Towards a better understanding of land conversion at the urban-rural interface: planning intentions and the effectiveness of growth management

Abstract: The conversion of open space to built land is a key feature of urban-rural transformations. In many countries, urban sprawl represents the dominant mode of urban growth. Against this background, urban growth management plays a crucial role in mediating between diverse spatial requirements and curbing sprawl-like land-use patterns, but its effectiveness is not fully understood. Relatively few studies have systematically addressed the goals of growth-management approaches, their implementation pathways and spatial outcomes. Most available work has been carried out as single case studies which hampers solid understanding. In this paper, we first outline the challenge in understanding the role of growth management approaches in land conversions. Then we propose research to focus on: a) comprehending the intended outcomes of growth management, and b) the effectiveness of growth management. We argue that future research in this regard will enable researchers to establish causal links between growth management and land conversions.

Keywords: planning evaluation; governance; digital plan data; peri-urban; sprawl; comparative research.

Introduction

Cities and urbanized areas have become a key factor for consideration when addressing the problems of a globally sustainable future (United Nations, 2018). In most parts of the global North and South, urban land use is rapidly spreading into the rural hinterland, accompanied by far-reaching processes of economic and social transformation (Burdett & Sudjic, 2007; Creutzig et al., 2019; Seto, Fragkias, Güneralp, & Reilly, 2011). Cities mainly grow at their fringes and along major transportation corridors, often creating extensive peri-urban landscapes (OECD, 2018).

The unrestrained growth of urbanized areas has many negative environmental impacts, in particular due to the incremental loss of fertile soils, forests and nature reserves (Siedentop & Fina, 2010). Moreover, urban growth comes along with changes in land-use patterns along the urban-rural interface (Ioja et al., 2014). The resulting

fragmentation of farmland and natural areas has severe implications for agricultural productivity, habitat quality and biodiversity (Hasse & Lathrop, 2003; Theobald, Miller, & Hobbs, 1997).

Whereas the multifaceted impacts of land consumption on soil resources, ecosystem services, landscapes and biodiversity are rather well-understood (Gerecke et al., 2019; Kroll, Müller, Haase, & Fohrer, 2012; Haase & Lathrop 2003; Salvati et al., 2018), the various driving factors behind urban growth are still a matter of controversial scientific debate (Colsaet, Laurans, & Lapuente, 2018). Classical models of urban spatial structure consider the growth of urbanized areas as a demand-driven phenomenon (e.g., van Vliet et al., 2016, Oueslati, Alvanides, & Garrod, 2015). Population and economic growth, as well as rising household incomes and declining transportation costs are seen as major drivers (e.g., Paulsen, 2014; Gordon & Richardson, 2000; Brueckner & Fansler, 1983). Many studies have highlighted the catalytic effect of transportation infrastructure for suburbanization and urban growth (see Handy (2005) for an overview). In addition, supply-related factors, such as the availability of developable land, local reliance on tax incomes generated by new development or fiscal incentives for urban renewal, have a significant impact on the intensity and spatial patterns of land consumption (Colsaet et al., 2018). Moreover, the regulation of land use is often discussed as an explanatory factor (e.g., Blöchliger, Hilber, Schöni, & von Ehrlich, 2017). Specifically, zoning instruments and growth-management approaches can have a strong positive or negative influence on urban land-use change (see Colsaet et al. (2018) and Siedentop, Fina and Krehl (2016) for an overview). However, the complex causal chains between regulation at local and regional levels and land-use change are still poorly understood.

Spatial development policy and planning have a long history of steering urban development, with urban growth management being used in particular to control the urban-rural interface (Fertner, Jørgensen, Nielsen, & Nilsson, 2016). We understand growth management as a target-oriented, integrated set of regulative, market- and information-based policies in order to achieve the desired urban land-use pattern. Such policies aim at steering land conversions in terms of quantity, location and timing, as well as physical design aspects of land cover, density and land-use mix (Bengston, Fletcher, & Nelson, 2004, Rudolf, Kienast, & Hersperger, 2018). For example, the main spatial strategies promoted at EU level refer to the “compactness” and “greenness” of cities, including a focus on urban regeneration, functional mix, higher densities and a

reduction of urban encroachment into rural areas at urban fringes (Cortinovis, Haase, Zanon, & Geneletti, 2019). At regional and municipal levels, well-established growth-management approaches are used in the designation of urban growth boundaries, greenbelts or protected conservation areas (Siedentop et al., 2016). Such management approaches play a key role in mediating between the numerous competing demands on land from different societal groups and land supply in existing and newly developed urban areas (Rudolf et al., 2018). Table 1 gives a global overview of frequently used instruments.

Table 1: Overview of frequently used growth-management approaches and instruments (based on Bengston et al. (2004) and Rudolf et al. (2018)).

General Approaches	Instruments
<i>Public acquisition</i>	Public ownership of open spaces
<i>Regulation (planning-based)</i>	Development targets (local, regional, national) Urban growth boundaries (local, regional) Urban service boundaries (local) Greenbelts (local, regional) Green wedges and corridors (local, regional) Protection of sensitive ecosystems (local, regional) Conservation zones (national, regional, local) Development (growth) moratoria (local) Minimum utilization densities (regional, local) Land banking (regional, local) Land readjustment (local) Measures against land hoarding (national, regional, local) Inventories of urban densification potential (local) Upzoning and rezoning (local) Phased development requirements (local) Growth poles (national)
<i>Quality-oriented measures</i>	Programmes for the redevelopment of existing urban areas (national, regional, local) Programmes for the qualitative enhancement of new development projects (national, regional, local)
<i>Incentives (market-based)</i>	Split rate property tax (national) Development impact fees (local) Public funds for infill and brownfield development (national) Transfer of development rights (local, regional) Density bonuses (local) Taxing added value (local)
<i>Social learning (information-based)</i>	Information campaigns Land supply monitoring Fiscal impact analysis Education and training of planners

However, the effectiveness of growth management is often questioned (Colsaet et al., 2018; Carruthers, 2002; Howell-Moroney, 2007). The same applies to spatial planning measures in general. Indeed, theorizing the role of urban planning in guiding land change is challenging (McNeill et al., 2014, Briassoulis, 2008; Hillier, 2007) and the identification of pivotal connections between planning and land changes is extremely difficult (Wong & Watkins, 2009). One reason behind these difficulties might be that the ability to control or manage land-use change processes depends on many contextual factors over which spatial planning has limited influence (Hersperger & Bürgi, 2009). Thus, these efforts can often only be partially implemented and the directions of the efforts are highly dynamic, as planners must respond to ever-changing external socio-economic and political conditions. Relatively few studies have systematically addressed the goals of growth-management approaches, their implementation pathways and spatial outcomes. Furthermore, most available work has been carried out as single case studies and generalizations based on larger samples are scarce (Fertner et al., 2016). Recently Hersperger et al. (2018) proposed to conceptualize the contribution of strategic spatial planning to urban land-use change by focusing on the role of planning intentions and the implementation process (including governance processes and contextual factors). Applying this notion to urban growth management at the urban-rural interface opens up two areas of interest that, if addressed with research, are expected to improve our understanding of land conversions. They are formulated as questions as follows:

1. What is the intended outcome of growth management in terms of the quantity and location of new development, and its timing and quality?
2. How effective is urban growth management in terms of reaching stated targets and avoiding unintended side-effects, and what are the potential reasons for the observed implementation pathways and degrees of effectiveness?

In the subsequent sections, we outline the main challenges for addressing the above-mentioned questions and highlight research directions which could help to overcome them. Take home messages are presented in the concluding remarks.

Comprehending the intended outcome of growth management

A better understanding of land conversions at the urban-rural interface requires robust knowledge of the normative content of growth-management approaches in terms of the quantity and location of new development, and its timing and quality (hereafter

called planning intentions). However, the complexity of growth-management approaches, including statutory land-use plans and strategic plans, and the commonly rather qualitative nature of spatial policies and planning statements, hamper the analysis and overall spatial understanding of planning intentions. Furthermore, spatial plans address issues beyond merely designated land use. Since they support decision-making, they are interlinked with social, economic and ecological aspects within a unique spatial context. Such interlinkages can make the intended spatial outcome difficult to assess, especially if the plans are framed in the form of visionary narratives. This often applies to strategic planning instruments like growth concepts, which might be sketchy rather than concrete and spatially explicit.

Nevertheless, all growth-management approaches comprise spatial information, and this provides a solid starting point for understanding their role in land conversions at the urban-rural interface. This information is commonly displayed in the form of geographically accurate data, diagrams or textual descriptions of locations, places or patterns of development (Palka, Grădinaru, Jørgensen, & Hersperger, 2018). The purpose of spatial information, however, might differ. It can provide a spatial context for the allocation of resources, help visualize the complexity of different demands on space (van Duinen, 2013), correlate future development with existing structures, or simply guide attention towards the most relevant spatial issues within a city (Dühr & Müller, 2012). Little research has been carried out into how plan statements can be translated into clear planning intentions. An exception is provided by Palka et al. (2018) who present a method of visualizing the planning intentions of the Copenhagen Finger Plan.

The representation of plans in the form of digital data (along with accompanying textual documents) provides a promising data source to analyse the normative content of plans (Fertner et al., 2019) and thus a way to overcome the outlined challenges. Open online access to digital plan data is a rather new issue, however, digital availability of public administration documents is gaining momentum (Maguire & Longley, 2005), and spatial planning is no exception to this trend. Increasingly, planning authorities are providing online access to all kinds of digital planning data, including written documents, digital maps (such as zoning ordinances), statistical data and information on the response of stakeholders in participatory processes. Table 2 provides examples of digital data. The examples were selected among easily accessible digital data platforms to represent the scale of the available data at the global to the local level, and illustrate a

range of characteristics. Potential use for different investigations and associated challenges are presented. Clearly, these data on planning content open up new methodological perspectives such as the application of machine learning for the content analysis of plans and text. However, further research is needed before digital plan data can be routinely used for growth-management evaluation. Fertner et al. (2019) stress the following challenges: data quality and data completeness, temporal precision in a context of a continuous planning and regulating process, and adequacy of available metadata. Furthermore, case studies should be conducted to understand which data derived from plans are useful for evaluation within which contexts.

Table 2: Examples of available digital plan data and illustrations of their potential use and associated challenges.

Level	Digital data	Characteristics	Potential use	Challenges
Global	Regulatory regime governing land and housing http://www.atlasofurbanexpansion.org/	Land-use planning practices, land ownership patterns, land prices, attributes of residential plots	Cross-country comparisons of urban growth approaches and effectiveness	Available for selected cities only
National	Building zones in Switzerland https://map.geo.admin.ch	Strongly harmonized data set with only nine zoning categories; to be updated every five years	Country-wide investigation of growth-management effectiveness	Many details, such as the type of residential zones, are lost during data harmonization
	National land survey of Finland https://kartta.paikkatietoikkuna.fi/?lang=en	Buildings, cadastral parcels, aggregation of regional plan development objectives.	Development of country-wide urban growth scenarios	Voluntary uploads by regions, which leads to inconsistencies in spatial coverage
	Danish digital plan register http://kort.plandata.dk	All legal plans, from national directives to local development plans	Analysis of share of population, jobs and zoning as distributed between urban, intermediate and rural areas in Denmark (Fertner et al., 2019)	Differences in the amount of information, for example, on different local development plans
	German register of regional plans (“Raumordnungsplan-Monitor”)	Digital register of regional planning content (digitalized plan maps)	Country-wide and state-specific investigation of growth-management effectiveness	Only statistical information is publicly available; digital data products are not provided for research
Regional	Harmonized zoning plans in the Canton of Zurich, Switzerland	Available for every year since 1994, more than 20	Assess conformance between long-term development	Data are not openly available, ongoing issues with

		categories, ongoing updates	objectives and ongoing changes in land-use planning	temporal and spatial harmonization
Local	Municipal zoning plan of Horgen, Switzerland https://www.geomedia.ch/horgenortsplan/BM3.asp	Actual situation regarding buildings, cadastral parcels, and zoning regulations	Investigate if the allowed density in residential zones decreases with distance from the centre and/or train station	Strongly context-specific zoning categories. Local analyses cannot address spillover of growth into adjacent municipalities
	Zonal plans of Bucharest, Romania http://urbanism.pmb.ro/	Show current and future land changes at parcel levels; including land function, density values, green space availability.	Investigate if new developments follow density regulations	Data require several steps of pre-processing before use for research purposes

Effectiveness of growth management

The effectiveness of growth management has been the subject of a long-standing scholarly debate. The complexity of statutory land-use plans and the commonly rather qualitative nature of planning statements impede simple comparisons of the intended and real development (Hersperger et al., 2018). Given the enormous challenges of sprawling urbanization in the North American context, it is not surprising that most contributions present a US perspective (e.g., Landis, 2006; Paulsen, 2013). However, increasing numbers of European studies have recently been published, reporting on the effects of urban containment and growth management (e.g., Colsaet et al., 2018; Gennaio, Hersperger, & Bürgi, 2009; Klaus, 2019; Siedentop et al., 2016).

Most of these studies provide evidence for positive outcomes of properly implemented growth-management instruments on land-use systems. Instruments such as urban growth boundaries and greenbelts have been found to be effective in terms of achieving a more compact urban form and preserving farmland and natural resources, as well as reducing infrastructure costs (Carruthers & Ulfarsson, 2003). However, scholars have also found evidence of negative implications. Poorly managed instruments and approaches might contribute to inflated land prices and housing supply shortages (Altes, 2006). The design and mix of the management approaches and instruments, therefore, play a crucial role in preventing these negative outcomes (Siedentop et al., 2016). Another major finding concerns the relevance of regional coordination and governance. Some studies have found that growth management is less efficacious in politically fragmented areas (Pagliarin, 2018), where a lack of cooperation among local jurisdictions leads to a “porous” land market (Carruthers, 2002; Klaus, 2019). In such

situations, developers and households tend to prefer less regulated areas. Spillover effects in the form of leapfrogging growth, which exceeds a contained urban zone, can severely threaten the success of growth-management approaches (Bae & Jun, 2003).

Most research on the implementation and outcome of growth management remains within a national (or subnational) context. Thus, the findings are highly context specific. A more generalized understanding of the effects of institutional factors on land-use change is, however, a prerequisite to transfer knowledge on effective growth-management approaches. There is, thus, a need for more international comparative research that reflects the specific political, social or cultural context of the successful management of urban expansion (see e.g., Grădinaru, Iojă, Pătru-Stupariu and Hersperger (2017) and Pagliarin (2018)). Against this background, the analytical model of “regional governance capacities” has been proven useful in empirical studies (see Dang, Visseren-Hamakers and Arts (2016)).

It will take some time before such studies provide robust evidence to support assessments of global and regional land change at the urban-rural interface. Attempts have, therefore, been made to work with readily available (though coarse) indicators of governance. For example, the World Bank annually reports Worldwide Governance Indicators - a collection of indicators corresponding to different dimensions of governance (Kaufmann, Kraay, & Mastruzzi, 2011). Of these indicators, two are relevant in the context of coupling land-change data with growth management: a) “regulatory quality”, the ability of governments to develop and implement policies that permit and promote private sector developments; and b) “government effectiveness”, representing the quality of policy formulation and implementation, and the credibility of governmental commitment to such policies. These two indicators are available at country level and cover the period from 1996 to 2016. A more detailed governance measure is the European Quality of Government, developed by the Quality of Government Institute at Gothenburg University (Charron, Dijkstra, & Lapuente, 2014). The index is a measure of institutional quality within the European Union at the regional level and is available for three timeframes: 2010, 2013 and 2017. Such governance indicators could be used as proxies for the successful implementation of urban policies as they have been used for studies of the effects of conservation policy (Amano et al., 2018).

Conclusions

The management of urban growth is a common practice aimed at controlling the conversion of land on the urban-rural periphery. However, the causal relationships between growth management and land conversion on the urban-rural fringe are poorly understood. In order to go beyond the mostly case-specific knowledge, and move towards general and transferable insights, more research on planning intentions and the effectiveness of urban growth management is needed. It is expected that digital planning data and machine learning methods will allow the development of a comprehensive spatial understanding of growth-management approaches acting in large regions. Similarly, rigorous international comparative research that takes into account the specific political, social, or cultural context of growth management is likely to provide the basis for a consolidated understanding of the effectiveness of growth management. Thus, the outlined approach should support the interpretation of land conversion in the light of planning and its implementation, and thus, advance our understanding of the causal relationships between growth management and land conversion.

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