world problems. This includes land use issues, starting with problem definition through identifying and describing land use conflicts to developing new land governance processes. The involvement of various actor groups, such as political and administrative decision-makers, is an immanent part of the co-design and co-production process. Especially transdisciplinary approaches, translated into the field of land use sciences, are seen as adequate methodological ways to be tested and implemented in the context of land use challenges. They also show great promise for creating social innovation processes. Various forms of simulation games and real-world labs are being discussed to support creative ways of handling new challenges in land use. Quite often, these knowledge production processes are supported by new ways of knowledge management, implementation and transfer, using the manifold opportunities offered by digitalisation processes.

The first chapter in this part explains additional values of transdisciplinary approaches for solving land use problems against the backdrop of urgent complex real-world challenges and changed societal demands on knowledge. In *Transdisciplinarity in land use sciences*, Zscheischler states that transdisciplinarity is no longer just about the production of new scientific insights, but also about the solution-oriented goal and action knowledge that support sustainable development and land management. However, the extent to which these projects have succeeded has increasingly been critically questioned in recent years. The chapter introduces the development of the concept on transdisciplinary research (TDR), describes the current criticism of TDR and presents a critical assessment based on empirical findings from research practice. The results reveal several unsolved implementation challenges that can be traced back to a misfit with academic structures and a lack of empirical knowledge.

For decades, fostering innovations was seen as a key approach for problem solving, also in sustainable development. Socio-technological change and transformations should lead to more sustainable land use practices. However, new perspectives on innovation emerge when addressing long-term societal goals, the variety of actor groups involved, multi-level governance and a lack of usual commercialisation potentials. Sustainability innovations frequently contradict social practices, regulations and existing infrastructure, and focus on social innovation processes. Since there is little understanding of how transformation and socio-technological change can be effectively governed and supported in the specific field of sustainable land use and management, the chapter contributes specifically to this knowledge gap. In *Innovations for sustainable land management*, Zscheischler and Rogga refer to nine projects that address that specific issue. The authors identify different types and degrees of innovations, approaches to manage innovation processes, and the leverage points of these solutions in the governance system of sustainable land management. The results stress the need for reflexive processes of social learning and cognitive reframing by embedding experimental innovation management approaches such as real-world laboratories into larger transdisciplinary and participatory processes.

One of the key aspects in change and innovation processes is quite often underestimated or misunderstood: how to transmit knowledge from one actor to another. In the article on *Knowledge exchange at science-policy inter-faces in spatial planning, land use and soil management*, Pütz and Brassel investigate this topic in detail in the context of land use change. Based on literature review and expert interviews, they identify six types of knowledge exchange and examine barriers and opportunities for knowledge exchange. This offers a better understanding of processes, and provides suggestions for knowledge exchange activities. However, this will be a challenging task for the future, due to actors' different expectations and experiences of how knowledge is to be exchanged.

Knowledge-driven change and innovation processes will be supported by new integrative methodological approaches. Maaß addresses this in her chapter entitled *Serious games in sustainable land management* by the using the method of experimental games. She presents an integrated approach that combines a serious game with a land use and transport model for analysing the effects of high prices for fossil



fuels on land use. This approach opens up the possibility to simulate the complexity of sustainable land management and to incorporate learning aspects for decision-makers. Participants in the serious game came from the Hamburg Metropolitan Region. The decision-makers attended several meetings to develop their individual strategies on how to cope with rising energy prices.

Beyond simulation, it has always been a great challenge to test and implement sustainability-driven processes of change and innovation. Real-world laboratories have gained in importance as an adequate research format in recent years in Europe and especially in Germany. The underlying assumption is that transformation processes towards sustainability can be investigated under real-world conditions in order to gain knowledge of their dynamics, to identify characteristics of successful transformation processes, and to be able to transfer this knowledge to other cases. The chapter by Kanning, Richter-Harm, Scurrrell and Yildiz entitled *Real-world laboratories initiated by practitioner stakeholders for sustainable land management* analyses existing types of real-world labs, and reflects on the possibilities generated by real-world laboratories that have been initiated by practitioner stakeholders. “Energieavantgarde Anhalt” provides evidence for such labs, which contributes to sustainable land management in the context of the energy transition in rural areas, featuring small and medium-sized towns. The practicability and variability of real-world lab approaches pave the way for future options for application.

Another dimension of transitions is highlighted in the chapter on *Knowledge management for sustainability: The spatial dimension of higher education as an opportunity for land management* by Schulz, Köhler and Weith. In this case, digitalisation offers new opportunities for knowledge creation and dissemination, which are an essential part of sustainable land management. Digitalisation will support collaborative activities related to land use, bringing together diverse interests and help detect new patterns of cooperation. These developments will also have consequences for knowledge spaces and the institutional and personnel knowledge carriers established within them. The chapter outlines these consequences in the context of higher education research. Concepts from both domains—higher education and land management—are combined in a fruitful way, facilitating new interpretations of spatial and digital artefacts as well as debates about knowledge dissemination.

In recent years, the modes of knowledge transfer from science to society, and vice versa, have been changing. Our traditional understanding of scientific knowledge transfer in the form of unidirectional modes of communication is supplemented by new ways of knowledge exchange and knowledge production. As such, the notion of transfer and implementation should be discussed with a new focus in mind. Based on a framework for transfer and implementation activities in transdisciplinary research settings, Rogga discusses specific paths of knowledge dissemination, and especially of knowledge transfer, in his article on *Transcending the loading dock paradigm—rethinking science-practice transfer and implementation in sustainable land management*. He discusses the systemic understanding of transfer and implementation regarding unidirectional approaches, and provides definitions for transfer and implementation in sustainable land management. He recommends

taking a deeper look into knowledge management and considering what it means for sustainable land use management.

In **part three** *Co-evolution: new system solutions and governance*, the authors suggest and discuss various ways to integrate co-design and co-production approaches into applicable as well as integrative concepts, instruments and measures. In the cases outlined, system solutions are a result of co-design and co-production processes that demonstrate the complexity of interaction and competing targets.

Starting with embedded change projects, a description is given of small-scale system solutions that combine settlement development, water, and energy supply. Second, the new approach of urban agriculture combines different fields of action in cities, such as urban land use policy, development of open spaces, food security and social integration. Third, conceptual improvements reflect on the functional aspects of ecosystem services and the development of green infrastructure. The chapter ends with a broad discussion about upcoming challenges in land use science.

Changes towards meeting the ambitious 2030 Sustainable Development Goals (SDGs) demand new systemic approaches to resource management. Material Flow Management (MFM) is regarded as a vital tool for complex systems. Heck explains in the chapter entitled *Small-scale system solutions—material flow management in settlements* how MFM will contribute to the protection of land, the conversion of abandoned land and upcycling of degraded land. He demonstrates the usefulness of the concept, despite its relative novelty, by showing practical applications of MFM in small-scale systems characterised by decentralised material and energy flows. The chapter pays special attention to augmenting source and sink capacity, employing MFM to reduce impacts on ecosystems both upstream and downstream, i.e. on the use of resources as well as on the amount of emissions.

Specht, Schimichowski and Fox-Kämper illustrate another applicable concept. They focus on a concept that combines urban and rural potentials of co-production of goods as a (business) model in the chapter on *Multifunctional urban landscapes: The potential role of urban agriculture as an element of sustainable land management*. They explore how urban agriculture can contribute to sustainable land management and co-production. To this end, background information is given on the (re-)emerging phenomenon of urban food production and on what motivates those involved to implement collaborative practices. The functions and services provided by urban agriculture as an element of sustainable land management are explored using the three pillars of sustainability. It is shown that urban agriculture may reduce land use conflicts, and support new social activities for saving and qualifying open spaces.

In recent years, new scientific concepts for the assessment, and hence development, of ecosystems have also been established in science and land use planning. In the chapter on *Integrating ecosystem services, green infrastructure and nature-based solutions*, Haase includes three perspectives for developing new solutions to save urban nature as a habitat for humans, flora and fauna. Complementary paths to increased urban sustainability are shown, combining knowledge for action. Nonetheless, implementation is still a long way off, and there are also unsolved issues, such as the social inclusiveness of the three approaches.

Part three closes with a chapter on *Upcoming challenges in land use science—an international perspective* by Fürst. This chapter complements and extends the discussion on important concepts such as multifunctionality and social-ecological frameworks applied in land use science. The author also reflects on current political debates and challenges in terms of methodological aspects, actor involvement and project designs—in the context of sustainable land management. Future research topics related to the UN Sustainable Development Goals are raised, along with proposals for advancing land use science. As a future perspective, Fürst discusses how the co-development of knowledge and the co-design of land use system research could be conceived.

An **Outlook** is given in the final chapter of the book, entitled *Conclusions and research perspectives*. Here, the editors reflect on the different aspects of knowledge based on sustainable land management. They develop an integrative view on the topic and point out options for improving in particular the science-policy interface in the European context.

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