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Environmental impact assessment of urban land use transitions— A context-sensitive approach

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ABSTRACT

Land consumption due to residential development, economic growth and transportation belongs to the most serious environmental pressures on landscapes worldwide, in particular in urbanised areas. Accordingly, the aim of containing the development of land is rated increasingly high on the agenda of environmental policy, at least in densely populated countries such as Germany, Belgium, the Netherlands or the UK. As a result, different strategies and instruments to prevent excessive land consumption are being discussed. However, many of these strategies and instruments adopt a rather general approach, while it seems more effective to define the particular areas where the goal of reducing land consumption is to be pursued. Such an approach must draw on information about how detrimental specific land use transitions are with regard to, for instance, the functionality of soils, water balance or habitat quality at specific locations. This paper introduces a conceptual framework for the impact assessment of land use transition in urban areas which highlights how such information can be acquired. This framework includes the differentiation of two levels of impact assessment: the level of the single land unit and the context level which takes into account regional and aggregated impacts of land use transition bound to the spatial context. The conceptual framework provides a basis to disaggregate (supra-)national policy targets regarding land use, to scale them down to the regional level, and thus to clarify the spatially explicit implications of land use policies.

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Introduction: The quest for a methodology of integrated impact assessment of land use transition

The problem of land use transition

The transformation of natural, open or agricultural land into urban land is one of the major environmental impacts in most urbanized countries and regions (OECD, 1997). Moreover, along the urban rural gradient this land consumption is often characterised by dispersed developments, mono-functional and low-density land uses and reliance on private car ownership—thus displaying the typical features of veritable urban sprawl (Squires, 2002; Torrens

and Alberti, 2000; Couch et al., 2005). This is also true for Europe, although European cities and towns have traditionally been rather compact (Kasanko et al., 2006). In Germany for instance, between 1993 and 2004 daily land consumption has amounted to 80–130 ha (BBR, 2007). Accordingly, the share of urban land (settlement and transportation) of the total territory of Germany in 2007 is some 12.8% compared to 7.1% in 1950—a ratio which is only exceeded by smaller and more densely populated states such as the Netherlands (18%) or Belgium (14%; EEA, 2006) (Fig. 1).

Land consumption is not only a problem because it contradicts a normative ideal of spatial planning. In a multitude of studies it has been shown that land consumption is usually detrimental to the environment in different regards (e.g. Johnson, 2001). Its impact reduces the ability of nature to fulfil human requirements and thus impairs ecosystem services in various ways (De Groot et al., 2002; MEA, 2005; Curran and Sherbinin, 2004). Individual ecosystem services that are affected by land use transition include the production of food, regulation of energy and matter flows, water supply, supply of recreational space, biodiversity or natural aesthetic values.

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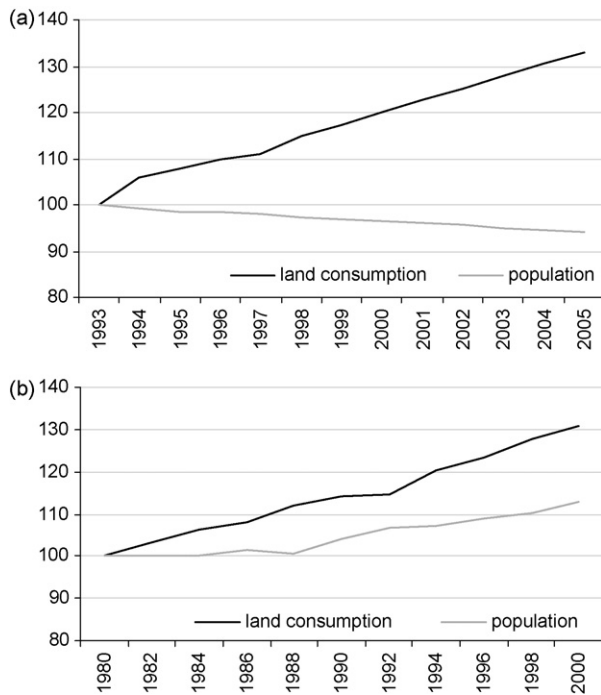


Fig. 1. (a) Land consumption (settlement and transport) compared to the population and employee development 1993–2005 for the shrinking greater metropolitan area of Leipzig (in German: Regierungsbezirk Westsachsen), eastern Germany (1993 = 100). (b) Land consumption (settlement and transport) compared to the population and employee development 1980–2000 for a growing Bavaria, western Germany (1980 = 100).

Current land use policy approaches

It is widely accepted in the field of land use policy that the incessant consumption of open land demands intervention and regulation. At EU level, documents such as the European Landscape Convention (CoE, 2000; CEC, 2001, 2004, 2005), the European Spatial Development Plan (1999), or the guidelines for the funding schemes of the common structural and agricultural policies call for the reduction of land development. While these documents are not legally binding for the member states, the EU further requires the introduction of an environmental impact assessment for spatial plans. This latter instrument has the potential to considerably reduce the negative impact of urban development and land use transitions, provided there is a sound methodology of impact assessment at hand that can be applied in practice.

At the national level an array of different policies for addressing the challenge of land consumption are being discussed in the different EU member states. In Germany, the Netherlands or the UK, for instance, the discussion on strategies and instruments to inhibit the further growth of settlement and transport areas is a high priority on the agenda of environmental politics. Besides the regulatory means of both the planning system and environmental policy, this discussion also highlights more informal instruments – such as spatial development concepts, municipal resource management schemes aiming at the reuse of brownfield land, and inter-regional cooperation initiatives – as well as so called economic instruments – such as changes in land taxation, or the introduction of a scheme of tradable development permits (German Council of Sustainable Development, 2004; Bundesregierung, 2004). Above and beyond these instruments, the Federal Government of Germany has defined the so called “30-hectare-goal” (Bundesregierung, 2004; Dosch, 2001). It thus committed itself to the goal of reducing the daily rate of land consumption from currently around 110 to only 30 ha

in 2020. This figure might be seen as a political manifestation rather than a strict quantification of a land use policy goal, but it clearly provides political guidance towards the goal of mitigation of land consumption. However, the “30-hectare-goal” is abstracted from the context-sensitivity of land use transition impact, such as deterioration of water balance, soil functions or habitat quality, which differ tremendously depending on where the ‘consumed’ land is located. This leads to the question whether such general goals can be specified and differentiated in terms of *where* the incremental development that is still deemed acceptable should take place (EEA, 2006)—i.e. how the ‘remaining’ development can be steered to the most desirable locations.

Generally speaking, the different policy approaches and instruments on the containment of land consumption aim at two interrelated but distinguishable goals (Schröter-Schlaack and Ring, 2006): firstly a reduction of the (aggregated) amount of land development; secondly, an improvement of (particular) land use and development patterns, i.e. the achievement of a development pattern that is least detrimental in terms of deterioration of ecosystem services. In practice however, only if it succeeds in pursuing both goals at the same time can land use policy successfully mitigate the environmental impact of land consumption. In other words, a quantitative reduction in land consumption will only substantially contribute to the preservation of ecosystem services if supplemented by efforts to break it down to the regional and local level. Such efforts should be substantiated by scientific knowledge of the impact – or at least on the methodology of assessing the impact – of land use transition. Compared to more complex and innovation-related definitions (cf. Elzen et al., 2004; Wiek et al., 2006) the term ‘transition’ in this paper is understood as the change of one type of land use to another.

Studies on the impact of land use transition

The assessment and evaluation of the impact of land use transition, including both land consumption and land abandonment, is a major task of landscape research in general (Wu and Hobbs, 2002; Naveh, 2001). Accordingly, there is affluent expertise on the effects of land use transition on ecosystem services concerning, for instance, landscape clustering and fragmentation (Ewing, 1997; Pauleit et al., 2005), disturbances in the water balance (Samaniego and Barossy, 2006), soil compaction (EEA, 2006), air pollution and noise (cf. indicator set by Wiek and Binder, 2005), or increased risk of flooding (Bertoni, 2006). However, as a rule these studies are highly sophisticated contributions to the research on individual aspects of land use transition and employ a scientific methodology which could hardly be copied in practical spatial planning.

On the other hand, we find integrated assessment schemes for whole city regions, drawing on a multitude of disciplines and taking account of interlinked urban dynamics, such as suggested by Ravetz (2000), Hasse and Lathrop (2003) or, in a more participatory form, Wiek and Binder (2005). However, the primary focus of these studies is not the problem of land use transition but rather the conceptualization and evaluation of urban development processes in general. Hence, a systematic, scale-spanning and practically applicable approach to the integrative assessment of the impact of (urban) land use transition is still missing. In particular, the various forms of land use transition in the housing sector need a more detailed analysis so as to enable an assessment of its impact at the relevant spatial scales.

Objectives and structure of the paper

In this paper we deal with the question of how environmental science can support land use policy and planning in making quan-

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