Chapter 6
Urban-Rural Interrelations—A Challenge for Sustainable Land Management

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Abstract Although the relevance of urban-rural interrelations is widely acknowledged in science and practice, there is as yet no feasible theoretical or theory-driven approach or model that addresses the multiple interconnections in urban-rural spaces at the regional level and makes them applicable to actors in policy and planning practice. In this chapter, we give a short overview of how the topic has developed; present core concepts for urban-rural interrelations; and discuss their applicability and potential improvements by integrating other concepts and connecting governance debates. In the process, we develop new ideas for the analysis and governance of regional functional interrelations in a bid to improve sustainable land management.

Keywords Urban-rural interrelations · Land management · Telecoupling · Regional governance

6.1 Introduction

For a long time, theory and practice focused on either "urban" or "rural" issues of spatial development and land management (e.g. rural development policy). Planning and policy focused on the urban-rural dichotomy, which is also reflected in dualistic definitions and classifications such as statistical and spatial-functional (Tacoli 1998; Dick 2011; OECD 2013). Although scientific discussions have emphasised the social construction of such spatial categories over the past few years, all practical applications in planning and policy have used this differentiation in the past. In

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addition, a growing number of studies have shown the variety of material and non-material interlinkages between distinct urban and rural areas (e.g. Tacoli 1998; Stead 2002; Buciega et al. 2009; Gebre and Gebremedhin 2019). Many observers consider urban-rural linkages to be an important element for economic development and for achieving greater sustainability, which has led to them identifying policy fields and agendas for promoting urban-rural linkages, cooperation and integrated partnerships (Akkoyunlu 2015; OECD 2013; UN-Habitat 2017; MUFPP 2015; Piorr et al. 2011; Wolff and Mederake 2019; DV 2013).

In the face of growing global challenges (e.g. climate change; intensive resource and land use; food, water and energy insecurity; and social and environmental injustice), greater relevance and urgency are attached to the questions of how cities, city regions and rural areas (and their various interfaces and system intersections) can be sustainable, as well as effectively developed and managed (Bock et al. 2013; UN-Habitat 2017: New Urban Agenda, Seto and Reenberg 2014; WBGU 2016). Urban-rural spaces (especially in peri-urban) exhibit a close interdependence of spatial functions, different demands on land, and a complex constellation of actors and governance schemes, which often results in land use conflicts and requires different modes of research and governance (Repp et al. 2012; PURPLE 2014; Augère-Granier 2016; Zscheischler et al. 2017; Piorr et al. 2018).

No conceptual approaches exist at present that are simultaneously (1) comprehensive in terms of current fields of action, (2) able to capture the complexity of urban-rural interrelationships, and (3) suitable for practice, also in the context of regional governance.

This chapter pursues three major objectives. First, it gives a short overview of societal discourses and the relevance of urban-rural interrelations (Sects. 6.1 and 6.2). The second objective is to examine concepts that describe and analyse urban-rural interrelations. The two analytical concepts presented in Sect. 6.3 can be interpreted as the two ends of a range that displays an increase in complexity from one extreme to the other. The model by Stead (2002), which is easy to understand and is self-evident, is positioned at one end of the range, while the highly sophisticated concept of telecoupling (Liu et al. 2013; Friis et al. 2016) represents the other extreme. Assuming a general science-policy gap (Taylor and Hurley 2016; Diller and Thaler 2017), we then explore how the models can be applied in the practice of regional governance and sustainable land use. The third objective, explored in Sect. 6.4, is to present initial ideas about how to rethink these analytical models to address the practical needs of planners, administrative professionals and other actors involved in land management in urban-rural areas. Finally, we link the discussion about urban-rural interrelations to the question of governance and knowledge for governance and innovation (Sect. 6.5) and provide an outlook (Sect. 6.6).

6.2 Societal Discourses About Urban-Rural Spaces and Interlinkages

Seeking to define urban and rural spaces as distinct places or regions, various attempts have been made to define their characterising factors (Stead 2002; Smith and Courtney 2009; Schnore 1966). In the European Union, for example, each Member State has its own definition of a rural area (Smith and Courtney 2009). Variables such as population size, population density, employment density and land use type are often used to this end, either individually or in combination, depending on the country, organisation and purpose (Stead 2002; Schaeffer et al. 2013, p.81). Nonetheless, there is a "lack of a single standard definition of urban and rural areas", as Stead (2002: 299–300) ascertained.

Looking back to the history of definitions of rural and urban areas reveals an interesting development. While compact cities prevailed up to the nineteenth century, implying a clear dichotomy between the rural and the urban area, the ensuing industrialisation and expansion of urban spaces softened this division towards a rural-urban continuum (Repp et al. 2012; Borsdorf and Bender 2010). By the mid twentieth century at the latest, the progress of urbanisation and of social and economic development had resulted in an approximation of these previously opposing areas (Schaeffer et al. 2013). Seto et al. 2012 confirmed this transformation of the understanding of the term by calling the rural-urban dichotomy a "false idea" (p. 7687). Schaeffer et al. even talked about "one system" with regard to this interconnected area (Schaeffer et al. 2013, p. 81), coming back to Jefferson (1931, p. 446) who was convinced, as early as 1931, that "[u]rban and rural, city and country are one thing, not two things."

Although there are ongoing discussions about "blurred boundaries" (Woods 2009), "middle landscapes" or "hybrid geographies" (Ulied et al. 2010), a recent publication issued by the European Parliament acknowledges that "the traditional division is not completely gone and despite nowadays being urbanised and largely made up of 'hybrid geographies', Europe retains clearly recognisable rural and urban areas" (Augère-Granier 2016, p. 2). This dichotomy is questionable, but the underlying assumption of two relational spaces with reciprocal flows is useful when urban-rural interrelations need to be investigated or governed (Repp et al. 2012).

Only a few efforts have been made to address the interlinkages between the rural and the urban area in their entirety, although many specific areas (e.g. commuting) have been thoroughly investigated as stand-alone phenomena (Stead 2002; Smith and Courtney 2009; Schulze Bäing 2007; Schaeffer et al. 2013; Tacoli 1998). However, the complexity of interactions between both spaces appear to have been underestimated (Smith and Courtney 2009, see Caffyn and Dahlström 2005; Hoggart 2005). In fact, at the urban–rural interface, land use planning and land management in general remain quite challenging (Woods 2009; Geneletti et al. 2017).

Not only scientists and planners have recognised the increasing need to take into account rural-urban interrelations—the political sphere has also become aware of the considerable importance of these ties.

Back in 1999, the European Spatial Development Perspective (ESDP) called for more attention to be paid to urban-rural relationships in order to balance disparities in Europe via measures of spatial planning and regional development (European Commission 1999). An important shift towards an integrative view of this interconnected space is currently discernible.

Several policy documents highlight the relevance of urban–rural interlinkages (UN-Habitat 2017; Wolf and Mederake 2019; Piorr et al. 2018; OECD 2013) to sustainable development in order to promote a balance between human welfare, economic activities, and environmental quality. This new paradigm is expressed in a series of international resolutions and agendas, such as the Sustainable Development Goals (SDG) and Habitat III, both adopted in 2016.

The UN SDGs entered into force, determining the development goals to be achieved globally by 2030 (United Nations 2017). Although they cover a wide range of topics, several objectives of the SDGs point to urban-rural linkages. Both the regional level and the national level of development planning are addressed in the SDGs. In the process, the positive mutual effects generated between the urban, rural and peri-urban space should be promoted with the aim of meeting all three pillars of sustainability—social, economic and environmental sustainability. Furthermore, the SDGs call for city-related issues such as sustainable urbanisation processes and settlement development linked with participatory methods, a reduction of environmental pollution, and the provision of green areas for all city dwellers. Furthermore, the SDGs cover people-centred topics such as combating poverty and hunger, promoting health, education and gender issues, and economic themes such as city development, and climate and environmental protection (United Nations General Assembly 2016). In SDG 11 "Sustainable cities and communities", the UN calls for the support of positive economic, social and environmental links between urban, peri-urban and rural areas by strengthening national and regional planning and development activities.

While the SDGs take a broad approach, Habitat III, the third United Nations Conference on Housing and Sustainable Urban Development, held in Quito/Ecuador in October 2016, focuses on urbanisation processes. The Habitat III resolution gives considerable weighting to rural-urban interlinkages, especially in connection with their role in sustainable urban development. Spatial planning instruments are considered to be ideal for exploiting the promising potential of rural-urban interconnections. Relationship and exchange should be integrative in favour of both areas. One form of exchange is organised such that it reflects supply and demand along the value chain. Other forms of exchange include communication, technology, transport and infrastructure, which may help increase productivity and ensure the better utilisation of spatial, social and economic potential. One aspect of Habitat III is the target of achieving the equal development of regions within the urban-rural-continuum, based on enhanced productivity as a result of synergies between both areas. Partnerships and regional infrastructure projects should support this pathway. Another challenge addressed by the resolution is assuring the consistency of sectorial policies in consideration of the functions of areas, regardless of administrative boundaries. Habitat III also attaches importance to the role of land resources, including their ecological and social features. It calls for the conservation and sustainable management of natural

resources, especially ecosystems and biodiversity. In sum, polycentric and balanced territorial development should contribute to achieving sustainability (United Nations General Assembly 2016).

In continuation and advancement of the Habitat process, the UN published "Urban-Rural Linkages: Guiding Principles and Framework for Action to Advance Integrated Territorial Development" (UN Habitat 2019) in 2019. This document broadens and deepens the view on urban-rural interrelations. The ten guiding principles, based on human rights, are integrated governance, balanced partnership, participative, environmentally sensitive, data-driven and evidence-based. Interventions should be locally grounded, functional and spatial system-based, and financially inclusive; they should not harm, and provide social protection. The last point refers to the need to "strengthen urban-rural linkages to overcome conflicts […] and reduce inequalities" (p. 11).

These three resolutions prove the timeliness and societal relevance of addressing rural-urban interlinkages, and show which big challenges linked with this issue must be tackled in future.

A better understanding of the interconnections in urban-rural spaces as socio-ecological systems, and hence **feasible analytical and conceptual approaches** with an adequate complexity, are needed to strengthen urban-rural linkages, and to create options to influence the management of natural resources such as land (management) towards sustainability at different spatial scales and policy levels.

6.3 Simple Models Versus Complex Models: Two Opposite Approaches

Several scientists endeavoured to design models for explaining spatial phenomena and interdependencies, starting with von Thünen, Launhardt and Lösch in Europe in the late nineteenth century (Schöler 2005). Scientists from various disciplines contributed models to this development process. Since the 1970s at the latest, scientists have been searching for more sophisticated models to further their understanding of the manifold interactions and interdependencies between rural and urban areas. There are now several models with different starting points and varying levels of complexity (Repp et al. 2012; Akkoyunlu 2015; Kasper and Giseke 2017). In the following, we compare the model by Stead (2002) with the very complex model of telecoupling (Liu et al. 2013) in order to present two concise examples from a multitude of models and to illustrate the extreme bandwidth of complexity.

6.3.1 Stead's Model of Urban-Rural Flows

According to Stead (2002), urban and rural areas are regarded as being distinct (however they are defined), but interconnected and interdependent. In the model, functional relations (flows) are used to describe urban-rural relationships. Based on the theoretical framework of Preston (1975), Stead (2002) places the functional relations between urban and rural spaces in the centre of his model, and differentiates between flows of people and flows of materials/goods (Fig. 6.1).

For the "flows of people" category, the model presents six sub-categories: Work; Education and training; Migration; Recreation and tourism; Cultural activities; and Commerce (see Fig. 6.1). The second category ("flows of materials") has two sub-categories: Waste and pollution, and Food, Water, Resources, Environmental Benefits. In addition, the flows are attributed with **directions** that specify the direction in which the flows move within the interrelationships between both spatial units. As Fig. 6.1 shows, flows may be unidirectional (e.g. waste) or bidirectional (e.g. recreation and tourism).

This framework is able to cover "observable and quantifiable" exchange between rural spaces and urban spaces, and vice versa (Preston 1975: 173; Stead 2002). Stead (2002) used this framework to examine typical urban-rural interrelationships in the West of England. However, this examination was limited to flows for which

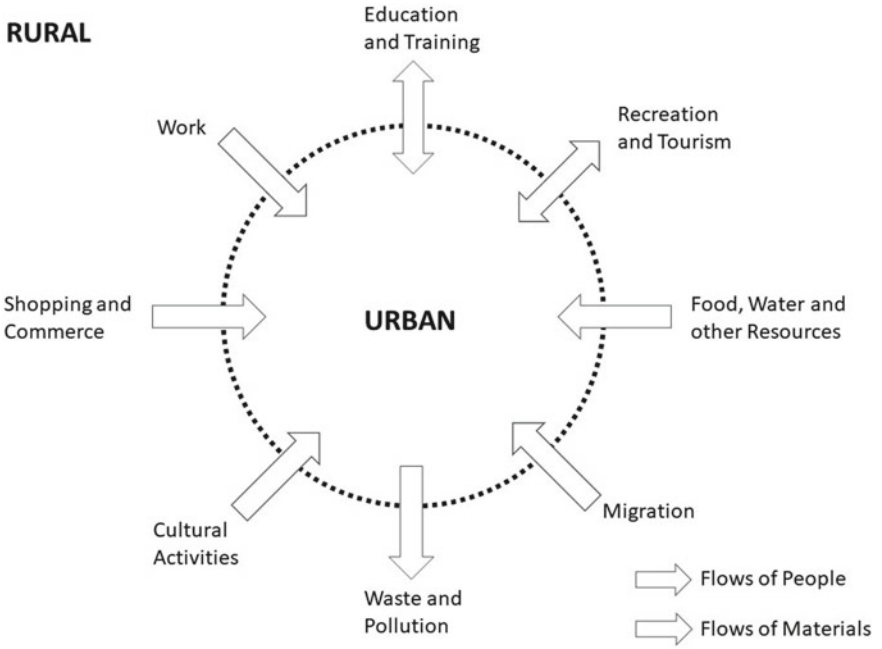

Fig. 6.1 Original model of flows of people and materials by Stead (own illustration based on Stead 2002)

quantitative data was available, and ignored difficult-to-measure interdependencies such as information and financial flows, due to lack of data (Repp et al. 2012).

Stead's model is useful for theoretically analysing the interlinkages between rural and urban areas. However, revisions must be made to reflect current spatial current dynamics and to grasp the even more complex interactions (Repp et al. 2012). One option is to update the model (see Fig. 6.2). First, flow directions are revised based on new scientific knowledge (e.g. about multi-local working places or re-urbanisation processes). In some cases, a bidirectional dimension needs to be added to the existing flows or directions even need to be changed, given that current situations do not reflect the situation in West England over 15 years ago. The second option is to introduce new categories of interlinking "immaterial flows" that are better at reflecting current developmental trends, which go beyond the exchange of goods and people. Adding the categories "Knowledge and Innovation", "Habitation" and "Lifestyle, Consumption Patterns and Social Values" emphasises the greater importance of linkages relating to information, knowledge and network integration (Repp et al. 2012). The grey arrows in Fig. 6.2 show how the original model has been modified, and highlight the greater complexity of urban-rural interdependencies (e.g. reciprocal relations in housing and work) as well as the existence of non-material flows.

In the revised version Repp 2012 recognizes that urban-rural interlinkages are also shaped by power constellations and distant effects (see also Pütz 2004).

From the authors' point of view, the flow-based model provides a useful systematisation scheme that is adaptable and can therefore be applied more generally to show the different development stages (e.g. urbanisation cycle of cities) or, more specifically, the interrelations of a particular urban-rural area under investigation. Many policy and planning documents refer implicitly to the concept (e.g. regional development concepts for retail, transport or housing), without explicitly naming

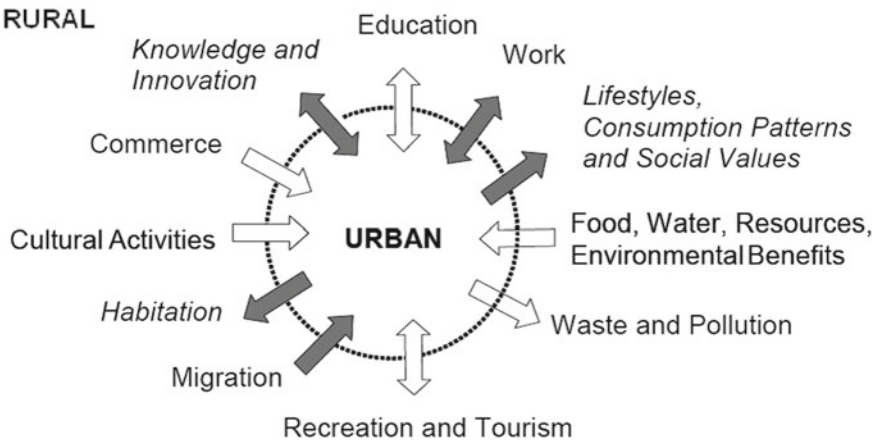

Fig. 6.2 Adapted model of rural-urban interlinkages by Repp et al. 2012 (own illustration, modified and extended based on Stead 2002)

it. The Stead model and its adaptation by Repp et al. 2012 are not well known in the scientific community (examples include Eppler et al. 2015; Kasper and Giseke 2017).

6.3.2 Complex Models of Teleconnection and Telecoupling

Focusing on social-ecological and human-environmental systems, the framework and concept of telecoupling offers a different perspective on urban-rural relations as well as land use systems. Telecoupling is an umbrella concept that merges relevant frameworks from land use science such as teleconnection and globalisation (Liu et al. 2019). "It enables researchers to explore interrelationships among various distant interactions and feedbacks across multiple scales. It also captures the complexity of increasingly prevalent distant environmental and socioeconomic interactions, as well as their diverse drivers and effect" (Liu et al. 2019: 21). In a nutshell, the concept means that human–environmental systems are increasingly interlinked and therefore interact over large distances. Human-induced processes in one part of the world affect another distant part. The feedback between social processes and land outcomes in the interacting systems make the concept highly interesting for researchers in land use science and beyond (Eakin et al. 2014; Friis et al. 2016).

The concept was first applied on thematic areas related to vulnerabilities in connection with environmental changes (Adger et al. 2009) and later in broader contexts such as urban studies (Seto et al. 2012; Haase 2019). In the urban context, the conceptual frameworks of urban teleconnections and telecouplings (UT) were used to study urban-rural relations (Seto et al. 2012; Friis et al. 2016). They represent the shift from place-based to process-oriented conceptualisation along a continuum of land systems (Seto et al. 2012).

These concepts address the observation that land use changes induced by urbanisation and the use of environmental, economic and cultural resources by the urban population affect not only the cities and their surroundings, but also distant places (e.g. rural areas in other regions of the world) and are interlinked (Seto et al. 2012; Liu et al. 2019). These interrelations can be illustrated using the example of meat-based diets in European cities, which cause deforestation in the Amazonas region (Haase 2019).

Two major strands of telecoupling concepts have co-evolved in recent years (Friis et al. 2016): first, the original structured approach that was developed by Liu et al. (2013, 2014) and has been represented by scholars such as Friis et al. 2016 and Garrett and Rueda 2019; second, the heuristic and actor-oriented approach following Eakin et al. (2014), which include social and functional distances in the concept alongside geographical distance.

The idea of telecoupling is based on a set of human and natural **systems** as the core of a telecoupled system (Liu et al. 2013; Friis et al. 2016). In the initial concept by Liu et al. (2013), the systems address **agents, causes and effects** that are interconnected. These causes and effects are inseparably interlinked with each

other by "feedback loops", meaning that a cause induces an effect, and vice versa (Liu et al. 2013, p. 3). The systems are linked by **flows** that can transport material (e.g. goods, natural resources, organisms), energy and information (e.g. land titles, agricultural techniques). These flows may be unidirectional or bidirectional (Liu et al. 2014). At the system level, a distinction can be made between sending, receiving and spillover systems (Fig. 6.3). While the functions of sending and receiving systems are obvious—one system acts as the sender of a flow and the other as the recipient—the spillover systems require further explanation. Spillover systems are involved in the interaction between sending and receiving systems influencing or being influenced by the connecting flows in mainly three different ways: they can either act as an intermediate stop to the flow medium (e.g. transportation hub), as a point on the route being affected by the passing flow (e.g. local pollution by passing traffic), or as an active part of the hitherto bilateral interaction, turning it into a trilateral issue (e.g. as an additional trade partner) (Liu et al. 2013). The role played by systems (sending, receiving, spillover) depends on the type of flow, and is therefore not determined a priori (Friis et al. 2016).

The initial concept and its further developments (Liu et al. 2014) have been applied in various studies dealing with aspects such as threats to biodiversity and conservation (Kuemmerle et al. 2019), transnational land deals (Liu et al. 2014) or flows and processes in global agri-food systems (Garrett and Rueda 2019).

The following situation is conceivable when applying the telecoupling concept to the context of close urban-rural interrelations. A power plant located at the rural site

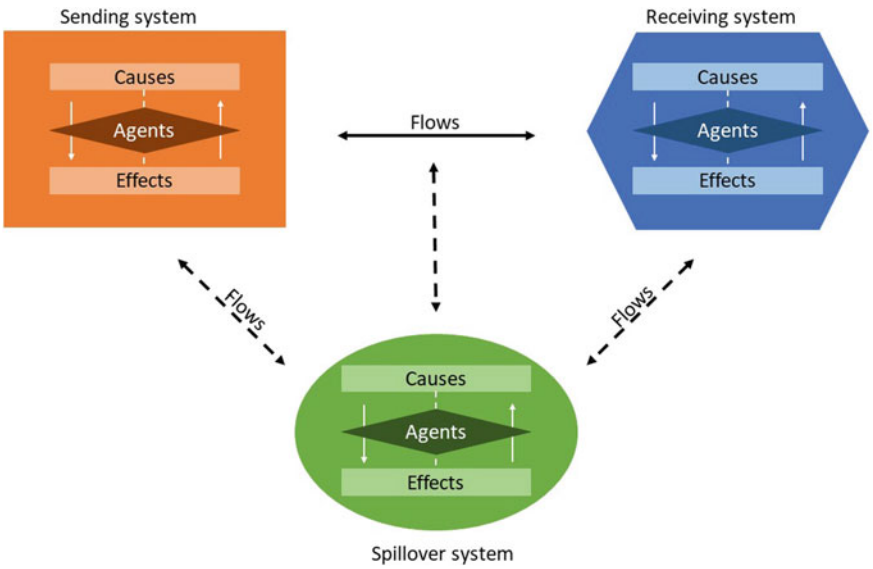

Fig. 6.3 Initial telecoupling framework (own illustration according to Liu et al. 2013; Friis et al. 2016)

where the raw material is converted into energy represents the spillover system. The agents involved are the producers of the energy carrier (e.g. farmers who produce short rotation coppice), the power plant operator, the network operator, the energy supplier, and the receiving households in the city. Besides flows of energy, raw material and money as payments for the traded commodities, information is also exchanged between the agents about energy prices, demand and trade details. The causes of this urban-rural relationship include energy demand by the city population, the limited possibility of fully producing one's own urban energy, the rural capacity of producing renewable energy carriers, and the political orientation towards renewable energy within the overarching framework of the energy transition. In this telecoupled system, the effects are the expansion of the production of renewable raw materials, entailing the avoidance of nuclear risks, climate-friendly energy production, the diversification of income for rural farmers, a land-use change in the production area, and energy supplies for city dwellers.

In contrast to Liu et al. 2013, the heuristic and more actor-centred approach by Eakin et al. (2014) (see Fig. 6.4) assumes that there are spatial and social distances between the systems, and that they are not connected a priori. These distances are considered to be geographically separate, and are viewed in terms of social networks, institutions and governance. Place-based socio-ecological systems are governed independently and within a given governance frame (1), which may cause unexpected and indirect effects (2) if they interact (e.g. via market transactions). The outcome of a telecoupling process can be positive or negative (e.g. biodiversity loss, population placement, reforestation). Land change-related problems occur when the actors (institutions) and governance mechanisms fail to recognise the effects of telecoupling or are unable to account for the consequences (Eakin et al. 2014; Friis et al. 2016).

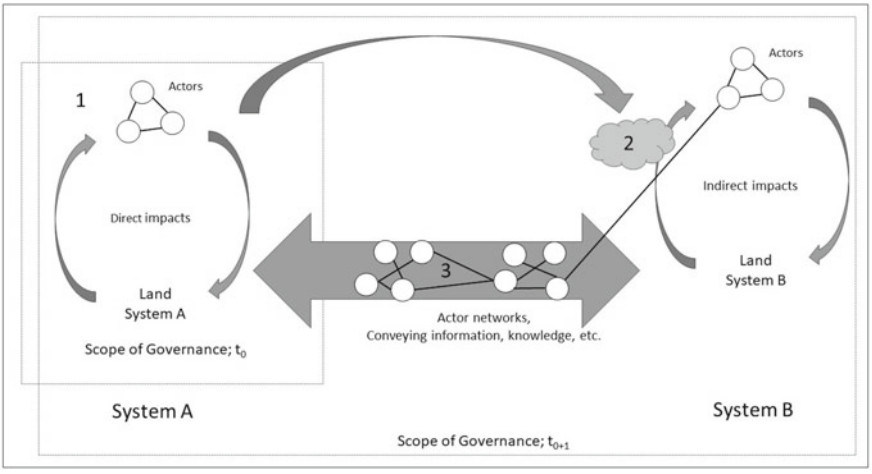

Fig. 6.4 Heuristic approach of the telecoupling framework by Eakin (own illustration based on Eakin et al. 2014: 147)

Feedback processes in (distantly) coupled systems can influence the existing governance structure or create new institutional arrangements (3), and have therefore been assessed as having the potential for institutional change (Friis et al. 2016). Another relevant distinction from the initial concept by Liu et al. (2013) is the recognition of differences of power, influence, and possible asymmetrical relationships in terms of material, capital, information, etc., which "create[s] asymmetries in the responsibility and nature of response" (Eakin et al. 2014: 149). Due to globalisation, processes of economic intensification and connection can be observed. The material flows induced (goods, people, capital) often go hand in hand with non-material flows such as information, knowledge, ideologies or discourses facilitated by information technologies and social networks (Eakin et al. 2014; Persson and Mertz 2019). These flows enable actors in the systems to interact or even to change scales (Friis et al. 2016).

A prominent example of indirect land use changes is biofuel production, such as induced by the European Union's Renewable Energy Directive or by US energy policy. These measures have caused negative environmental and social impacts in many countries around the globe, including increased land competition and international trade, a decrease in food crops, a loss of biodiversity. In the case of biofuel production, land use changes occur not only in the countries where the policy decisions were made, but also in other countries such as Mexico or Brazil (Eakin et al. 2014,2017), which also raises questions about the governance of food systems.

6.3.3 Preliminary Summary and Discussion

The two core concepts and their adaptations (flows of people and materials, and telecoupling) provide useful analytical perspectives on urban-rural interrelations. As yet, however, both concepts have mainly been applied in science and tested in a number of empirical studies with different thematic fields (Stead 2002; Friis 2019).

Table 6.1 summarises the strengths and weaknesses of the different concepts in terms of urban-rural relations, land management and governance.

Both concepts display the variety of urban-rural interrelations (represented by flows). Whereas the Stead model and its adaption by Repp et al. 2012 focus on the type and direction of functional interlinkages, the models' explanatory power regarding land use changes remains rather limited. Although the models make no direct reference to land use management and governing urban-rural relations, they enable subject areas, actors and programmes for urban-rural relations and regional planning to be identified and operationalised by differentiating functions and flows (Repp et al. 2012; Kasper and Giseke 2017). They are less complex and easier to understand than the teleconnection and telecoupling approaches, making them more feasible for practitioners.

The telecoupling model by Liu et al. (2013) is similar to Stead's concept in that different material and non-material flows are also an important element for analysis. However, the telecoupling concept provides an additional analytical layer

Table 6.1 Overview of the key concepts concerning urban-rural interrelations

Concept/model	Background/focus of the (case) study	Explicit reference to urban-rural relations and spaces	Space and scale	Reference to land management	Reference to (regional/functional) governance	Key references
Urban-rural relationships (flows of goods and people)	Relationships between urban and rural areas	Yes	Urban/regional scale Nearby spaces	No, focus is on functions	Yes, key issues for managing relationships are identified	Stead (2002)
Urban-rural interrelations	Land use and land management	Yes	Urban/regional scale Nearby spaces	Yes, feasibility of the concept for sustainable land management was examined	Yes, implicit discussion of governance instruments	Repp et al. (2012)
The urban land teleconnections (ULT) and urban telecoupling (UT) framework	Land use change (urban-rural) resulting from urbanisation links processes and places, allows the consequences of urbanisation and land use change to be identified, and connects urban functions with rural land uses	Short distance (peri-urban, suburban, regional) and long distance (interregional and international) But concepts aim to overcome the local and global aspects of land use change and typical urban or rural classifications (based on density, form of building space or administrative boundaries)	Short distance (peri-urban, suburban, regional) and long distance (interregional and international)	No, focus is on urbanisation processes and land change and related impacts	No (ULT) UT concepts can be linked to government and agency Haase (2019)	Seto et al. (2012); Güneralp et al. (2013); Haase (2019)

(continued)

Table 6.1 (continued)

Concept/model	Background/focus of the (case) study	Explicit reference to urban-rural relations and spaces	Space and scale	Reference to land management	Reference to (regional/functional) governance	Key references
Structured telecoupling approach	Land use changes driven by globalisation	No, but possibility to combine local couplings and telecoupling	Usually global, distant telecoupling In Liu et al. (2013), no explicit reference to urban and rural spaces or to local couplings	Yes, but not in detail	Partly, a link to governance is possible, but is not an element of analysis Recognition that local coupled and telecoupled systems require different governance approaches due to multiple flows, agents, causes and effects that go beyond different scales and administrative and political borders in telecoupled systems Liu et al. (2013)	Liu et al. (2013, 2014); Friis et al. (2016)
Actor-centred telecoupling approach	Changes in land use and land ownership, as well as the actors and institutions involved		Usually global, distant telecoupling	Land resources as part of the food system, problem of land grabbing Eakin et al. (2017)	Yes, explicit reference to governance and institutional change: national governance (Eakin et al. 2014), international governance (Eakin et al. 2017) Link to multi-scalar agency	Eakin et al. (2014); Eakin et al. (2017); Friis et al. (2016)

such as causes, effects and feedback loops. The analysis of causes in particular can provide useful information for land use policy and management (Liu et al. 2019). One major feature of the telecoupling concept is that it offers a structured and processual perspective on urban-rural relations and widens the perspective "from rural-urban interactions to wider human–environment interactions" (Friis 2019: 58).These two analytical perspectives can be also found in approaches that are used in ecosystem research (Liu et al. 2019). The concept by Liu et al. (2013) provide a kind of checklist for analysing land change (Friis et al. 2016). This makes it possible to describe the components and entities of telecoupling, enabling different entry points for analysis. Finally, the model can be used for multiple scales and to study temporal dynamics and system changes.

However, the model's explanatory features focus primarily on distant interactions in the original concept of telecoupling. Potential expansions of the concept arise from the possibility to combine local couplings and telecoupling (Liu et al. 2019). This could be very useful when studying urban-rural relations or land change processes in peri-urban spaces.

The urban telecoupling (UT) concept offers another possibility "to link decision making, actions, government, agency and land (use) changes at both urban and rural ends of the pathway" (Haase 2019, p. 263). We therefore state that the telecoupling approach can be applied to show the complex interactions and interdependencies between urban and nearby rural spaces. In our opinion, the concept is ideal for application to study urban-rural linkages at the local and global scale where not only the social and spatial distance, but also and the complex interplay of social processes and effects at land level play a significant role.

We assume that the combination of local couplings and telecouplings may bring additional valuable insight when studying urban-rural interrelations in Germany, Europe and elsewhere. The effects of distant actions or of high-level policy decisions and discourses (e.g. EU and national bioenergy strategies) can also be observed in cities and their hinterlands (e.g. renewable energy production, which competes with food production and other land uses that address local needs, land grabbing). On the other hand, this increases the complexity of approaches that are already quite complex.

Finally, we want to highlight the importance of distinguishing between analytical and conceptual approaches. Following Kasper and Giseke (2017), we recommend using the term "analytical approaches" for theories and models that aim to describe, analyse and explain specific phenomena, including relations, functions and underlying rules, and to create a better understanding and common knowledge base. The term "conceptual approaches" should be reserved for principles, plans or strategies that operationalise the procedure for achieving policy or planning objectives, for instance, and that are more actor and action-oriented.

6.4 Discussion About Potential Improvements

After presenting the strengths and shortcomings of the two concepts of flows (Stead 2002) and telecoupling (Liu et al. 2013; Eakin et al. 2014), we now introduce two additional analytical layers that are of relevance to urban-rural relations. The first layer relates to the functional flow of ecosystem services, and ties in with questions of governance and environmental justice. The second layer refers to land uses, and draws attention to the relation between multiple land uses (multi-functionality) and interconnections.

6.4.1 The Ecosystem Service Concept and Urban-Rural Relations

Both the Stead (2002) model and the telecoupling model by Liu et al. 2013 refer more or less explicitly to ecosystem services (ESS) as an essential flow or interaction between urban and rural areas. However, ESS may also provide a good reference frame when discussing the questions of sustainability, the quality of life and environmental justice in regional and global contexts.

A common definition of ESS is that introduced by Constanza et al. (1997), who defined them as "the benefits human populations derive, directly or indirectly, from ecosystem functions" (Constanza et al. 1997: 253). Examples of ESS include food, raw material production, flood protection and cultural services such as aesthetic and recreational services (MEA 2005).

While the concept of ESS has become very prominent in science over the last two decades, practitioners and policy-makers have difficulty putting the concept into practice, due, among other things, to a lack of a framework that links the valuation of ESS with "effective policy instruments and governance arrangements" (Bouma and van Beukering 2015: 4).

Since the delivery of ESS and the distribution of social benefits and costs occur in different spatial units and at different scales (local, regional and global) (Bouma and van Beukering 2015), the concept is quite useful when discussing questions concerning urban–rural relations, land use competition around land-based ecosystem services (Müller et al. 2016) or environmental justice (Agyeman, et al. 2016). Its potential for supporting decision-making in planning and policy is widely acknowledged (Fürst et al. 2017). On the other hand, the multi-level nature of ESS and the spatial mismatch between many ESS and administrative boundaries impede the governance of ESS (Bouma and van Beukering 2015) and the implementation into practice. Moreover, criteria are still required to decide in which planning contexts are conducive to applying the ESS concept (Fürst et al. 2017). This could also weaken the applicability of the concept in the management of urban-rural relations.

Many authors and policy documents refer to the role that rural areas play in providing ESS to cities (Augère-Granier 2016; Schröter-Schlaack et al. 2016). For

example, the German TEEB report (Schröter-Schlaack et al. 2016) highlights the role played by rural areas in providing ESS, and the use of ESS by urban dwellers. The report also provides examples of cooperation between rural and urban actors involved in agriculture and water management. In contrast, Gebre and Gebremedhin (2019) stress the mutual benefits from ecosystem-based interlinkages between urban and rural areas, but call for good management (including the protection of rural services) in the face of an increased urban demand for rural resources.

6.4.2 Multi-Functionality

The concept of multi-functionality reflects the ability to use a site for multiple different purposes. Adopting an economic perspective, the production process of a commodity, e.g. the cultivation of wheat, always creates side effects in the form of non-commodities. These are outputs with an economic, social and/or ecological benefit, such as food security, recreation or education (Wüstemann 2005). The connection between both types of products is described as synergetic and joint. At the farm level, multifunctional agriculture is seen as a means of diversification (Zasada 2011). Multi-functionality is often associated with agricultural activities, but "it is not specific to agriculture; it is a property of many economic activities" (OECD 2001, p. 9). According to this statement and following Wüstemann et al. (2008), the concept of multi-functionality can also be applied to reflecting on urban-rural interlinkages. Changes in society and lifestyle in recent decades have increased the importance of non-productive outcomes from rural areas compared to traditional agricultural commodities (Zasada 2011; see also Marsden 1999; Brandt and Vejre 2004; Luttik and van der Ploeg 2004). Urban dweller therefore have a greater demand for rural non-commodities such as enjoying the countryside, experiencing farm tourism and buying locally produced food from the farm (Zasada 2011). Consequently, this concept is ideal for depicting this new trend, enabling functional interrelations to be analysed in a much more complex setting. This includes the necessity to reflect the fact that one type of land use causes a variety of interconnections.

We assume that integrating these two analytical layers may make a valuable contribution to the research and governance of urban-rural relations.

6.5 Governance of Interrelations: Knowledge for Governance

Until now, interrelational models have mainly focused on an analytical understanding of functional connections and spatial relations. However, causes, effects and flows also simultaneously affect the options for influencing and changing land use. There has been little debate about modes of regional governance, particularly in

land use issues (Nölting and Mann 2018), although knowledge about new types of "governance" has been developed and used more frequently since the 1990s.

Whereas in the past the (national) state was regarded as an (assumed) central actor that influences and controls land use and spatial development, various different actors and their interactions are now coming to the fore. The key aspects are the varying forms of interaction and coordination of different social actors from the state, economy, civil society and science (Benz et al. 2007, p. 13). Consideration is therefore given to the entire organisational and regulatory system, which coordinates interaction between actors of all kinds. "It is … about how we establish goals, how we define rules for reaching the defined goals, and finally how we control outcomes following from the use of these rules" (Vatn 2010, p. 1246).

The introduction of collectively effective regulations will lead to the minimisation of land use conflicts and to the achievement of common goals. This means ensuring a target-oriented perspective for action that includes a process-oriented view of the various steps from policy formulation to implementation and the analysis of effectiveness (Ostrom 2011). The complexity of governance results especially (1) from vertical interconnectivity, the "multi-level system" (Benz 2009) and (2) consideration of cross-sectoral horizontal interconnections. This is in part represented by spatial planning at the national, regional and regional level, municipal land use planning, environmental planning and various forms of sectoral planning (e.g. transport, waste) in Europe (Reimer et al. 2015). In addition, regional development approaches (e.g. development concepts, networks), financial subsidies (e.g. tax incentives, Common Agricultural Policy) and other project-driven activities need to be included.

In the context of land use, Gentry et al. (2014) additionally request that the perspective is opened for international governance instruments since distant relationships often cross international borders. In the light of the original notion of the telecoupling concept—the distance between the interrelated systems—the need to develop governance instruments becomes even more urgent so that their increased tasks can be matched. There have also been calls for greater consideration of flows especially, between urban and rural areas, as a proper component of this analytical concept (Gentry et al. 2014). Land use changes in one place can be induced by social, economic or political processes and changes elsewhere.

At the same time, this perspective refers to the dimension of functional governance, which goes hand in hand with functional relations, complementing traditional forms of place-based and territorial governance. For this reason, the "construction of space by governance" has also been coined (Kilper 2010: 16). Functional governance takes up the above-mentioned forms of spatial interrelations in a space of flows (Massey 2005), and has so far been regarded primarily as a challenge without a comprehensive solution (cf. also Friies and Nielsen 2014). The interrelations themselves may influence land differently and may change over time, e.g. due to feedback loops. Hence, dynamics are an additional challenge.

The discussion of dynamics is quite often linked to debates about innovation and transition. Since spatial activities in one system can cause pressure in other systems, reactions such as change or rejection must be expected. In addition to unintended flows, explicit and intended flows of knowledge (e.g. about effects, impacts, etc.) may

also influence actors. This can cause direct or indirect pressures on an institutional system and, as a result, on land use and land management. Although research about change and transition processes is still in its infancy (cf. Oberlack et al. 2019), knowledge about social innovation processes (Sovacool and Hess 2017; Petterson and Huitema 2019) and change models (e.g. Kristof 2010; Oberlack et al. 2019) exists in various forms. For example, the concept of the regional innovation system (RIS) highlights the generation, transfer and application of knowledge. The RIS seeks to draw attention to regional conditions for establishing innovation (Tödtling and Trippl 2005). Organisations, institutions and actors involved in the generation, diffusion and use of knowledge are important (Arnold et al. 2014; Doloreux and Parto 2005; Fritsch 2013). Regions have different potential for change, innovation and adaptation. In consequence, account must be taken of specific regional constellations and the permanent change of interrelations (innovation).

Conversely, forms of governance require comprehensive knowledge about the objects and processes to be influenced. New forms of knowledge are therefore directly linked (Rydin 2007) and are required in the scientific debate on telecoupling (Zaehringer et al. 2019). The interaction between knowledge for governance (e.g. functional interrelations) and knowledge about governance (e.g. multilevel governance experiences) is of particular importance. This means, on the one hand, integrating and reflecting on mutual learning processes, depending on places and people. On the other hand, "distance learning" is necessary, reflecting spatial interrelations and feedback loops. To this end, additional resources are needed to realise internal and external exchange. In consequence, co-design processes must reflect not only inner-regional knowledge generation and dissemination, but also the appropriate inclusion of knowledge flows from other regions.

At the same time, this requires a differentiated understanding of knowledge transfer. Going beyond a simple loading dock approach, answers must be found about what kind of knowledge can be transferred from or to other spaces from different contexts with different and heterogeneous networks of actors and a range of institutional settings, and then applied and implemented there (Rogga et al. 2014).

6.6 Outlook

From the authors' perspective, the main tasks for the future are (1) to further develop a model to integrate regional interrelations based on functional interrelations, and (2) to improve regional governance and transition processes, based on the analytical model.

The challenge here is to adequately consider the aforementioned complexities of the various approaches.

To reflect current discussions about the role of science in solving real-world problems by using co-design approaches, developers of models must also consider the need to find applicable models that allow a broad practical application for the solution of real-world problems. This is also a consequence of a decade-long ongoing

debate about gaps between theory and practice in the field of spatial development and land use planning, addressed by a number of scientists (Alexander 2010, 2015; Taylor 2016; Sanyal 2000; Thomson 2000; Vogelij 2014). On the one hand, scientists state that theories are needed to broaden planners' minds (Diller and Thaler 2017); on the other hand, theoretical approaches are thought to be too far from practical planners' working reality, and unhelpful in their daily tasks (Sanyal 2000; Hellmich et al. 2017).

A further development and linkage with governance approaches (such as urban-rural partnerships, DV 2013) should not only include governance modes (Rydin 2007) and their application. It also requires a first reference to the objectives to be pursued and the underlying values and norms. This also comprises the presentation of value conflicts and the distribution of benefits and costs. Thus, interregional cooperation and exchange are generally thought to increase prosperity, especially economically, due to achieving comparative cost advantages. At the same time, this may be accompanied by negative environmental impacts that cause spatially one-sided pressures. Such one-sided pressures are now frequently criticised in the discussion about environmental justice. Although there are some parallels between the development of approaches in environmental justice and land use science (especially telecoupling research), adoption of the normative dimension of environmental justice is a major methodological challenge, and could politicise telecoupling research (Corbera et al. 2019).

Nonetheless, the authors wish to go one step further, and see the need for a societal and scientific debate about spatial interrelations (and, in particular, urban-rural interrelations) in the broader context of spatial justice, which goes beyond the environmental dimension. In Germany, for example, initial approaches exist in the form of political and scientific discourses on equal living conditions or in the context of research projects on a just urban-rural equilibrium (see www.regerecht.de). A new cross-regional debate on globally accepted values such as justice (Höffe 1989) could change the framework conditions for global and regional governance.

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