

Chapter 5

Urbanisation and Land Use Change



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Abstract Urbanisation is one of the major driving forces behind the formation of today's land use systems. It almost always involves the conversion of land use from non-urban to urban uses. A great deal of contemporary urbanisation has been characterised as urban sprawl, i.e. a highly extensive form of land take for urban uses having environmentally detrimental effects. However, urban land use change can occur in relatively diverse forms in terms of layout, building density and speed of change, to name but a few aspects. In recent decades, researchers have made substantial progress in empirically addressing the various forms of urban land use and its change over time. As a consequence, the global dimension of urbanisation-related land use change is now on the agenda of policymakers and researchers worldwide. In order to provide an overview of the many geographical, environmental, sociological and political aspects that are relevant with respect to urban land use change, this contribution strives to make (1) some conceptual clarification regarding the notions associated with urban land use change, before (2) highlighting its (economic, social and political) drivers, as well as its (3) impacts. The text then moves on to (4) briefly systematising the instruments and strategies that have been put in place to cope with urban land use change. Finally, (5), we reflect on the current state of the art regarding research and policies on urban land use change.

Keywords Urban land use change · Measurement of urban sprawl · Drivers and impacts · Planning policy

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5.1 What is Urban Land Use Change and Why It is a Relevant Issue?

Apart from cultivation, the use of land for residential and related purposes has been part of the encroachment of human civilisation upon natural ecosystems since the beginning. However, the amount of land covered by settlements was largely negligible until the advent of industrialisation and the processes of massive urbanisation it brought along. Urbanisation—understood as an increase in the urban (as compared to rural) population and an “urban” workforce—i.e. manufacturing as compared to agricultural workforce—has almost always involved the conversion of land use from non-urban to urban uses, because it requires an increased need for space in (existing) settlement areas. The visible outcome of land use change in the wake of urbanisation is the spatial expansion of built-up areas (which implies a significant alteration of land cover features), accompanied by changes in the urban spatial structure and the urban form.

The rapid conversion of open, mostly agricultural land into settlement areas has been accompanied by pronounced criticism since the heyday of industrialisation in the nineteenth century. Even at that time, the rapid growth of industrial urban centres raised great suspicion and was blamed not only for the accumulation of human disorder, vice and despair (i.e. the “traditional” anti-urban concerns), but also for the destruction of the traditional (pastoral) landscape due to its greed for land. In a 1937 speech to US urban planners, Earl Draper, the Director of the Tennessee Valley Authority, became the first to use the term “sprawl” to indicate a specific pattern of urban growth that makes the countryside—from his point of view—“ugly, uneconomic [in terms] of services and doubtful social value” (cited in Wassmer 2002). Since then and up to today, the scientific and political discussion about the negative impacts and drawbacks of urban land use change in both developed *and* developing countries has largely been linked to the notion of urban sprawl (e.g. Whyte 1958; Clawson 1962; Harvey 1965; Benfield et al. 1999; Burchell et al. 1998; Burchell et al. 2002; Peiser 2001; Gillham 2002; Squires 2002; Nechyba and Walsh 2004).

More recently, and linked to a growing concern for ecological issues and the finiteness of natural resources (Meadows et al. 1972), urban land use change has often been labelled “land consumption” (Frenkel 2004; Köck et al. 2007; Nuissl et al. 2009), which is a somewhat imprecise notion because the (amount of) land does not diminish on account of altering its use. However, concepts such as urban sprawl, land consumption and land take clearly indicate the association of urban land use change with negative side effects.

For the period from 1990 to 2000, Angel et al. (2005: 56) estimated that the annual increase in built-up areas in developing countries was around 3.6%, whereas it amounted to only 2.9% on average in industrialised countries. Among world regions, East Asia, including the Pacific, and Southeast Asia witnessed the most intensive land consumption, with growth rates of 7.2% and 6.4%, respectively. In Europe, the annual growth of urban land is expected to range between a maximum of 2% in rapidly

growing areas and nearly zero in remote rural regions (EEA 2006). Focusing on the European Union, Kuemmerle et al. (2016) put this observation in relation to other kinds of land use change: “The most widespread changes in the extent of land-use categories in the EU between 1990 and 2006 were cropland decline ($\sim 136,660 \text{ km}^2$), followed by expansion of grazing land ($\sim 75,670 \text{ km}^2$), and expansion of forest areas ($\sim 70,630 \text{ km}^2$). The least common conversion among broad land-use categories was urban expansion ($\sim 16,820 \text{ km}^2$). ... At the European scale, these area changes translate into moderate land-conversion rates in the agricultural sector between 1990 and 2006, ranging from -13.4% for permanent crops to $+6.5\%$ for meadows and pastures, while urban areas expanded by approximately 21% ” (Kuemmerle et al. 2016: 5). In addition, various other studies have provided empirical evidence that the spreading of urban land uses has clearly exceeded population growth, resulting in declining overall densities (e.g. Fulton et al. 2001; Glaeser and Kahn 2003; Lopez and Hynes 2003; Angel et al. 2005; Theobald 2005). At the same time, urban density gradients have significantly levelled off over time in metropolitan areas. Urban densities decreased between 1990 and 2000 worldwide, in East Asia by as much as 4.9% per year and in Europe by a relatively moderate 1.9% .

However, looking merely at the size or the growth of urban areas would provide only poor insights into the dynamics of urban land use change (even if related to population growth), because there are different kinds of urban land use change that have rather diverse impacts (McGranahan and Marcotullio 2005). For instance, residential development on former agricultural land usually damages considerably fewer and other wildlife habitats than industrial development on a drained wetland site; likewise, new development in the vicinity of existing settlements infringes on the landscape matrix to a lesser degree than the development of many small and unconnected patches of urban land. Hence, it is not only the quantity of land converted to urban uses that needs to be considered, but also:

- the previous land use and land cover (agricultural, forest and natural);
- the dominant purpose of the new urban use (residential, commercial, industrial, recreational or other) and the corresponding land cover features (such as the imperviousness of surfaces and the emission of pollutants);
- the location and pattern of new urban land; and
- the efficiency of land use.

Recognition of these aspects is key not only to a comprehensive understanding of land use change dynamics and their knock-on effects on environmental qualities, but also as a basis for urban planning and management.

Significant improvements in the resolution and quality of digital land use and land cover data have opened up new possibilities for a more complex monitoring of land use change dynamics that captures differences in aspects such as urban form, land uses, development and location patterns as well as efficiency of land use (e.g. Schneider and Woodcock 2008). Drawing on the availability of such data, numerous methodological approaches have been introduced to provide a quantitative assessment of urban land use change (for a brief overview see, e.g. Chin 2002; Frenkel and Ashkenazi 2008, or Siedentop and Fina 2010). Table 5.1 lists prominent measure-

Table 5.1 Frequently proposed land consumption and urban sprawl measures

Indicator	Description	Sources
Size or share of urban land	Size of urban land (km ² or sqm); percentage of urban land (%)	Galster et al. (2001), Kolankiewicz and Bleck (2001), Angel et al. (2005), Schneider and Woodcock (2008), Siedentop and Fina (2010), Wolff et al. (2018)
New land consumption	Converted urban land (in hectares or acres)	Anthony (2004), Siedentop and Fina (2010)
Urban density	Number of people, jobs or housing units per hectare of urban land (gross or net)	Razin and Rosentraub (2000), Torrens and Alberti (2000), Chin (2002), Ewing et al. (2002), Glaeser and Kahn (2003), Angel et al. (2005), Siedentop and Fina (2010), Wolff et al. (2018)
Change in urban density	Change in urban density between two base years (percentage)	Emison (2001), Anthony (2004), Angel et al. (2005), Siedentop and Fina (2010), Wolff et al. (2018)
Density gradient	Regression of density against distance by ordinary least squares (OLS)	Torrens and Alberti (2000)
Land use mix/land use separation	Degree to which different urban land uses exist in close vicinity to each other	Galster et al. (2001), Chin (2002), Ewing et al. (2002), Song and Knaap (2004), Torrens (2008)

(continued)

Table 5.1 (continued)

Indicator	Description	Sources
Concentration/decentralisation	Degree to which urban development is located near to the CBD (e.g. measured by the percentage of population and employment within concentric rings around the CBD or the median person's/worker's distance in distance units from CBD)	Galster et al. (2001), Glaeser and Kahn (2003), Lopez and Hynes (2003), Weber and Sultana (2005), Huang et al. (2007), Torrens (2008)
Continuity/dispersion/fragmentation/complexity	The degree to which developable land is built up continuously; the degree of irregularity of built-up patches (measured using certain indices such as patch density or more complex statistical measures of spatial regularity)	Galster et al. (2001), Chin (2002), Huang et al. (2007), Schneider and Woodcock (2008), Siedentop and Fina (2010), Salvati and Carlucci (2016)

ments (indicators) of urban land use change along with their function (description) and sources in the literature.

The final indicator listed in Table 5.1 (“Continuity/dispersion/fragmentation/complexity”) concerns the spatial pattern of urban land use change in relation to the existing settlement area, and has been widely used to describe the general shape of urban land use change in a particular urban region. Over time, most metropolitan areas have changed their urban form from a highly concentrated compact structure to a more irregular, discontinuous or dispersed urban land use pattern (e.g. Nelson 1992; Theobald 2001; Carruthers and Ulfarsson 2002; Lang and LeFurgy 2003; Salvati and Carlucci 2016). This trend has often been discussed using terms such as “leapfrogging” or “ribbon” development.

5.2 Drivers of Urbanisation and Urban Land Use Change

In order to fully comprehend the phenomenon of urban land use change, simply observing it and measuring it—even using sophisticated methods of geoinformatics and statistics—is not sufficient. What is also needed is an account of its driving factors. This helps to explain, for instance, why urban land use change occurs at a given rate and in a given pattern, and why these significantly differ among countries

and even regions (e.g. Kolankiewicz and Beck 2001; Lambin et al. 2001; Huang et al. 2007; Creutzig et al. 2019). However, first of all, it is crucial to note that there is no grand theory of urbanisation or comprehensive explanatory model of urban land use change that would make it possible to interpret and explain actual observations. Instead, social sciences and economics have offered various theories that hint at important drivers of land-consuming human activities.

Neoclassical economic theory in particular has provided a closed framework for the explanation of urban growth. Basically, it postulates an unregulated land market, where land rents near the urban core are highest (because of maximum accessibility to urban services and correspondingly negligible transport costs), and argues that location decisions by both private households and firms reflect the goal of achieving maximum utility by balancing space needs, location preferences and financial budget constraints. Based on these primary considerations, it might be plausible to assume that high-income groups (with more land-demanding aspirations) would prefer to live at a greater distance from the city centre where large building lots are available, while low-income households would choose a location near the urban core which would incur lower transport costs. Starting from these assumptions, the neoclassical monocentric model of urban spatial structure (the “Alonso-Muth-Mills model”) explains the spatial expansion of cities and density gradients with just a few variables, specifically the demand for new housing and commercial land, rising incomes, innovations in intra-urban transport systems, and decreasing transport costs (Alonso 1964; Muth 1969; Mills 1972; Mieszkowski and Mills 1993). This meant that the growing physical footprint of cities and their declining density was the combined effect of a growing population, rising affluence and enhanced individual mobility due to the increasing affordability of the private motor car.

In addition to economic theorising, technical viewpoints underpin the importance of distance and transport costs with respect to the spatial diffusion of urban land uses. They associate the compactness of the pre-industrial city with the fact that most trips had to be made on foot or similarly slow modes of transport. This constraint disappeared with the availability of faster mass transport technologies and the private automobile (e.g. Antrop 2004). Following this logic, the physical growth of cities became a function of transport technology. Nelson (1992) pointed out that other improvements in technology, such as the personal computer, cellular phones and the internet, may have encouraged the spatial decentralisation of people and firms even further, setting up conditions for more land-intensive forms of urbanisation.

Empirical observations of how urban areas develop, such as the emergence of polycentric urban configurations, often defy the simple assumptions of pure neoclassical urban theory. In contrast to the fundamental assumption in the neoclassical city model that employment was concentrated in central business districts (and gradually decreased with increasing distance to the urban core), modern agglomerations in developed countries are characterised by their multi-nodal settlement system, with a complex pattern of primary and secondary centres (Garreau 1991; Champion 2001; Davoudi 2003). Accordingly, many additional factors other than land prices and commuting costs have been identified that affect the location decisions of individual households or firms (Nechyba and Walsh 2004). Examples include the

quality of urban services, specific priorities and demands of different social groups in terms of urban and environmental amenities, or the desire to live in a socially homogeneous neighbourhood. The Tiebout Local Public Finance Model (Tiebout 1956) suggested that people decided to locate in a particular jurisdiction based on their preferences and taste for local amenities. Tiebout described factors that “pull” people out of the central areas of metropolitan regions on account of attractive characteristics of suburban communities (e.g. good service levels or lower taxes) and others that “push” people out of central areas as a result of inner city problems such as poor environmental quality and services, or crime. Theoretical accounts of this nature hint at the importance of particular social-cultural trends that mould the current demand for urban land, such as the proliferation of both land-consuming urban lifestyles (tourism and recreational activities, second homes) on the one hand and a (re)orientation (particularly among upper middle-class households) towards urban centres (“reurbanisation”) on the other.

With urban sprawl and land consumption being a major environmental concern, recent scholarly efforts have broadened the knowledge on its causes and drivers significantly. However, while it is often possible to explain the intensity of urban land use change on a broader scale, e.g. on the European (Oueslati et al. 2015) or global scale (Creutzig et al. 2019), predicting its spatial patterns remains a challenging issue. As a consequence, spatially explicit land use models have been developed which not only explain *at what rates* urban land use change occurs in a given period of time, but also address the question *where* it will take place, i.e. its likely location (Frenkel 2004). Poelmans and van Rompaey (2010) have distinguished five groups of explanatory variables that have been frequently used in models of urban land use change:

- Biophysical factors, such as the slope or water table, have an impact on the suitability of land tracts for the construction of buildings or infrastructure facilities, and can explain why certain areas are excluded from development.
- Social factors reflect the location preferences of households (or household types). Examples include the income level or ethnic composition of nearby neighbourhoods, and the availability of open green spaces. These factors may encourage or discourage a household’s choice of development site.
- Economic factors refer to accessibility features as proxy values for market access. Frequently used measurements include the distance to urban centres or main roads, and the availability of public transport services within a walkable distance. Undeveloped properties with good accessibility are more likely to become urbanised in the future.
- Neighbourhood interactions refer to an observed spatial autocorrelation between new developments and existing urbanised areas. In contrast, some potentially conflicting land uses (e.g. residential and industrial development) are unlikely to be located directly next to each other.
- Spatial policy and planning include the possibility to legally define, i.e. distinguish the usability of different land parcels. These policies can be labelled “negative planning” inasmuch as they aim to protect current land uses (habitat conservation,

prime farmland) or “positive planning” inasmuch as they define the suitability of a piece of land for a specific use (i.e. where they explicitly designate sites for urban development).

While some of these determinants of urban land use change illuminate the total pressure on the land within a region or even a nation-state, others—such as moderate land prices or above-average accessibility—are suited to identifying the local hot spots of development, but are largely unable to explain the aggregate regional growth rate of urbanised land. Table 5.2 presents a set of relevant variables with their estimated explanatory capacity.

Various studies (Ulfarsson and Carruthers 2006; Siedentop et al. 2009) have found that urban land use change is to a large extent a supply-driven process. They have argued that it is not only the result of demand driven by demographic and economic growth pressures or social preferences, but is also fuelled and facilitated by policies at national as well as local levels. For instance, the political agenda of local decision-makers in stagnating or economically declining areas often emphasises the importance of cheap land for residential or commercial uses as a means to attract people and enterprises and thus to generate tax revenue. This can explain why some regions and municipalities without demographic or economic demand pressure nevertheless show significant land consumption rates (Nuissl and Rink 2005). Government policies such as the commuter tax allowance in Germany, the financing of highway

Table 5.2 Explanatory variables used in land consumption model applications (dark grey = strong explanation, pale grey = moderate explanation, white = not relevant)

Factor	Examples	Explanation of ...	
		rate of land consumption	location of land consumption
Biophysical	Slope		Dark grey
	Hazardous land		Dark grey
Economic	Economic growth	Dark grey	
	Land prices	Dark grey	Pale grey
	Distance to urban centres		Dark grey
	Distance to the main road		Dark grey
	Fiscal motives to convert land into urban use	Dark grey	
Demographic/ social	Population growth	Dark grey	
	Income growth and changes in lifestyle	Dark grey	
	Motorisation	Dark grey	Pale grey
	Social preferences for housing types and locations	Pale grey	Dark grey
Spatial policies	Land use regulation (positive and negative planning)	Dark grey	Dark grey
	Revitalisation and regeneration policies	Dark grey	
	Public funds for greenfield development	Dark grey	

infrastructure in the US, or subsidies for the development of industrial or retail development by the European Union are likely to support this effect (Persky and Kurban 2001).

Some scholars have presented evidence that the institutional fragmentation of local authorities could be another important factor explaining the rate and pattern of land consumption. According to this position, decentralised land use governance with numerous local governments controlling urban land use is more likely to promote urban sprawl, as it increases the number of jurisdictions seeking extra-budgetary revenue through land conversion to urban uses (Downs 1998; Razin and Rosentraub 2000; Ulfarsson and Carruthers 2006). The size of local government units is also important in other ways—the bigger they are, the less likely they will be reliant on one particular investor or project, and the less vulnerable they will be to the influence of individual local land owners with regard to planning policies and decisions. Furthermore, smaller communities are more likely to permit exclusionary zoning policies, where local governments attempt to exclude low-income groups from their municipalities (Pendall 1999; Clingermayer 2004). These policies are driven by suburban residents' desires to protect their housing investments and to maintain their social status (Downs 1998).

5.3 Impacts of Urban Land Use Change

While urban land use change on the global scale has only become a hot topic in recent decades (e.g. Foley et al. 2005; Seto et al. 2012; Creutzig et al. 2019), urbanisation, suburbanisation and urban sprawl—i.e. urban land use change at the local and regional level—have been a subject of major concern and passionate debate for quite some time because of their obvious effect on the morphology of urban systems (increases in artificial surfaces, changes in densities, alteration of land use patterns) and consequent impacts on the environment and other amenities. While the unintended effects of urban growth have been a matter of discussion in the United States since as early as the mid-twentieth century, they are an issue of concern all over the globe today. Initially, urban growth was mainly blamed for endangering landscape beauty, weakening community life and overloading the transport and network infrastructure (e.g. Nechyba and Walsh 2004). However, the debate has clearly broadened its scope and increased in intensity over the decades, now also raising concerns regarding the loss of habitats and biodiversity, the rise in greenhouse gas emissions, and environmental justice in general, to name but a few.

Despite its various drawbacks, it would be an inappropriate simplification to simply blame urban land use change as an environmentally harmful and generally non-sustainable phenomenon. On the one hand, the use of land for urban purposes inevitably infringes on its “value” in other (mainly environmental) respects; but on the other hand, urban land use change is essentially a by-product of demographic change and economic growth, and it is difficult—yet not impossible—to conceive of

prosperous and dynamic societal development without any kind of “land consumption”—particularly in economically growing nations (e.g. Deng et al. 2010). The dispute on whether urban land use change is a curse or a blessing is not only one about the prioritisation of goals, but also includes a fervent academic debate about the validity of countless empirical findings on its adverse impacts. Critics mark these findings as well as the methodologies with which they were obtained, as largely ideological, i.e. based on the normative assumption that urban land use change should be contained. This kind of criticism, put forth in defence of laissez-faire urbanisation, however, usually appears at least as “ideological” as the criticised studies.

The scholarly debate about the impacts of urbanisation and urban land use change has become almost incomprehensible. However, it is possible to distinguish a few major threads of debate each of which emphasises a particular issue of concern. First of all, there are major concerns regarding the environmental outcomes of urban land use change. These impacts are largely related to changing land cover, i.e. the sealing of land, which almost inevitably occurs when land is being developed (Johnson 2001; Pauleit et al. 2005). In other words: urban land use change leads to an increased share of artificial, impervious surfaces, including built-up land, i.e. rooftops, roads, parking lots, pavements, etc. (Arnold and Gibbons 1996; Haase and Nuissl 2007). Imperviousness physically limits the infiltration of rainfall into the ground. Rainfall and snowmelt that is unable to infiltrate instead must become surface runoff (Alberti 1999). Thus, soil sealing in highly urbanised areas is widely viewed as an important causal factor for flood risks (Frenkel 2004). Due to the fact that urban runoff water carries with it chemical pollutants (e.g. from automobile traffic or industrial land uses), imperviousness also contributes to the biochemical degradation of water resources. Based on many empirical studies, Moglen and Kim (2007) estimated that, once the rate of paved surfaces exceeds a threshold of 10–15%, various indicators of biological stream quality begin to markedly decrease. Moreover, the spatial concentration of artificial land cover with specific thermal characteristics also creates local temperature anomalies. This leads to a higher average temperature in the dense urban fabric compared to the urban periphery (“urban heat island”) (Voogt 2002; Watkins et al. 2007).

In addition to the magnitude of urban land use change, its spatial pattern has also to be taken into account. Dispersed and fragmented land use patterns are a crucial contributor to landscape fragmentation, which is characterised by a process of perforation, dissection and isolation of habitat areas and natural or semi-natural ecosystems (Jaeger 2000). Thus, many scholars have regarded urban land use change as a major cause of the alarming loss of species all over the world (Theobald et al. 1997; Cieslewicz 2002).

The overall impact of urban land use change not only depends on the environmental “quality” of resulting land use patterns. Indeed, the characteristics of the land (e.g. soil quality, habitat quality, vegetation, etc.) that became urbanised within a specific period of time also have to be examined from an economic perspective. One particular concern is the loss of prime agricultural land, which has major importance for the long-term competitiveness and sustainability of agriculture generally (Hasse and Lathrop 2003). The European Environment Agency (EEA 2005: 176)

has argued that the “continent’s best soils” have been sealed off due to the fact that most urban centres were built on fertile valley soils and around estuaries (see also American Farmland Trust 1994; Kuemmerle et al. 2016; Creutzig et al. 2019). Hasse and Lathrop (2003) presented quantitative findings that prime farmland was more vulnerable to urbanisation than farmland of lesser quality. Urban development in increasingly fragmented agricultural landscapes can also be problematic for the production of food and fibre on the remaining farmland. For instance, conflicts between farmers and their residential neighbours “can arise over noise, chemical applications, and smells that are part of farming” (Merenlender et al. 2005: 2).

The (not only monetary) costs for providing settlements with public services have often been addressed in urban sprawl studies that focus on the economic effects of urban land use change. In 1974, the “costs of sprawl” study (Real Estate Research Corporation 1974) presented empirical evidence for a negative interdependency between the density of residential developments and the fiscal costs for providing basic urban services. The findings of this study triggered an intensive dispute not only with respect to the implications for urban development policies, but also in terms of methodological uncertainties. A couple of subsequent studies confirmed the results of the 1974 work (see Burchell et al. 1998 with many references); others disputed the relevance of urban form variables on infrastructure costs (Peiser 1989; Ladd 1991). Ultimately, researchers today widely acknowledge the idea that low-density and dispersed urban developments are more cost-intensive than more compact development patterns (see also Speir and Stephenson 2002; Carruthers and Ulfarsson 2003; Burchell et al. 2005).

Urban land use change has also been criticised for unintended social outcomes, particularly in association with the broad process of suburbanisation that has affected cities and urban agglomerations worldwide for many decades (e.g. Power 2001). The “spatial mismatch” debate, starting in the 1960s (Gordon et al. 1989; Kain 1992), addressed the extent of limits on residential choices for minority populations (especially people of colour in the US), combined with the intra-regional decentralisation of employment. Proponents of the spatial mismatch hypothesis have argued that the exclusion of low-income and non-white households from suburban communities, together with the continuous spatial dispersal of jobs, especially for low-skilled employees, is responsible for the high rates of unemployment and the low earnings of minority populations living in inner cities. More recently, studies have found evidence that low job accessibility in public transport catchments has a negative effect on the likelihood of employment among social groups that tend to lack access to cars (Matas et al. 2010). Moreover, suburban development has also been associated with gender issues, as it is usually linked to a traditional (key) family model, with the female adult being responsible for reproductive work and childrearing. In such mono-functional residential areas characteristic of suburbia in particular, women are largely unable to participate in the labour market and even have difficulties in accessing public spaces.

More recently, another social effect of dispersed urbanisation patterns has attracted major attention from researchers and environmental policymakers. Various studies have highlighted the relationship between urban form variables and physical activities with their corresponding health implications. These studies came to the conclusion

that urban sprawl could have a severe impact on public health, leading to obesity and a generally insufficient level of physical activity among many people (e.g. McCann and Ewing 2003; Kelly-Schwartz et al. 2004; Committee on Physical Activity 2005).

Box: Systematisation of Systematic Accounts of Land Use Change Impacts

Numerous approaches to systematise the impacts of (urban) land use change have been introduced, each of which applies a particular dimension of categorisation (see table).

	Dimension of categorisation	Impact categories	Author
1.	Issue of concern	Environmental impacts	Chin (2002)
		Economic impacts	
		Social impacts	
2.	Causality	Direct impacts	Cooper (2004)
		Indirect or cumulative impacts	
3.	Spatial scale	Direct impacts (on the plot)	Nuissl et al. (2009)
		Cumulative impacts (on aggregated plots)	
		Contextual impacts (regional effects)	
4.	Impact pathway	Land surface-related impacts	Siedentop & Fina (2010)
		Land use pattern-related impacts	
		Density-related impacts	
5.	Appraisal (prioritisation of goals)	Negative impacts (as costs)	Burchell et al. (1998)
		Positive impacts (as benefits)	

1. Comprehensive reports on urbanisation and urban land use change issues usually classify effects and impacts according to the sphere (or policy field) in which they occur. Distinguishing between environmental (i.e. ecological), economic and social impacts, this classification often corresponds with the “classic triangle of sustainability”. Sometimes additional dimensions, such as transport or politics, are considered as well.
2. At a more general level, it is possible to distinguish between single, i.e. direct, and cumulative, i.e. indirect, impacts of urban land use change. While the first denotes the direct and immediate outcome of a change of

- land use on a particular plot of land, e.g. the reduction of agricultural land, significant land use-related environmental problems, such as the modification of urban climate conditions (“urban heat islands”) or an increase in runoff, usually result from the cumulative effects of development activities.
3. After a closer look, it is possible to add a third kind of urban land use change impact. Contextual impacts depend on the characteristics of the larger territory (context) in which a land use change takes place. One example of this type of impact is the generation of traffic due to the development of an exurban retail facility.
 4. Siedentop and Fina (2010) distinguish between three key dimensions of urban land use which they use to explain and model a broad range of land consumption impacts. These are land cover features (surface), the pattern of land use (the spatial configuration of urban and non-urban land patches) and the intensity of use (urban density).
 5. Last but not least, the literature on urban sprawl in particular has often adopted a decidedly normative stance as to the impacts of urban land use change in that it distinguishes between costs and benefits. However, the sharp disagreement about the overall assessment on whether urban sprawl is “good” or “evil” illustrates that it is a matter of perspective (if not a political standpoint) if a certain issue is assessed in positive or negative terms.

Last but not least, the impact of urban land use change on motorised transport demand is probably the most frequently discussed issue in this field of research. Many scholars have argued that households in peripheral, low-density environments have long travel distances and tend to use their car extensively (Banister 1999; Naess 2003). Some critics dispute the causality between urban form and travel behaviour, pointing to the possibility that private households self-select themselves to places that are in accordance with their preferences for particular modes of transport (Handy 2005). At the same time, studies that controlled for demographic, socioeconomic and attitudinal variables (such as household income, family size or age) proved the significant effect of urban form on transport (Cervero 2003; Naess 2007; Vance and Hedel 2007; Ewing and Cervero 2010).

5.4 Policies on Urban Land Use Change

The desire to control the dynamics of land consumption was one of the earliest motivations for spatial planning. However, while this desire used to be of minor importance in comparison to the goal of mitigating land use conflicts and safeguarding the most rational form of urban growth, it has since become one of the major issues in land use policy (e.g. Gallent 2006). This issue is probably most disputed in the

US, where public concern about sprawl has grown significantly in the recent past (Bengston et al. 2005), resulting in a strong anti-sprawl movement. This in turn has prompted a number of states to adopt growth management programmes that attempt to contain urban growth and preserve open space. However, urban land consumption is also a major concern in Europe (EEA 2006; Nilsson et al. 2013), where quite a few planning strategies and instruments have been placed under scrutiny regarding their effectiveness (Hersperger et al. 2018). Such policies, however, have met with strong opposition by more liberal academics and planners who emphasise the importance of individual choice and the free market (e.g. Ewing 1994; Ewing 1997; Benfield et al. 1999; Gordon and Richardson 2001; Bruegmann 2005). Elsewhere, most notably in Western and Central Europe and Australia, the debate about the drawbacks of urban land use change has gained considerable momentum, too (e.g. Newman 1992; EEA 2006). In England, the former Labour government set a national target of delivering 60% of all new housing units on previously developed land and through conversions of the existing building stock. The government saw the reuse of urban land as a key policy in reducing development pressures on the open countryside (Downs 1999; Ganser and Williams 2007). The Chinese government, concerned about the alarming loss of prime farmland due to urbanisation, has introduced regulatory policies that have attempted to protect farmland more effectively (Lichtenberg and Ding 2006). The federal governments of Austria, Germany and Switzerland have all introduced national targets to reduce the rate of conversion of non-urban to urban land uses (Bundesregierung 2002). They argued that urban land use change and landscape fragmentation were key drivers of species loss, landscape deterioration and reductions in infrastructure efficiency.

A great variety of policy and planning instruments have been proposed to implement the goal of taming urban land use change. One common way to categorise policy and planning instruments is their classification according to whether they are concerned either with (I) regulation, or (II) spending, taxation and subsidies, or (III) advocacy (e.g. Bengston et al. 2004). Adopting and slightly modifying this approach, we propose differentiating policy and planning instruments according to where they are located on the continuum that ranges between the poles of two basic planning principles:

- *Planning*, reflecting the “traditional” regulatory approach of spatial planning to set legally binding rules for the use of land via regulatory plans, and
- *Market*, reflecting the “economic” approach of land use policy which employs “market-based instruments” that modify incentives in a way that lead actors to use the land in an intended manner. For instance, taxation schemes that put an additional cost on the development of land are clearly among the most efficient ways to minimise the total amount of urbanised land (e.g. Song and Zenou 2006).

Somewhere in the middle between these two poles, there is a wide array of instruments that are primarily managerial by character because they basically focus on influencing the decision-making processes of (either potentially land consuming or land use policy making) actors. This group of instruments can be subsumed under a third planning principle:

- *Management*; reflecting the “persuasive” approach that tries to change the behaviour of land-using actors, either by providing them with information on the consequences of their behaviour, or by involving them in a communicative process together with actors that wish to restrict land consumption.

These planning principles are of course ideal types. In reality, policy responses and planning instruments that address the problem of land consumption are frequently combinations of several instruments that entail the adoption of various principles.

Table 5.3 illustrates the three general approaches that land use policy can adopt to pursue its goals, including the goal of taming urban land use change. However, only the regulatory and the persuasive approach fall into the scope of spatial planning in a strict sense, while the modification of incentives is usually achieved in other policy fields such as taxation or social policy (Nuissl and Schröter-Schlaack 2009).

While there is a plethora of instruments that could be used in principle to interfere in the process of urban land use change, the likelihood of achieving the goal of

Table 5.3 A taxonomy of land use policy instruments

Governance principle	Planning approach	Examples of strategies and instruments
Planning	Regulation (law)	Land use planning, i.e. zoning (e.g. Hirt 2007; Köck et al. 2007)
		Urban design planning (e.g. density controls) (e.g. Acioly and Davidson 1996; Churchman 1999)
		Transit planning (Freilich 1998; Handa 1996) etc.
Management	Persuasion (information and communication)	Forums and roundtables (e.g. Healey 1992; Wates 2000)
		Information campaigns (e.g. Besecke et al. 2005; Haughton 1999)
		Land use change assessment and forecasting tools (e.g. Criterion Planners/Engineers 2001; EPA 2000) etc.
Market	Modification of incentives	Development taxes (e.g. Gihring 1999; Korthals-Altes 2009)
		Subsidies (e.g. urban regeneration) (e.g. Couch et al. 2003; Newton 2010)
		Tradable permit schemes (e.g. Nuissl and Schröter-Schlaack 2009; Pruetz 2003) etc.

minimising land consumption is not only dependent on the theoretical availability of such instruments, but also on the political will to use them for precisely this purpose. In this vein, the normative ideas underlying actual development policies and planning practices are of major importance. Three of the most important normative ideas to turn policy and planning towards a prudent use of land resources and minimising urban land use change are (A) the Green Belt and the Urban Growth Boundary, (B) various leitmotifs of urban development that promote a compact and mixed-use city, and (C) the prioritisation of urban regeneration.

1. The delineation of Green Belts or Urban Growth Boundaries are among the most famous “tools” designed by spatial planners to provide a clear orientation about where to steer new development and where to prevent urbanisation (e.g. Al-Hathloul and Mughal 2004; Bengston and Youn 2006; Abbott and Margheim 2008; Siedentop 2016). While both involve the idea of defining a ring of open land that surrounds the urban area, the latter concept usually implies a precisely defined line beyond which no building activity may take place, whereas the former is the more general concept which is often used in nonbinding regional plans and usually needs to be enforced by specific plans that prohibit development in the Green Belt areas. Urban Growth Boundaries are often difficult to implement in densely populated regions where it is hardly possible to make a sharp distinction between urban and rural areas. In addition, there is a broad debate in the US as well as in the UK on whether the definition of a rigid boundary around a settlement is indeed the most effective means for curbing urban sprawl and its associated negative impacts (e.g. Carlson and Dierwechter 2007; Gant et al. 2011). Several scholars claim to have proven this assumption (e.g. Weitz and Moore 1998), while others doubt it (e.g. Bae and Jun 2003). Likewise, Green Belt policies or Urban Growth Boundaries can prove unsuitable in a situation where informal housing is a frequent phenomenon (Wang and Scott 2008).
2. Since its beginnings, spatial planning has been heavily influenced by the predominant leitmotifs of the time regarding the “optimal” urban environment. Today, the chief guiding stars in urban planning promote, in one way or another, the economic use of land—this holds true for the ideal of the mixed use and compact city (e.g. Williams et al. 2000), which is at the heart of the New Urbanism campaign in the US (Talen 2005), for instance, as well as the discourse on the European City which has become influential in particular in Central Europe (Rietdorf 2001). These guiding stars have developed over the last several decades as a reaction to the neglect of the particular qualities of “urban” environments that was characteristic of post-war principles and trends of urban development (Jacobs 1961) and that have at their heart the idea of the “compact city” (Burgess 2000; Richardson et al. 2000; Dielemann and Wegener 2004).
3. Within the last 50 years or so, urban regeneration in many countries has become a major paradigm in spatial policies, and a variety of strategies and instruments have emerged to promote it. These include specific legislative measures that regulate urban renewal processes (e.g. Couch et al. 2003), urban regeneration schemes aiming to re-establish the attractiveness of inner urban areas (e.g. Haase

et al. 2005), congestion charges in inner urban areas (Anas and Rhee 2006), or graduated density zoning (Shoup 2008). These efforts have helped to make the existing urban area as attractive as newly developed areas as a place to invest, develop, set up a business, live and work, from the perspectives of economic return, social satisfaction and environmental quality (Couch and Karecha 2006). Moreover, the most common strategies of urban development include the densification and intensification of existing settlements by reusing brownfields and creating infill development.

5.5 Outlook

It is widely accepted today that extensive urban land use change brings about several unwelcome effects in that it goes along with the loss of open land and natural resources, causes ecological damage, generates automobile dependence, wastes energy, leads to atmospheric pollution, imposes economic costs on local authorities, and implies potential negative social effects such as the exacerbation of spatial social segregation and the exclusion of non-car-owning households from a good deal of work and leisure facilities. The regulation of urban land use change is therefore a key issue of land use policy.

In recent years, however, concerns about the dynamics of urban development and land use change seem to have diminished—at least in the European context. This may be due in part to the wide range of strategies and instruments that exist and can be employed today to bring urban land use change under control. Yet the main reason for reduced worries related to land-demanding developments is probably linked to current reurbanisation trends in many European urban regions. As the demand for inner-city housing has significantly increased in recent years, there is a widespread perception that the problem of extensive urban land use change and urban sprawl has vanished. However, a closer look reveals that in most countries and regions, the dynamic of urban land use change is largely unbroken (e.g. Hierse et al. 2017; Hesse and Siedentop 2018). Therefore, reflecting on how urban land use change can be controlled is still a key element of land use policy and planning. In particular, it seems useful to account for a few challenges in this regard:

1. It appears crucial to embed any attempt to minimise urban land use change in a strategy which at the same time eliminates existing incentives for land-consuming development. It is therefore important to identify and then counteract such incentives in, for instance, tax policies or policies for structural development.
2. Since the rigid control of urban land use change is largely dependent on the political will to achieve this task (which is often lacking), the provision of powerful tools to monitor land use changes and to assess their various impacts is essential. In this vein, ongoing attempts to seek scientifically sound arguments in favour of compact urban development can facilitate efforts to minimise urban land use change with scientific evidence.

3. Given the variety of policy and planning instruments, it is worthwhile to evaluate the effectiveness of these instruments in different contexts and to also scrutinise the feasibility of possible combinations of different instruments. However, such an evaluation of the instruments put in place to curb urban land use change is particularly difficult to credibly carry out due to the countless potential interfering variables. And it is even more difficult to undertake such an evaluation by way of international comparison, because of the differences in administrative and legal structures and cultures that exist in various countries. Against this background, it remains a major research task to keep an eye on practical experiences regarding the applicability of policy and planning strategies and instruments in different contexts, as this will provide a basis for their adaption to the context in which they are to be utilised. Without such efforts to allow for the particularity of different contexts, it hardly seems possible to control, manage and steer the development of fresh land to the most acceptable locations, to minimise urban land use change, and to increase the sustainability of land use patterns.
4. Last but not least, more effective containment of urban sprawl requires social learning and a long-term agenda-setting process. Experience to date with growth management policies has made it clear that a “top-down” strategy operating solely through laws and regulations at the national level cannot be successful. What is needed, instead, is a cooperative political approach that includes a coordinated action programme at the state and local levels based on shared land policy goals. The alliances (*Bündnisse*) that exist in various German *Länder* advocating a more land-saving approach to urban development are an example of this. All the relevant actors and stakeholders (policymakers, administration, chambers of commerce, associations, researchers, NGOs) are represented in them. The aim is to reach a consensus on land-saving targets and to find suitable implementation strategies and instruments. Even though such cooperative approaches have not been consistently successful in the past, there is no doubt that sustainable settlement and land development will not be possible without the mobilisation of actors and their participation in a multi-level decision-making process.

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