

Chapter in an edited volume

Land Use Competition

Ecological, Economic and Social Perspectives

Jörg Niewöhner* Antje Bruns Helmut Haberl Patrick Hostert
Tobias Krueger Christian Lauk Juliana Lutz Daniel Müller
Jonas Ø. Nielsen

2016

Abstract: This chapter introduces competition as a heuristic concept to analyse how specific land use practices establish themselves against possible alternatives. We briefly outline the global importance of land use practices as the material and symbolic basis for people’s livelihoods, particularly the provision of food security and well-being. We chart the development over time from research on land cover towards research on drivers of land use practices as part of an integrated land systems science. The increasingly spatially, temporally and functionally distributed nature of these drivers poses multiple challenges to research on land use practices. We propose the notion of ‘competition’ to respond to some of these challenges and to better understand how alternative land use practices are negotiated. We conceive of competition as a relational concept. Competition asks about agents in relation to each other, about the mode or the logic in which these relations are produced and about the material environments, practices and societal institutions through which they are mediated. While this has centrally to do with markets and prices, we deliberately open the concept to embrace more than economic perspectives. As such competition complements a broadening of analytical attention from the ‘who’, ‘what’ and ‘when’ to include prominently the ‘how’ and ‘why’ of particular land use practices and the question to whom this matters and ought to matter. We suggest that competition is an analytically productive concept, because it does not commit the analyst to a particular epistemological stance. It addresses reflexivity and feed-back, emergence and downward causation, history and response rates—concepts that all carry very different conceptual and analytical connotations in different disciplines. We propose to make these differences productive by putting them alongside each other through the notion of competition. Last not least, the heuristic lens of competition affords the combination of empirical and normative aspects, thus addressing land use practices in material, social and ethical terms.

Keywords: Relational perspective, Land cover, Global change, Scaling, Interdisciplinarity

*joerg.niewoehner@hu-berlin.de; ORCID: 0000-0002-9034-9761

This is the accepted manuscript (postprint) of a chapter in an edited volume published as follows:

Title	Land Use Competition
Subtitle	Ecological, Economic and Social Perspectives
Authors	Niewöhner, Jörg; Bruns, Antje; Haberl, Helmut; Hostert, Patrick; Krueger, Tobias; Lauk, Christian; Lutz, Juliana; Müller, Daniel; Ø. Nielsen, Jonas
Date of publication	2016
Title of the edited volume	Land Use Competition: Ecological, Economic and Social Perspectives
Editors	Niewöhner, Jörg; Bruns, Antje; Hostert, Patrick; Krueger, Tobias; Ø. Nielsen, Jonas; Haberl, Helmut; Lauk, Christian; Lutz, Juliana; Müller, Daniel
Pages	1–17
Publisher	Springer
DOI	10.1007/978-3-319-33628-2_1

Land Use Competition

Ecological, Economic and Social Perspectives

Jörg Niewöhner Antje Bruns Helmut Haberl
Patrick Hostert Tobias Krueger Christian Lauk
Juliana Lutz Daniel Müller Jonas Ø. Nielsen

2016

1 The Global Relevance of Land Use Practices

Land is essential for sustaining human existence and development on Earth. People's livelihoods are largely land-based or are affected by land-based activities. People live on land and land provides them with food, energy and the material and symbolic basis for social–ecological development and welfare. Yet this utility derived from land and land use is highly unevenly distributed across the Earth's surface—an uneven distribution that leads to ethically and ecologically untenable effects: human starvation and disease, irreversible damage to ecosystems and biodiversity, the permanent lack of energy to sustain a dignified everyday life.

In principle, the Earth's surface provides enough land to sustain current and future generations. However, land is a limited resource and considered a planetary boundary. While most studies suggest that this boundary has not been reached (Rockström et al. 2009; Steffen et al. 2015), the pressure to use land efficiently and effectively is mounting. Yet what is considered efficient and effective use of land, what suitable, feasible or just, and for whom and on the basis of what kind of evidence, experience or belief system, is anything but trivial. Alternative land uses therefore constantly compete with each other. The dynamics of these processes are increasing in speed, interconnectedness and complexity and are shifting for a number of reasons.

The demand for land is increasing as the world's population grows. The United Nations Department of Economic and Social Affairs has revised its median global demographic projection for 2100 to 11.2 billion people. Africa will likely exceed 4 billion people, thus almost catching up with Asia, and accounting for more than half of the population growth between 2015 and 2050 (United Nations 2015). Food consumption increasingly shifts to more livestock-based diets with higher resource demands (Kastner et al. 2012). New non-food uses have entered the arena, e.g. bioenergy, carbon storage, biodiversity conservation. And land has rapidly become a significant asset class for major investors such as pension and sovereign wealth funds. As a result, the number of actors competing

for land and particular land uses has increased and land use competition has become part of global ecological, trade, finance, information and people flows. These flows are rapidly increasing in speed and number of participating agents and sites. Land use competition has thus become one of *the* central arenas within which the effects of global change on human–environment systems are negotiated.

Actual land use practices and their drivers are key to better understanding the dynamics in these arenas. Land use practices are highly local and for many people on this planet they are the very site of existential struggles to make a living (Martinez-Alier 2002). Yet they are at the same time highly embedded in a complex global network of driving forces, reaching from climate dynamics through financial flows to transnational trade networks or diasporic relations. It is in the everyday practices of competing over how land and land-based resources may—or should (not)—be used that the complex dynamics of human–environment relations crystallize. These changing practices in turn drive global environmental changes, e. g. in climate, biodiversity, and other realms, that again feedback on people and their livelihoods. Understanding these dynamics is a key challenge for science and governance alike.

2 Land: Matter, Markets and Meaning

Land is a biophysical entity. It has an Euclidian extent and biophysical properties. It can be categorized into types of land cover and mapped with different resolutions. Yet land is also used, owned and traded. It is territory and it is a good that can be commodified in various ways. It is a material resource and the basis for all kinds of productive activities and housing. It is often allocated to people, regulated and administered, but it is also often an open access resource or used in a variety of customary ways by individuals or groups without formal property rights. Last not least, land is a source of meaning. It is home, it is part of landscapes and it is symbolically loaded. It is an element of belief systems, religious or otherwise, and it is an anchor for memories and heritage as well as for hopes and aspirations. Competing over the use of land thus takes many different forms.

2.1 From Land Cover to Global Change: The Loss of Innocence

The biophysical characteristics of the Earth’s surface are classified into land cover classes. Increasingly fine-grained analyses of high-resolution remote sensing data deliver information about types of cover as well as the spatial and temporal dynamics of change (e. g. Hostert et al. 2015). These studies raise questions of land use that cannot be answered from data on land cover alone. Instead, land system science expands the research agenda integrating several natural sciences from physical geography to ecology, supported by a number of international research platforms (Gutman 2004; Verburg et al. 2013; Verburg et al. in press).

Land use dynamics, however, are shaped simultaneously by biophysical, ecological, economic and sociocultural drivers. Data and knowledge is needed on the actors involved

in land use, their reasons for using land in particular ways and the rationales for decision-making. Large-scale changes in land use patterns over time are now linked to global trade and financial flows to demonstrate the increasingly complex interactions across the globe between changing demands, modes of production and distribution as well as land and resource use (Garrett et al. 2013; Lambin et al. 2001; Meyfroidt et al. 2013). Questions of governance of land use competition, i.e. of the mechanisms of achieving an efficient, legitimate and just distribution of access to and resources from land across people and time, have gained substantial attention (Verburg et al. in press). Increasingly, the role of environmental social sciences and humanities is considered to better contextualize biophysical and economic development within the relevant social and moral orders.

Land system science in this broad sense has become an integral part of global change research (Turner et al. 2007). This raises two major new challenges. Firstly, global change is fundamentally a societal issue. At its heart lies the question how people live together on this planet, how they organize production and consumption and the related resource flows (Fischer-Kowalski and Haberl 2007), how that affects land use (Krausmann et al. 2003; Kastner et al. 2012) and how all of this is changing. This question is fundamentally about the manifold entanglement of nature and culture and about the dynamics of human–environment relations (Palsson et al. 2013). The very framing of relevant research problems in this context already requires a multitude of disciplinary perspectives rooted in very different epistemological and ontological assumptions (O’Brien 2010). Conducting research in this area then requires a portfolio of methods operating on different spatial and temporal scales (Young et al. 2006). Yet knowledge from such vastly different methods and thought styles does not simply add up to an integrated whole. Instead, much research will be required on the intersections of these different approaches. The challenge is as much empirical as it is conceptual.

Secondly, research on the dynamics of human–environment relations under conditions of global change cannot be entirely disentangled from normative questions about how researchers think people *ought* to live together. This holds true for natural and social sciences alike and it has at least three consequences: (1) In order to understand each other, the empirical sciences need to work closely with the normative sciences, namely philosophy and law, particularly environmental ethics and political philosophy as well as international and environmental law. (2) Such collaborative research must not be a sequential endeavour, where a reality described by the natural sciences in a first step is evaluated in ethical terms thereafter. Rather a more symmetrical approach must entail an opening up and analysis of the normative and social theoretical assumptions inherent in empirical work. (3) Research on global change is seeking to intervene explicitly in the governance of the very change it is trying to understand and explain. This seems appropriate to many given that global change is a paradigmatic example of a “wicked problem” (Rittel and Webber 1973). The notion of transformation has been suggested to cover this duality of research to understand transformation and research to affect transformation (WBGU 2011). Such transformative research is explicitly working towards particular futures. Choosing one path towards a particular future over another can be informed by different kinds of empirical data and predictive models. Yet it is never

determined by data. Value-laden choices abound in transformative research. They need to be explicated and assessed in their consequences with the help of the normative disciplines as well as through an opening up of the scientific community and its knowledge practices to civil society and policy-making. The co-production of knowledge between science and society to legitimate transformative research and ideally arrive at a shared ownership for a common world is the continuation of a long-standing critique of the ivory tower model of scientific expertise (Krueger et al. 2016).

3 The Case for Land Use Competition: Going Beyond Drivers

Research on the dynamics of land systems has begun to reframe its object of research in the context of global change. Patterns of land use practices are increasingly framed as the outcome of a complex web of driving forces that operate across many spatial and temporal scales. Within the land system science community, the concept of telecoupling has been put forward as a conceptual framework to deal with this increasingly spatially distributed and interactive nature of driving forces (Eakin et al. 2014; Liu et al. 2014). It has already been put to useful effect in focusing attention on connections that emerge between hitherto seemingly independent human–environment systems. Hence, it makes the analysis sensitive to connections that were not expected within the dominant framework of governance and it draws out new spatial configurations of sending and receiving systems particularly in the context of rapidly changing urban-rural relations (Seto et al. 2012).

Yet the challenge of reconceptualizing land use change in the context of global change goes further (see also Friis et al. 2015):

- Metabolic aspects of land use practices and lifestyles need to be articulated, localized and quantified.
- Actor networks and their complex interactions and power relations need to be understood without losing sight of the material and ecological components of the dynamics.
- Driving forces can only be disentangled when the analysis explicitly considers the institutional and infrastructural contexts through which these forces are mediated.
- Better understanding of vertical and horizontal shifts in market integration is necessary to shed light on the effects of increasingly globalized value chains particularly in agricultural trade.
- The role of power, knowledge and agency is crucial in understanding shifts in control over land use decisions.
- A highly visible discussion about social–ecological notions of equity needs to be developed.

What is required is a process that brings into dialogue different epistemological frameworks and the expertise from economic geography, institutional analysis, ecological

economics, political ecology, social ecology, environmental anthropology and ethics and integrated land change science (Chap. 2 and Sect. 1).

We propose ‘land use competition’ (Haberl 2015; Lambin and Meyfroidt 2011; Smith et al. 2010) as one concept that holds the potential to further this agenda. We begin by defining competition in simple terms: Competition occurs when two or more agents strive for a goal that only one can attain or that not all can attain to the desired degree. Competition unfolds in constellations where an increase in one agent’s ability or desire to attain that goal brings about a decrease in other agents’ ability to do so. Thus, competition refers to the mode of solving antagonisms between agents or processes in the production of social or material order.

Competition takes the focus beyond drivers of land use because it is inherently and explicitly a relational concept. Competition asks about agents in relation to each other, about the mode or the logic in which these relations are produced and about the societal institutions through which they are mediated. As such competition complements, a broadening of analytical attention from the ‘who’, ‘what’ and ‘when’ to includes prominently the ‘how’ and ‘why’ of particular land use practices and the question to whom this matters and ought to matter (Lambin and Geist 2007). Importantly, competition is principally indifferent to the type of agents that compete. They can be human actors, but need not be restricted to humans (Law and Hassard 1999). Discourses, policies, ideologies and knowledge about land use change may also be said to compete in the context of land use (Latour 2005). The nature of the competing agents will have an impact on the nature of competition, on the practices, processes and infrastructures of competition as well as on its outcomes. The notion of competition is thus perfectly suited to relate material and social elements within human–environment systems. One dominant mode in which alternative land use practices are negotiated is the market. Therefore, our analytical concept deliberately has strong ties with the discipline of economics. While the understanding of competition in economics varies according to disciplinary school of thought, competition is commonly seen to be dependent on a number of prerequisites, first and foremost the existence of a market, but also an antagonistic relationship between at least two actors, the complementarity of incentivizing and coordinating mechanisms of (capitalist) markets and, last not least, the existence of goals.

Yet competition is a concept widely used in different disciplines (Chap. 8). These ties into different methodologies and different theoretical traditions are its strength. They allow a broad range of topics and foci to be pursued while retaining a joined conceptual base. The following aspects of land use competition are of particular relevance to land use competition in the context of land use and land use change:

1. In anthropology and sociology, competition has not so much been the object of explicit theorizing (Wetzel 2013 for an overview) as a constant analytical dimension of and a lens for understanding processes of social ordering. In this sense, it is often paired and contrasted with conflict, where competition solves antagonistic processes and interests within existing conventions, social and moral orders, whereas conflict operates ‘out of order’. Three main directions of investigation can be discerned: (a) particularly sociology is concerned at the macro-level of empirical investigation

whether competition as a mode of social interaction stabilizes or destabilizes social order. Investigations usually rely on large samples and comparative analyses between different forms of competition within or across societies (Hall and Soskice 2001). (b) Closely related but pursued at the micro-level of everyday practices, anthropology is interested in the ‘how’ of competing. The theoretical vanishing point is the question how social–ecological order is being produced and reproduced (or not). The approach is largely ethnographic and qualitative, investigating social conduct as well as practices and infrastructures of competition, e.g. markets, traders and trading technologies such as algorithms as they operate *in everyday action* (Ouma et al. 2013; Knorr-Cetina and Bruegger 2002; Callon 2012). It is particularly in this reading that land use competition can act as a boundary concept facilitating dialogue between econometric analyses and the sociocultural histories and ethnographic analyses of markets and their consequences in everyday action (Clark et al. 2011). And it can help to analytically grasp the manifold interactions between increasingly fast transnational and global market flows and ‘local’ social–ecological systems. (c) A third direction is shared by sociology and anthropology and is concerned with the subject positions and forms of collectivity afforded by competitive social processes. What sort of subjects do market economies produce, how is economic capital and agency distributed across populations and what forms of collectivity and individuality does this afford?

2. Political science is interested in competition within structures of governance. This stretches from political theory to empirical analyses of concrete processes of governing. Of particular interest in the context of this volume is the question how political competition facilitates market integration as well as the coordinating mechanisms of markets (e.g. Kosec et al. 2015). The interaction between economic and political competition is an important field. In many emerging market economies, e.g. in post-socialist Europe or in sub-Saharan Africa, corruption, family ties, old political and regulatory networks or tribal structures play a considerable role. It will not be sufficient to consider this panoply of real-world economic action as ‘informal’ or ‘imperfect’ vis-à-vis the ideal of market dynamics at the heart of neoclassical theory. It might be the more prudent strategy to unpack the notion of informal markets also in the context of post-colonial theories about different forms of modernity and multiple cosmopolitanisms (Breckenridge et al. 2000).
3. The affinity of social theory and ecology has been noted ever since sociologists started to use biological and organic metaphors for descriptions of social groups if not long before (Park 1915). Most recently, many discussions about ecological and historical materialism (Hughes 2000) and the rise of political ecology have taken this link far beyond metaphor and into the heart of studies of land use change. Other disciplinary junctures such as cultural ecology (Sahlins and America 1964), historical ecology (Balée 2013) or environmental history (Grove 1995) further attest to the fruitful intersection of material and social thought in ecology. In general, ecology discusses competition as a phenomenon of interactions between organisms

within one species (intraspecific competition) as well as between different species (interspecies competition). Competition usually emerges about access to resources (depletable) within the framework conditions set by environmental factors (non-depletable). Intraspecific competition is density-dependent and limits population growth, whereas interspecific competition is the main process structuring biological communities, a hugely important factor affecting the course of evolution (Cain 2008, and Chap. 8).

4. Moreover, competition is scale-bound in that competition occurs at the level of direct interaction between individual organisms. Increasingly sophisticated models of competitive processes, for example in co-evolutionary approaches to niche construction, allow for different strategies in competing and model the different forms of hierarchical sociality that emerge from such strategic competitive interactions (Odling-Smee et al. 2003). At the other end of the scalar spectrum, macro-ecological investigations of species distribution, patterning or invasion tend to pay less attention to actual competitive processes either because they are solely focused at levels above concrete entity interaction or because model or computational restraints force them to abstract from micro-interaction. Hence, competition is sensitive to scale and the analytical understanding and choice of scale heavily impacts on the analysis of competition. In sum, competition in ecology is a relational concept that describes a prominent mode of species interaction as a prerequisite for discriminate relations between organisms.
5. Competition is not in itself committed to a single epistemological stance. Studies of land use competition draw on very different epistemologies from forms of positivism to constructivism. While explicit debates about epistemology—or ontology for that matter—are rare, people stand their epistemological ground and debates often erupt when that ground appears to come under threat. Conflicts between, for example, climate scientists and political ecologists over the quality of climate models can rapidly turn into unnerving entrenchment. At the same time, however, these debates are absolutely vital for global change research. Finding ways of turning them into constructive debates and learning from them is an important task. We propose competition as a helpful concept here because it does not pre-empt epistemological conflict. Instead, it may act as a boundary concept linking different thought styles (Star and Griesemer 1989). Using competition as an analytical lens within a case study, for example, allow to focus on issues of power asymmetries inherent in structures of governance or on price levels within market dynamics. Competition does not solve potential conflicts between the two perspectives or suggest priorities. Yet it offers conceptual common ground to continue discussion.
6. Competition enables the combination of empirical and normative analyses. Most analysts of the dynamics of land use practices would concede that any particular land use is historically and socially contingent, i. e. could have developed into a different state over time and could be organized differently under different circumstances. Few would defend land use as some kind of natural given, particularly under

conditions of global change where the idea of ‘nature’ as an untouched state seems to be an anachronism. A prominent perspective in anthropology and the social sciences analyses the processes of negotiation between these alternative social–ecological orders (Mol 2002; Boltanski and Thévenot 1999): How do agents reason and legitimate ‘their’ order of things vis-à-vis alternatives? Do they even ‘see’ alternatives and, if so, how do they relate to them and why? And how do they pursue a particular path? ‘Seeing’ here is not only a matter of individual perspective, but also an infrastructural phenomenon (Scott 1998). The type of vision is heavily dependent on the instruments used to see: remote sensing enables a vision different from econometrics or surveys. People, markets and governing institutions are heavily reliant on such instruments to (re-)present the world to them and suggest certain pathways. How do these negotiations between alternative pathways operate in everyday life and what sources of justification and legitimacy do agents employ in competition? Competition as a relational concept is ideally suited to analyse these differences in vision and how they relate to each other. It enables a close alignment of empirical analysis—how do agents justify their actions—and normative assessment: What are the ethical premises of particular justifications, are they coherent and how do they fare within larger normative frameworks relevant to land use competition.

3.1 Scales and Scaling

The above discussion of different notions of competition has already demonstrated how understandings of competition may vary with analytical stance. Land use competition may be understood as the direct competition of two agents on a single piece of land. Yet land use competition may also be heavily mediated by economic and political infrastructures, contexts, mechanisms and instruments. These discussions always run the risk of conceptual confusion between scale and level of analysis as well as between scale, aggregation and resolution. In research on land use competition, this potential confusion is ever-present. Widespread terminology such as ‘global drivers’ or ‘local case studies’ is pragmatic, yet does not necessarily stand up to closer scrutiny. Furthermore, epistemological differences among researchers compound conceptual confusion. We do not pretend that we can solve a debate about scale here that has been pursued for many decades (Marston et al. 2005; Manson 2008; Cumming et al. 2006). Yet we can try to clarify our own usage of terms.

Within a Euclidian universe, entities differ in spatial extent. We may therefore refer to some entities as local, meaning small and in one single space, and to others as global, meaning large and covering a significant amount of space relative to the planet as a whole. Spatial extent is, of course, relative to some agreed upon yardstick, yet even constructivists today accept that this material dimension of the world may assert itself in relevant ways.

We only know the spatial extent of an object, because we measure it in some way. Hence, the object is in practice always a mixture of something out there and us looking at it with a particular method. When we use concepts such as ‘agro-forest frontier’ in land

system science, we mean something that we know through a particular set of methods. This is the constructivist stance that informs much of this volume. It is not social constructivism in the sense that such frontiers only exist, because scientists talk and write about it. Neither is it positivist in the sense that such frontiers cannot be known independently of the observing apparatus used to study it, i. e. somehow objectively represented. It is constructivist in that the phenomenon agro-forest frontier is part of the material world as known through particular methods. In science studies, the phrase ‘reality kicks back’ has been coined to alert social and natural scientists alike to the fact that the material world contributes to its being known through scientific method (Barad 1999).

Importantly, looping effects exist between the world and how it is known and represented (Hacking 2006). Take remote sensing operating with different temporal and spatial resolutions as a case in point. If we, for example, use 1-km resolution daily data, we will analyse very different agricultural phenomena in highly variable landscapes of sub-Sahel Africa, compared to using fine-scale (e. g. 10 m) data—that is only available 3 times a year. The same applies to optical versus radar sensors that ‘see different worlds’. The resulting maps are potentially used to inform farmers or decision-makers at World Bank—with very specific and probably different conclusions. Hence, ‘seeing like a geographical information system’ (Scott 1998; Law 2009) alerts us to the fact that the choice of scale in scientific knowledge production is reflected in how we represent and intervene into the world.

This includes scalar terminology. Working at the ‘regional’ scale, for example, constructs the phenomenon of the region—and, already confusing, this could be a world region as in many integrated assessment models or a far more local area of some degree of geographical, political or cultural coherence. Using the term sets boundaries in particular ways, because it implies the use of particular methods and hence particular types of data. So does research at ‘national’ scale. A nation state is a political unit and very different from saying $x \text{ km}^2$. It is obvious that the choice of scale needs to reflect the object of research and the research question. What we want to highlight here is that the choice of scale contributes in significant ways to the framing of the phenomenon under investigation and thus to the problematization (Rabinow 2004) of an issue. Climate change is one phenomenon when investigated through an Earth system model, and it is quite another when investigated ethnographically in a village in northern Burkina Faso (Nielsen et al. 2012). This is not to say that the two are not related in many ways. We just want to emphasize that a looping effect exists between choice of scale, problematization of land use competition, actual land use change and interventions into land use. This means being reflexive about and taking responsibility for methodological choices and their social–ecological implications.

Last but not least, many land use-related phenomena are complicated with respect to their spatial extent. They run across different scales. Take the farmer somewhere in sub-Saharan Africa arguing in the local market with a potential customer that his wheat is now more expensive, because it said on the news that drought and fires in Russia have increased global wheat prices. It is obvious that this social situation cannot be adequately analysed in either local or transnational terms. It is both. It is what

some sociologists today call a “synthetic situation”, i. e., a situation that is constructed from different spatially distributed elements that are brought into an interactive social situation with the help of different kinds of technology (Knorr-Cetina 2009). Synthetic situations rarely occur on a single scale. They are neither local nor global. They are distributed across different scales and research methods need to take that into account by “following” situations through different scales and conducting multi-sited investigations (Marcus 1995).

The land science community has responded to this multi-scalar challenge by investigating teleconnections and telecoupling, i. e. the spatial, temporal and functional distribution of drivers of land use practices (Friis et al. 2015 and Sect. 1). Importantly, telecoupling does not only alert us to events in different places and on different scales. It alerts us to the processes that connect these events. It complements the space- and place-based understandings of scale by adding a process-based or relational perspective. Such processual understandings of processes of ‘scaling’ help to capture how competition unfolds across different scales. Importantly, we note that physical processes tend to scale differently from social processes. For many intents and purposes, a tree, a coppice and a large forest exhibit many common properties. An individual person, a family, a social or ethnic group and a society, on the other hand, are organized in categorically different ways. Institutions and norms, dynamics of social interaction, systems of exchange and reciprocity all change radically along discriminate forms of sociality. Society is not simply ‘more people’ than a family or a village. Fundamentally different logics of social practice and order develop. Further, questions of representation arise and social processes are reflexive in (self-)conscious ways that differ from the feedback dynamics in physical systems. The pueblo system in the Chaco in Argentina, for example, operates as a local and highly distributed social system within a shared ecology (see Chaps. 4 and 13). When approached by an agri-business operating at a regional scale and wanting to buy several plots of land, farmers’ concerns lack collective representation at such a regional level. Upscaling from the local farm in this context is an intricate political process that requires social organization, a political culture and suitable power structures to be successful.

Anthropology and the social and cultural sciences have thus insisted ever since Durkheim that sociality is an emergent phenomenon *sui generis*, the properties and dynamics of which cannot be captured at the level of the individual (Durkheim and Lukes 1982). At the same time, it has become very clear in social–ecological research that social and physical dynamics cannot be strictly separated in analyses of transformation processes. The biophysical structures of society are entangled in many ways with their social processes and moral orders (Fischer-Kowalski and Haberl 2007). Nature and culture do not neatly split along received disciplinary traditions (Ingold 2004) and social and ecological variability as well as their interactions may be driven by very different underlying processes and dynamics. Great care thus needs to be taken in social–ecological research when, for analytical purposes, assuming properties of systems and dynamics such as scales, hierarchical structures or agent-based rules (Young et al. 2006). Reflexivity and feed-back, emergence and downward causation, history and response rates all carry very

different conceptual and analytical connotations in different disciplines that need to be taken into account in social–ecological research on land use competition.

3.2 Interdisciplinarity: Alternatives to Integrative Theories

We set out land use competition as a boundary object (Star and Griesemer 1989) that enables links between many different theoretical and methodological traditions. We are not suggesting that land use competition ought to form the basis of some kind of integrative land system theory. We believe that any attempt at integration is futile and not productive. Research on land use competition thrives on epistemological, methodological and theoretical differences. Our goal is to find ways of exploring tensions rather than to level them.

We take our cue here from analyses of interdisciplinarity in the sociology of science and scientific knowledge. Barry and Born (2013) observe three modes of interdisciplinarity:

- the integrative–synthesis mode where two or more disciplines converge into a new perspective;
- the subordination–service mode where one discipline supports research within the framework of another;
- the agonistic–antagonistic mode where two or more disciplines argue over the ontological status of a common object of research.

Whereas the first two modes are very much self-explanatory, the third deserves explication. Take ‘land’ as a perfect example. We have discussed above that land is a biophysical entity, commodity and source of meaning, all at the same time and depending on the observer. Hence, while geographers, economists and anthropologists share ‘land’ as the object of their research, they assign a different ontological status to this object. The agonistic–antagonistic mode now suggests that the different disciplines argue with each other trying to change the respective other’s ontological stance with respect to a shared research object, thereby engendering reflexivity about disciplinary philosophies and methods on the part of the researchers that may lead to novel research questions, objects and practices and, at its most powerful, a reshaping of the originating disciplines themselves.

We suggest that research on land use competition pursues all three modes of interdisciplinarity depending on the research problem at hand. In some cases, particularly across the great divide of generalizing and interpretive epistemologies, however, it might well be most fruitful to begin in agonistic mode and keep the tensions transparent and productive rather than striving too soon for integrative frameworks that lack analytical sharpness. In other cases, analyses of land use competition have already begun to move forward in an integrative mode, for example, by bringing closer together geographical, economic and governance perspectives in the formation of land system science (Ledford 2015; Turner et al. 2007, Verburg et al. in press).

4 Land Use Competition in This Volume: Generative Differences

This volume comprises four sections each pursuing a different aspect of land use competition:

- Conceptualizing distal drivers in land use competition,
- Competition for land-based ecosystem services: trade-offs and synergies,
- The future is made: imagining feasible food and farming futures in an unpredictable world and
- A water perspective on land use competition.

This is, of course, not a comprehensive coverage of the topic of land use competition. Neither is it just an eclectic list of subthemes. The four sections address four areas of concern that currently appear particularly pertinent to researchers in the field. The concern with the notion of the ‘distal driver’ in section one is borne out of the observation that increasingly land use change is driven by factors that are spatially, temporally or functionally remote from the actual territory in question. The section aims to alert research to these different facets of ‘distalness’ and to the fact that attending to these facets means attending to different epistemologies. Section two differentiates the trade-offs between different ecosystem services. Rather than reproducing current polarized controversies around food vs. fuel or feed, the chapter systematizes forms of competition and discusses possible synergistic effects between different land uses with regard to their contribution to ecosystem services. Section three and four explore the manifold and deep intersections between land science, food production and water governance. Section three discusses how research on land use competition is implicated in constructing futures. Using research on agro-food systems, the section demonstrates the importance of understanding place-based dimensions of food production vis-à-vis the more established regional and planetary dimensions. Section four complements this expansion of perspective by addressing land–water intersections. Building on the concept of waterscapes, the authors suggest that the study of power as a material *and* social phenomenon ought to be central to investigations of land-water governance.

The authors’ disciplinary backgrounds span from ecology and geography via agricultural economics to sociology and anthropology. We have not aimed at integrating this diversity into a collection of research papers that promote a single, coherent theory of land use competition. Rather, the different sections use their respective case study material to make inroads into the spaces in between different thought styles and matters of concern.

The attentive reader will recognize the epistemological and political tensions between the lines and between the sections. They reflect very real differences in perspective between individual researchers and between disciplinary approaches. The editorial team has not been concerned with leveling these differences. Rather we have tried to edit the chapters such that the reader may appreciate the differences as generative. It is in

this diversity that we feel the real value of research lies on land use competition under conditions of global change.

References

- Balée, W. L. (2013). *Advances in historical ecology*. New York City: Columbia University Press.
- Barad, K. (1999). *Agential Realism. Feminist interventions in understanding scientific practices*. In M. Biagioli (Ed.), *The science studies reader*. New York: Routledge.
- Barry, A., & Born, G. (2013). *Interdisciplinarity: Reconfigurations of the social and natural sciences*, New York: Routledge.
- Boltanski, L., & Thévenot, L. (1999). The sociology of critical capacity. *European Journal of Social Theory*, 2, 359–377.
- Breckenridge, C. A., Chakrabarty, D., Bhabha, H., & Pollock, S. (2000). *Cosmopolitanisms*. *Public Culture*, 12.
- Cain, M. L. (2008). *Ecology*. San Francisco, CA: W.H. Freeman.
- Callon, M. (2012). Framing finance: the boundaries of markets and modern capitalism. *Contemporary Sociology-a Journal of Reviews*, 41, 665–666.
- Clark, W. C., Tomich, T. P., Van Noordwijk, M., Guston, D., Catacutan, D., Dickson, N. M., & Mcnie, E. (2011). *Boundary work for sustainable development: Natural resource management at the Consultative Group on International Agricultural Research (CGIAR)*. In *Proceedings of the National Academy of Sciences*.
- Cumming, G. S., & Cumming, D. H. M., & Redman, C. L. (2006). Scale mismatches in social-ecological systems: Causes, consequences, and solutions. *Ecology and Society*, 11.
- Durkheim, E., & Lukes, S. (1982). *Rules of sociological method*, New York: Free Press.
- Eakin, H., Defries, R., Kerr, S., Lambin, E. F., Liu, J., Marcotullio, P. J., et al. (2014). Significance of telecoupling for exploration of land use change. In S. Kc & A. Reenberg (Eds.), *Rethinking global land use in an urban era*. Cambridge: MIT Press.
- Fischer-Kowalski, M., & Haberl, H. (Eds.). (2007). *Socioecological transitions and global change. Trajectories of social metabolism and land use*. Cheltenham: Edward Elgar.
- Friis, C., Nielsen, J. Ø., Otero, I., Haberl, H., Niewöhner, J., & Hostert, P. (2015). From teleconnection to telecoupling: taking stock of an emerging framework in land system science. *Journal of Land Use Science*, 1–23.
- Garrett, R. D., Lambin, E. F., & Naylor, R. L. (2013). Land institutions and supply chain configurations as determinants of soybean planted area and yields in Brazil. *Land Use Policy*, 31, 385–396.

- Grove, R. H. (1995). Green imperialism: colonial expansion, tropical Island Edens and the origins of environmentalism, pp. 1600–1860.
- Gutman, G. (2004). Land change science: observing, monitoring and understanding trajectories of change on the earth's surface. Springer Science & Business Media.
- Haberl, H. (2015). Competition for land: a sociometabolic perspective. *Ecological Economics*, 119, 424–431.
- Hacking, I. (2006). Kinds of people: moving targets. London: British Academy Lecture.
- Hall, P. A., & Soskice, D. (2001). Varieties of capitalism: the institutional foundations of comparative advantage: the institutional foundations of comparative advantage. Oxford: Oxford University Press.
- Hostert, P., Griffiths, P., Linden, S. V. D., & Pflugmacher, D. (2015). Time series analyses in a new era of optical satellite data. In: Kuenzer, C. (Ed.), *Remote sensing time series*. Dordrecht: Springer.
- Hughes, J. (2000). *Ecology and historical materialism*. Cambridge: Cambridge University Press.
- Ingold, T. (2004). Beyond biology and culture. The meaning of evolution in a relational world. *Social Anthropology*, 12, 209–221.
- Kastner, T., Rivas, M. J. I., Koch, W., & Nonhebel, S. (2012). Global changes in diets and the consequences for land requirements for food. *Proceedings of the National Academy of Sciences*, 109, 6868–6872.
- Knorr-Cetina, K. (2009). The synthetic situation: interactionism for a global world. *Symbolic Interaction*, 32, 61–87.
- Knorr-Cetina, K., & Bruegger, U. (2002). Global microstructures: the virtual societies of financial markets. *American Journal of Sociology*, 107, 905–950.
- Kosec, K., Haider, H. S., Spielman, D. J., & Zaidi, F. (2015). The effects of political competition on rural land: evidence from Pakistan. IFPRI Discussion Paper, 1441, .
- Krausmann, F., Haberl, H., Schulz, N. B., Erb, K.-H., Darge, E., & Gaube, V. (2003). Land-use change and socio-economic metabolism in Austria—Part I: driving forces of land-use change: 1950–1995. *Land Use Policy*, 20, 1–20.
- Krueger, T., Maynard, C., Carr, G., Bruns, A., Mueller, E.N. & Lane, S. (2016). A transdisciplinary account of water research. *Wiley Interdisciplinary Reviews: Water*, 3, 369–389. doi:10.1002/wat2.1132.
- Lambin, E., & Geist, H. (2007). Causes of land-use and land-cover change. Retrieved from .
- Lambin, E. F., & Meyfroidt, P. (2011). Global land use change, economic globalization, and the looming land scarcity. *Proceedings of the National Academy of Sciences*, 108, 3465–3472.

- Lambin, E. F., Turner, B. L., Geist, H. J., Agbola, S. B., Angelsen, A., Bruce, J. W., et al. (2001). The causes of land-use and land-cover change: moving beyond the myths. *Global Environmental Change*, 11, 261–269.
- Latour, B. (2005). *Reassembling the social: An introduction to actor-network-theory*. Oxford: Oxford University Press.
- Law, J. (2009). Seeing like a survey. *Cultural Sociology*, 3, 239–256.
- Law, J., & Hassard, J. (1999). *Actor network theory and after*, Oxford [England]; Malden, MA, Blackwell/Sociological Review.
- Ledford, H. (2015). How to solve the world’s biggest problems. *Nature*, 525, 308.
- Liu, J., Hall, V., Moran, E., Nagendra, H., Swaffield, S.R., & Ii, B. L. T. (2014). Applications of the telecoupling framework to land-change science. In: S. Kc, & A. Reenberg (Eds.), *Rethinking global land use in an urban era*. Cambridge: MIT Press.
- Manson, S. M. (2008). Does scale exist? An epistemological scale continuum for complex human-environment systems. *Geoforum*, 39, 776–788.
- Marcus, G. E. (1995). Ethnography in/of the World System: The emergence of multi-sited ethnography. *Annual Review of Anthropology*, 24, 95–117.
- Marston, S. A., Jones, J. P., & Woodward, K. (2005). Human geography without scale. *Transactions of the Institute of British Geographers*, 30, 416–432.
- Martinez-Alier, J. (2002). *The environmentalism of the poor: A study of ecological conflicts and valuation*. Edward Elgar Publishing.
- Meyfroidt, P., Lambin, E. F., Erb, K. H., & Hertel, T. W. (2013). Globalization of land use: distant drivers of land change and geographic displacement of land use. *Current Opinion in Environmental Sustainability*, 5, 438–444.
- Mol, A. (2002). *The body multiple: Ontology in medical practice*. Durham: Duke University Press.
- Nielsen, J. Ø., D’haen, S., & Reenberg, A. (2012). Adaptation to climate change as a development project: a case study from Northern Burkina Faso. *Climate and Development*, 4, 16–25.
- O’Brien, K. (2010). Responding to environmental change: A new age for human geography? *Progress in Human Geography*.
- Odling-Smee, F. J., Laland, K. N., & Feldman, M. W. (2003). *Niche construction: The neglected process in evolution*. Princeton: Princeton University Press.
- Ouma, S., Boeckler, M., & Lindner, P. (2013). Extending the margins of marketization: Frontier regions and the making of agro-export markets in northern Ghana. *Geoforum*, 48, 225–235.

- Palsson, G., Szerszynski, B., Sörlin, S., Marks, J., Avril, B., Crumley, C., et al. (2013). Reconceptualizing the 'Anthropos' in the Anthropocene: Integrating the social sciences and humanities in global environmental change research. *Environmental Science and Policy*, 28, 3–13.
- Park, R. E. (1915). The city: suggestions for the investigation of human behavior in the city environment. *American Journal of Sociology*, 20, 577–612.
- Rabinow, P. (2004). *Anthropos today. Reflections on modern equipment*. Princeton: Princeton University Press.
- Rittel, H. W. J., & Webber, M. M. (1973). Dilemmas in a general theory of planning. *Policy Sciences*, 4, 155–169.
- Rockström, J., Steffen, W., Noone, K., Persson, A., Chapin, F. S., Lambin, E. F., et al. (2009). A safe operating space for humanity. *Nature*, 461, 472–475.
- Sahlins, M. D., & America, V. O. (1964). *Culture and environment: the study of cultural ecology*, Voice of America, U.S. Information Agency.
- Scott, J. C. (1998). *Seeing like a state: how certain schemes to improve the human condition have failed*. New Haven: Yale University Press.
- Seto, K. C., Reenberg, A., Boone, C. G., Fragkias, M., Haase, D., Langanke, T., et al. (2012). Urban land teleconnections and sustainability. *Proceedings of the national academy of sciences of the United States of America*, 109, 7687–7692.
- Smith, P., Gregory, P. J., Van Vuuren, D., Obersteiner, M., Havlík, P., Rounsevell, M., et al. (2010). Competition for land. *Philosophical Transactions of the Royal Society of London B: Biological Sciences*, 365, 2941–2957.
- Star, S. L., & Griesemer, J. R. (1989). Institutional ecology, translations and boundary objects—amateurs and professionals in Berkeley's-Museum-of-Vertebrate-Zoology, 1907–39. *Social Studies of Science*, 19, 387–420.
- Steffen, W., Richardson, K., Rockström, J., Cornell, S. E., Fetzer, I., Bennett, E. M., Biggs, R., Carpenter, S. R., De Vries, W., De Wit, C. A., Folke, C., Gerten, D., Heinke, J., Mace, G. M., Persson, L. M., Ramanathan, V., Reyers, B., & Sörlin, S. (2015). Planetary boundaries: Guiding human development on a changing planet. *Science*, 347.
- Turner, B. L., Lambin, E. F., & Reenberg, A. (2007). The emergence of land change science for global environmental change and sustainability. *Proceedings of the National Academy of Sciences*, 104, 20666–20671.
- United Nations (2015). *World Population Prospects. The 2015 Revision*. New York: United Nations Department of Economic and Social Affairs.
- Verburg, P. H., Crossman, N., Ellis, E. C., Heinimann, A., Hostert, P., Mertz, O., Nagendra, H., Sikor, T., Erb, K. -H., Golubiewski, N., Grau, R., Grove, M., Konaté, S., Meyfroidt, P., Parker, D. C., Chowdhury, R. R., Shibata, H., Thomson, A., & Zhen, L.,

Land system science and sustainable development of the earth system: a global land project perspective. *Anthropocene* (in press).

Verburg, P. H., Mertz, O., Erb, K.-H., Haberl, H., & Wu, W. (2013). Land system change and food security: towards multi-scale land system solutions. *Current Opinion in Environmental Sustainability*, 5, 494–502.

WBGU (2011). *Welt im Wandel. Gesellschaftsvertrag für eine Große Transformation*, Berlin, Wissenschaftlicher Beirat der Bundesregierung Globale Umweltveränderung.

Wetzell, D. J. (2013). *Soziologie des Wettbewerbs. Eine kultur- und wirtschaftssoziologische Analyse der Marktgesellschaft*, Jena, VS Verlag für Sozialwissenschaften.

Young, O. R., Lambin, E. F., Alcock, F., Haberl, H., Karlsson, S. I., McConnell, W. J., et al. (2006). A portfolio approach to analyzing complex human-environment interactions: institutions and land change. *Ecology and Society*, 11, 15.