

## Article

# Assessing the Negative Effects of Suburbanization: The Urban Sprawl Restrictiveness Index in Romania's Metropolitan Areas

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**Abstract:** Urban sprawl is widely considered to be a major issue for the functioning of urban areas, threatening long-term sustainability and affecting the quality of living. The aim of this research is to develop a methodology for assessing the negative effects of uncontrolled suburbanization in metropolitan areas through a multicriterial approach. Based on the existing body of knowledge, we have defined a set of indicators for assessing the impact of suburbanization, covering themes such as land use, water, biodiversity and economy or social issues. A questionnaire was applied to experts in the field in order to find out the final set of indicators and their perceived importance. The product of our research is an urban sprawl restrictiveness index at the local level, tested on five of the most dynamic metropolitan areas in Romania. The results highlight the concentration of negative effects of urban sprawl in the areas most accessible from the city core, where additional in-depth analyses were performed for validation. This study thus proposes a novel method for assessing the negative impacts of urban sprawl. The index could be used in other comparative studies at the national or international level while also aiding policymakers in better managing metropolitan areas.



**Citation:** Cochechi, R.-M.; Petrisor, A.-I. Assessing the Negative Effects of Suburbanization: The Urban Sprawl Restrictiveness Index in Romania's Metropolitan Areas. *Land* **2023**, *12*, 966. <https://doi.org/10.3390/land12050966>

Academic Editor: Xiangzheng Deng

Received: 28 March 2023

Revised: 13 April 2023

Accepted: 24 April 2023

Published: 26 April 2023



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**Keywords:** suburbanization; urban sprawl; metropolitan planning; spatial analysis; land cover and use changes; Central and Eastern Europe

## 1. Introduction

Urban sprawl is most commonly understood as a suburban development characterized by low density, automobile dependency and segregated land uses around the periphery of cities [1–3]. It is widely considered to be a pattern of urbanization with complex economic, social and ecological impacts [4–8] that threaten the functioning of urban environments [9].

The emergence of the urban sprawl debate is mostly linked with the development of suburbia in the USA in the early years of the twentieth century. In Europe, the equivalent debate is centered around concepts such as suburbanization or peri-urbanization [2]. Both concepts describe a process of urban expansion and decentralization [10], with peri-urbanization referring to the development of intermediate areas between suburbs and typical rural areas [11]. Consequently, as sprawling areas may be located well beyond the administrative boundaries of cities, metropolitan areas become a more appropriate area of study. These urbanization patterns in the form of low-density discontinuous development pose specific challenges for planners and policymakers [12], as the lack of interjurisdictional land use planning makes it difficult to manage suburban development [13].

There is some debate regarding the definition of urban sprawl, regarded as a multidimensional phenomenon with various determinants [14–16]. Urban morphology (scattering

of development, connectivity and availability of open space), as well as a density, decentralization and land use mix, are considered among the dimensions of urban sprawl [15]. The focus on urban morphology dimensions is evident from previous attempts at measuring urban sprawl. Examples include weighted urban proliferation [17], which considers the dispersion of built-up areas and building density, and different urban sprawl indices containing variables such as shape irregularity and fragmentation [18] or spatial configuration indicators [19]. Some authors suggest that it is difficult to distinguish urban sprawl from other urban growth patterns, opting to focus more on urban sprawl as a process of urban change [2] made undesirable because of its impacts [20].

Urban sprawl is generally compared to an ideal type of compact city, regarded as a sustainable urban form [2,21–23]. However, individual residential preferences appear to be directed towards lower-density housing areas [20,24,25]. Consequently, some authors point out the social injustice of urban containment policies, which affect housing affordability and push residential areas even further away from the city [26]. Others suggest that, in time, sprawling areas can develop into complex suburban areas with mixed and various land uses [27,28]. The ecological value of interstitial spaces resulting from urban sprawl developments has also been discussed [29]. While acknowledging these various perspectives on the urban sprawl–compact city debate, our research focus is nevertheless on the negative impacts of urban sprawl. Three main categories are considered in the scientific reports prepared by the European Environmental Agency: (1) environmental impacts, (2) economic impacts and (3) social impacts and quality of life [30,31].

An important topic when analyzing the environmental consequences of urban sprawl is represented by land cover and land use change. Urbanization-driven changes in land cover affect ecological systems and may lead to landscape fragmentation and natural landscape degradation [1,32]. Other effects of land cover and land use change include the decrease of local biodiversity [33], the loss of agricultural land [34–36] and the sealing of soil surfaces [37,38].

Urban sprawl is also linked to energy and climate change issues, as well as air pollution [39–43]. Land cover changes, mentioned above, also lead to a decrease in carbon dioxide uptake as a result of vegetation removal [44,45]. The growth of transport emissions has been linked to the absence of specific urban planning policies that could limit the increase of artificial land [46]. Other environmental impacts of urban sprawl include increased water consumption per capita [47,48] and higher risk of leakages as the network of pipes increases [49].

As far as economic impacts are concerned, urban sprawl determines higher costs for transport due to increased daily commuting [50–52], as well as more material use for construction per housing unit [53]. Land conversion related to suburban development and changing land use regulations lead to rapid increases in real estate prices [54]. The reduction of cities' touristic attractiveness is also regarded as a negative economic consequence of unplanned suburban development [55].

Among the social impacts of sprawl, the most often discussed are the effects of the segregated land uses, with unequal distribution and accessibility of public infrastructure and services such as schools, healthcare and leisure facilities [20,56–58]. In this context, there is a perceived social vulnerability of suburbs lacking adequate social infrastructures [59,60]. The higher proportion of single households in urban sprawl developments [61] also leads to a more resource-intensive lifestyle [31]. Social interactions are also made difficult by the decentralization, fragmentation and long commutes associated with urban sprawl [62].

Considering the debates in the scientific literature related to the definition of urban sprawl, this paper focuses on urban sprawl as a process of change impeding the sustainable development of cities and metropolitan areas. While useful in establishing gradients of urban sprawl, the indices developed so far [17–19] do not explain the scale of the ecological, social and economic effects of suburban development. Other research in this area has focused on developing systems of indicators in order to explain the drivers and impacts of urban sprawl [63], while other authors have opted to quantify impacts in monetary

terms [64]. However, little attention has been given to temporal approaches and the integration of environmental, economic and social issues when discussing urban sprawl impacts. In order to fill in this gap, this paper proposes a novel method for measuring urban sprawl based on the impact assessment of suburbanization from 2006 in the selected metropolitan areas. By combining analyses using different scales and different datasets, it also provides new insights regarding the use of CORINE Land Cover and Urban Atlas data.

Hence, the aim of this paper is to develop a methodology for assessing the negative effects of urban sprawl in metropolitan areas through a multicriterial approach, taking into account the environmental, economic and social dimensions. After defining a set of criteria and possible proxy indicators, we applied a questionnaire to experts in spatial planning in order to determine a final set of indicators and their perceived importance. The product of our research is an urban sprawl restrictiveness index at the local administrative unit (LAU) level tested on five of the most dynamic metropolitan areas in Romania. In spite of data availability constraints, we believe that our method opens new research directions, including the possibility of in-depth comparative studies at the national or international level. The proposed index represents a solution for metrics-based monitoring, which can help the integrated assessment of urban sprawl's environmental, economic and social impacts. The fact that the assessment is done at the LAU level can support policymakers in better managing and planning metropolitan areas. The preliminary analyses done for the local administrative units with the highest index values suggest the need for updated planning instruments that are regulated across administrative boundaries and specific urban policies tackling the poor coverage of public infrastructure and services.

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