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Regional land pattern assessment: development of a resource efficiency measurement method

Geoffrey McD. Lewis[a,c], Elizabeth Brabec[b,*]

[a] *University of Michigan School of Natural Resources and Environment, 430 East University, Ann Arbor, MI 48109-1115, USA*
[b] *Utah State University Department of Landscape Architecture and Environmental Planning, Fine Arts Visual 230, Logan, UT 84322-4005, USA*
[c] *University of Michigan Taubman College of Architecture and Urban Planning, 2000 Bonisteel Boulevard, Ann Arbor, MI 48109-2069, USA*

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Abstract

Debate on the sustainability of human settlements has recently been focused primarily on the urban portion of the land use pattern. However, urban areas rely on suburban, rural, and other less densely settled lands for their existence. In order to quantify the impacts of various land patterns on their supporting resources, these exurban lands must be included in any sustainability assessment. This need for a regional view has resulted in a measurement method that enables comparisons of relative sustainability between various regional land use patterns. Existing methods employed to assess urban sustainability are reviewed and compared with the regional characteristic curves method, introduced here, that takes a more holistic regional view. Results from the application of the method are presented, displaying the spatial dimension it brings to the analysis of illustrative primary metrics as well as demonstrating its ability to spatially quantify change in these metrics over time.

Keywords: Sustainability assessment; Regional measurement; Land cover/land use; Resource efficiency; von Thünen

1. Introduction

Efforts to define, describe, and implement sustainable cities and towns have been a part of the land use planning profession for more than a decade. During that time, both the terms ‘sprawl’ and ‘sustainability’ have become catchwords in the popular media. Although most commentators agree that sprawl is ‘unsustainable’ as a land pattern that affects the ecological, social, and cultural fabric of communities (Diamond and Noonan, 1996), there has been debate over the severity of its effects. Some have even argued that polycentricity and sprawl, a low-density development pattern in which land is consumed at a faster rate than can be

* Corresponding author. Present address: Department of Landscape Architecture and Environmental Planning Utah State University Logan, UT 84322-4005, USA. Tel.: +1 435 797 0500; fax: +1 435 797 0503.
E-mail address: Elizabeth.brabec@usa.edu (E. Brabec).

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explained by population growth alone (Fulton et al., 2001), are inevitable and desirable consequences of the post-industrial city (Gordon and Richardson, 1996, 1997).

This debate over the pattern of land use and land cover lies at the center of land planning and growth management across the United States and throughout the world. A comparative analysis of the sustainability of alternate land patterns is necessary to support informed and valid responses in this debate. Perhaps more importantly, if political decisions to limit sprawl are to be actualized at the national, regional, and local levels, the analysis must be presented in a form that is easily accessible to a broad spectrum of society. Given the current state of research, analysis, and analytical methods, three primary issues emerge that constrain our ability to complete this type of comparative analysis. First, there is a tendency towards a focus solely on the (politically) bounded urban portion of the landscape, following the rationale that the majority of human impacts occur where the majority of humans are (Baccini and Brunner, 1991). This focus on the urban portion of the land pattern neglects the critical regional-scale interaction of suburban and rural land areas with each other and with the urban center. Lacking a holistic perspective of regional land patterns in all their complexity, it is difficult to adequately differentiate between more or less efficient land use patterns. A comprehensive discussion of the differential sustainability of land pattern and the effects of sprawl must be based on a regional perspective, since sprawl by definition includes land area other than the traditional urban core.

The second issue in analyzing the affect of land pattern on sustainability is the question of what to measure. Many sustainability analyses review the broad spectrum of topics that make up sustainability: politics, economics, ecology, and social issues (Alberti, 1996; Maclaren, 1996). However, the key factor in analyzing the effect of land pattern on sustainability is the quantification of an urban area's impact on its constituent ecological systems. Resource efficiency, a component of the larger concept of sustainability, describes the impact a region has on its ecological basis through the use and alteration of fundamental water, land, and energy resources. Regions that use fewer resources for a given function (i.e. are more resource efficient) will theoretically be better able to continue to function as these resources become scarcer and more costly.

Given the necessity for a regional perspective and the desire to analyze various land patterns by measuring resource efficiency, the third issue in conducting an analysis of land pattern and sustainability is the lack of an appropriate measurement method. A regional measurement method must be easily adaptable to various regions and a variety of metrics, providing a basis for equitable comparative assessment of the relative efficiency of alternative land patterns. Measurement approaches have been developed to assess sustainability across a variety of geographic scales ranging from local communities to the entire planet. These methods can be collected into three general categories: indicator frameworks, (urban) metabolism (Wolman, 1965), and the ecological footprint (EF) (Rees, 1992; Wackernagel and Rees, 1996).

Indicator frameworks collect sets of individual indicators (Arnold and Gibbons, 1996; Haberl, 1997), sometimes aggregating them to develop an overall index (Alberti, 1996; AtKisson, 1996; Maclaren, 1996; Sawicki and Flynn, 1996; Whitford et al., 2001). While indicator frameworks bring a large amount of disparate information together, in their presentation these frameworks necessarily tend to emphasize the separation and incommensurability of their constituent parts. Interpretation requires, in many cases, a high level of expertise and is complicated by multiple interpretations of the significance of particular indicator values.

The urban metabolism concept has been used repeatedly and expanded upon by other researchers since Wolman (Baccini and Brunner, 1991; Decker et al., 2000; Haberl, 2001). The metabolism approach to assessing an urban area involves quantifying all of the flows of material and energy into and out of a bounded area. Metabolism assessments are also sometimes called material flow analyses (MFA), for obvious reasons. There are several shortfalls in applying the concept of urban metabolism to an assessment of regional resource efficiency. The idea of an urban metabolism, at least as realized in material flow analysis, suffers from a technocentric view that sees human settlements as separate from and surrounded by 'the environment' (Baccini and Brunner, 1991; Haberl, 2001). While this is a mental construct meant to simplify calculations and develop knowledge of how urban areas function, it works against a more comprehensive understanding of the functioning of urban regions and does not provide the ability to assess regional land patterns or their