



## Urban sprawl and land conversion in post-socialist cities: The case of metropolitan Budapest

Zoltán Kovács<sup>a,b,\*</sup>, Zsolt Jenő Farkas<sup>c</sup>, Tamás Egedy<sup>a</sup>, Attila Csaba Kondor<sup>a</sup>, Balázs Szabó<sup>a</sup>, József Lennert<sup>c</sup>, Dorián Baka<sup>d</sup>, Balázs Kohán<sup>d</sup>

<sup>a</sup> MTA Research Centre for Astronomy and Earth Sciences, Geographical Institute, Budaörsi út 45., 1112 Budapest, Hungary

<sup>b</sup> University of Szeged, Department of Economic and Social Geography, H – 6722 Szeged, Egyetem u. 2, Hungary

<sup>c</sup> MTA Centre for Economic and Regional Studies, Institute for Regional Studies, Rákóczi út 3., 6000 Kecskemét, Hungary

<sup>d</sup> Eötvös Loránd University, Institute for Geography and Earth Sciences, Pázmány P. sétány 1/C, 1117 Budapest, Hungary

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### ABSTRACT

Former state-socialist cities were described by the literature as compact and relatively dense urban forms. However, the political transition of 1989–90 has changed the spatial characteristics of these cities, partly due to urban sprawl. Yet, we do not know if such a phenomenon as “sprawl” did exist before 1989. The main aim of this paper is to assess urban expansion in the metropolitan region of Budapest during state-socialism and after the political changes, and measure the intensity of urban sprawl. The main thesis is that urban sprawl did not start with the advent of market forces in 1989–90, but it was already present during state-socialism, however the tempo of sprawl was considerably increased by suburbanization, the dominant form of urban expansion, after 1990. In order to explore the longitudinal land use changes in the Budapest metropolitan region we analyse standardised databases and maps (e.g. military topographic map from 1959, Corine Land Cover database from 1990 and European Urban Atlas from 2012). The discussion is focused, on the one hand, on the growth of urbanized land as an outcome of urban sprawl and the main underpinning factors in different epochs and, on the other hand, on the main driving forces of suburbanization and sprawl. Research results clearly show that urban sprawl has intensified around Budapest after the political changes. This was the result of a complex interplay of socio-economic and political factors, a process driven by the free movement of residents, firms, as well as the reshuffle of the regulatory framework. The study demonstrates that urban sprawl has several negative impacts on social, economic and environmental sustainability in the investigated metropolitan region, which is in line with findings of the literature.

### 1. Introduction

According to the literature the spatial characteristics of cities under state-socialism in Central and Eastern Europe (CEE) were substantially different from their capitalist counterparts (e.g. Hirt, 2013; Sýkora, 2009; Szelenyi, 1996). In socialist cities the majority of urban land was owned by the state, property market was practically non-existent, urban policy and planning regulations fostered high-density developments. Residential or commercial sprawl could not evolve, at least that would have been comparable to the large-scale sprawls around cities in the United States or Western Europe. Consequently, one of the main differences between the physical appearance of socialist and capitalist cities was that the former were denser and more compact (Szelenyi,

1996).

The mechanisms of urban spatial production in CEE significantly changed after 1990, conditioned by the transition from state-socialist totalitarian to democratic political regimes and from centrally planned (command) to market economies (Sýkora, 2009). The state lost its monopoly on urban development, the majority of urban land became privatized, resources including land and property became distributed according to market principles (Hirt, 2013). The socio-economic conditions of urbanization also changed, younger people, and especially those with higher income sought better residential conditions outside the compact city, trying to fulfil their dream of having a detached house in attractive suburban environment (Slaev, Nedović-Budić, Krunić, Petrić, & Daskalova, 2018; Stanilov & Sýkora, 2014; Šveda, Madajová,

\* Corresponding author at: MTA Research Centre for Astronomy and Earth Sciences, Geographical Institute, Budaörsi út 45., 1112 Budapest, Hungary.

E-mail addresses: [zkovacs@mail.iif.hu](mailto:zkovacs@mail.iif.hu) (Z. Kovács), [farkasj@rkk.hu](mailto:farkasj@rkk.hu) (Z.J. Farkas), [kondor.attila@csfk.mta.hu](mailto:kondor.attila@csfk.mta.hu) (A.C. Kondor), [lennert@rkk.hu](mailto:lennert@rkk.hu) (J. Lennert), [kohan.balazs@caesar.elte.hu](mailto:kohan.balazs@caesar.elte.hu) (B. Kohán).

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& Podolák, 2016; Tammaru, Leetmaa, Silm, & Ahas, 2009). The profound economic restructuring of post-socialist countries resulted in massive deindustrialization and the development of consumer and producer services which in turn rapidly increased demand for commercial space (e.g. new offices and retail facilities) around cities. The outcome of these transitions was a robust suburbanization and concomitant urban sprawl. However, before we proceed any further the two terms need to be defined.

By suburbanization we mean the decentralization of people and urban functions (housing, jobs) from the core city to the periphery, the growth of urbanized land around cities. While there is a near consensus in the literature about the meaning of suburbanization, a common definition of sprawl is missing (Galster et al., 2001). By urban sprawl we understand the expansion of low-density land use forms on undeveloped land around a city driven by a multitude of processes (Oueslati, Alvadines, & Garrod, 2015; Shaw, 2009). Thus, sprawl can happen without suburbanization (e.g. when the population at place is growing), but suburbanization very often results sprawl as an unwanted side effect (EEA, 2006). Indeed, the two phenomena are intertwined by the causes and drivers that engender and sustain them (Slaev et al., 2018). Based on the literature, seven groups of causes can be distinguished: macro- and micro-economic and demographic factors, housing preferences of people, inner-city problems, transportation and regulatory frameworks (EEA, 2006).

One of the most widely studied processes of post-socialist urban transition is the phenomenon of suburbanization (e.g. Lisowski, Mantey, & Wilk, 2014 on Warsaw; Hirt, 2007; Stanilov & Hirt, 2014 on Sofia; Kok & Kovács, 1999; Kovács & Tosics, 2014 on Budapest; Leetmaa & Tammaru, 2007; Leetmaa, Tammaru, & Anniste, 2009; Leetmaa, Kährrik, Nuga, & Tammaru, 2014 on Tallinn; Ouředníček, 2007; Stanilov & Sýkora, 2014 on Prague; Pichler-Milanović, 2005, 2014 on Ljubljana; Slaev et al., 2018 on Belgrade and Sofia, Slavik, Grac, Klobucnik, & Kohutovic, 2011; Šveda et al., 2016 on Bratislava, Kubeš, 2015 on České Budějovice). Most of these studies focus primarily on the socio-economic contexts of suburbanization, the spread of single-family housing in suburban localities and the newly evolving patterns of economy around cities. However, the impacts of suburbanization on land use around post-socialist cities, the causes of these processes, and the socio-economic and environmental consequences of urban sprawl have been insufficiently explored. Sýkora (2009) reminds us that even though the framework conditions of the production of urban environment change quickly, the speed of changes in the built environment and land use patterns are much slower. Nevertheless, we think that enough time elapsed since the beginning of transition to allow us to examine the tempo and forms of land cover changes during state-socialism and in the free market system after 1990.

The main aim of this paper is to measure urban expansion and the spatiotemporal changes in land cover in the metropolitan region of Budapest before and after 1990, and to explore the determinants of urban sprawl during state-socialism and the post-socialist transition. Our analysis is based on high-resolution land use data from different sources referring to changes of the built-up areas in the post-WWII period. Similar method was used in studies focusing on Mediterranean urban regions (Salvati, 2013; Salvati, Munafò, Morelli, & Sabbi, 2012; Salvati, Sateriano, & Bajocco, 2013) and other European city regions (Kasanko et al., 2006). Results on land consumption and urban sprawl in the CEE context have been published only recently (e.g. Bičík & Jeleček, 2009; Grigorescu et al., 2012; Haase & Nuissl, 2007; Ianos, Sirodoev, & Pascariu, 2012; Nuissl, Haase, Lanzendorf, & Wittmer, 2009; Roose, Kull, Gauk, & Tali, 2013; Slaev et al., 2018). The main research questions of this paper are the following:

- Did Budapest remain really a compact city during state-socialism?
- How has suburbanization transformed the land use in the urban periphery since the transition?
- What have been the main causes of urban sprawl?

- What have been the main socio-economic and environmental consequences of urban sprawl since the change of regime?

Although the focus is on urban spatial character, attention will be paid to the wider historical, socio-economic and political conditions that have underpinned the process of suburbanization and sprawl around the Hungarian capital city. The rest of this paper is organized as follows. First, we review the literature in order to highlight the spatial outcomes of post-socialist urbanization and the main challenges caused by suburbanization and urban sprawl in CEE countries. We then discuss the methods of data collection and data analysis. A section then follows with main findings of the research and the key factors influencing the temporal and spatial dynamics of urban sprawl around Budapest. Finally, we turn back to the main research questions and present our conclusions.

## 2. Interpreting and measuring urban sprawl in post-socialism: a literature review

The last decade saw a growing plethora of academic publications on the variety of the forms of urban expansion and their possible measurement (Jaeger & Schwick, 2014; Oueslati et al., 2015; Schwarz, 2010). While early research in this area tended to focus on North American cities (Downs, 1999; Galster et al., 2001; Geddes, 1997) several recent studies have discussed the acceleration of urban sprawl across Europe (Couch et al., 2007; EEA, 2006; Kasanko et al., 2006; Oueslati et al., 2015; Reckien & Karecha, 2007). These studies also confirmed that differences in the nature and pattern of sprawl can be observed not only between Europe and North America but also within Europe. One of the main dividing-lines regarding urban culture, land-use traditions and urban forms in Europe runs between East and West.

Cities of East Central Europe exhibit distinct form of urban spatial structure and residential patterns which are still in sharp contrast with West European cities. After 1945 these cities were developed according to communist ideology, of which the main aim was to create a socially just society (Sýkora, 2009). The elimination of market economy, the nationalisation of land and property, the common ownership of almost all means of production had significant influence on urban development. Land and property markets were suppressed, land rent in terms of the mechanism of spatial allocation of functions ceased to exist, the spatial allocation of investments, services and housing was determined by the state (Hamilton, 1979; Szelenyi, 1987; Tosics, 2005). The socialist state prioritized the construction of high-density standardised housing estates within the city limits in order to maintain compact urban form (Enyedi, 1996; Slaev et al., 2018; Stanilov & Sýkora, 2012). As Hirt (2013, p. 530) noted, 'socialist cities were marked by a clear urban edge framed by the last towers of the vast mass-housing complexes' built during the 1970s and 1980s, and there were no signs that resembled residential or commercial sprawl. Sprawling effects were also prevented by poorly-organized public services, low levels of car ownership and limited infrastructural networks in urban fringe areas.

Post-socialist urban transition can also be characterized by several common features regarding the changes of urban spatial structure. The compact physical morphology of former socialist city has been vanishing due to increasing sprawl of different activities into the hinterland (Bičík & Jeleček, 2009; Slaev et al., 2018; Tammaru et al., 2009; Zlatar, 2014). Urban sprawl has been enabled by several factors, and even though their role might differ from country to country they seem to be rather universal throughout CEE. These factors include: the privatization of land, the reestablishment of real-estate markets, the decentralization of political power and planning rights, the proliferation of actors involved in urban development processes, the withdrawal of state from the housing market, the increasing car ownership and growing level of mobility of people, coupled by changing housing preferences (Pichler-Milanović, Gutry-Korycka, & Rink, 2008; Szemző & Tosics, 2005).

In his paper [Baňski \(2017\)](#) analysed the consequences of privatization and restitution of agricultural land on land use changes in five formerly state-socialist countries (Czechia, Slovakia, Poland, Hungary and Romania). Using official statistics he pointed out that land conversion and the loss of agricultural land clearly intensified after the turn of the millennium in the investigated countries. The greatest loss of agricultural land took place in the peri-urban zone of large urban agglomerations (e.g. Warsaw, Prague, Budapest) due to an urban expansion process caused by the development of new housing areas.

Mechanisms of land management and decision making on land use became also substantially modified after the collapse of state-socialism ([Václavík & Rogan, 2009](#)). Strict planning regulations were lifted, local municipalities became responsible for land management on their territory. As [Korcelli and Korcelli-Olejniczak \(2015\)](#) noted spatial planning and land use management has been characterized by insufficient coordination among local governments around post-socialist cities where short-term gains ruled out any long term strategic vision. The private sector, which replaced the state as the chief city-builder, focused increasingly on new residential and commercial developments in the periphery of large cities ([Pichler-Milanović et al., 2008](#)). A number of authors came to the conclusion that the interplay between market forces and weak planning regulations ([Kovács & Tosics, 2014](#); [Schmidt, Fina, & Siedentop, 2015](#); [Stanilov & Sýkora, 2012, 2014](#); [Tammaru et al., 2009](#); [Zlatař, 2014](#)) had utmost importance in the genesis of suburbanization and urban sprawl around CEE cities which resulted in variegated forms of “strange geographies” after 1990 ([Golubchikov, Badya, & Makhrova, 2014](#)).

Post-socialist urban transformation has been depicted by the literature mostly in a qualitative way, the number of quantitative analyses have been to date limited. Among the few studies, that have assessed and quantified land cover changes in the context of post-socialist urban transformation the comparative study of [Schmidt et al. \(2015\)](#) must be first mentioned. Using CORINE Land Cover and Urban Audit data for two distinct time periods: 1990–2000 and 2000–2006, authors measured land use changes and the occurrence of urban sprawl around major cities of five CEE countries. They found increasing rates of land consumption in the investigated period despite declining population figures. They also found that cities of the former German Democratic Republic began to sprawl already in the early 1990s, much before than cities of other investigated countries (i.e. Poland, Czechia, Slovakia and Hungary). Similar changes only became visible in other CEE countries later, during the 2000s. This finding somehow contradicts other authors (see e.g. [Kovács & Tosics, 2014](#); [Pichler-Milanović, 2005, 2014](#)) who reported accelerated suburbanization already during the 1990s around other non-German cities in the region.

Based on different space-time GIS indicators [Garcia-Ayllon \(2018\)](#) analysed changes of the spatial configuration of five representative capital cities in post-socialist CEE: Warsaw, Budapest, Prague, Bucharest and Sofia. He found that the abrupt adaptation to capitalist market rules and the application of neoliberal planning principles generated vast urban sprawl around the investigated cities that have been excessively unplanned and unbalanced. The consequences of the suburbanization phenomenon have been especially prevalent in Budapest and Sofia, producing chaotic and diverse suburban landscape that is characterized by old and new suburbia, later includes gated communities (‘bedroom’ communities) of elites, thriving shopping centres, office parks and many other built forms. Sprawl as dominant socio-spatial process in the larger urban zone (LUZ) of Budapest was also pointed out by [Reckien and Karecha \(2007\)](#) who investigated the population dynamics of 258 large and medium sized cities within Europe between 1991 and 2001. Authors noted that sprawl was exacerbated by population shrinkage at the metropolitan region level, which hit the core-city especially hard.

[Václavík and Rogan \(2009\)](#) applied remote sensing techniques (landsat images) in order to assess and quantify land use/land cover changes (LULCC) in the greater Olomouc region in the Czech Republic

for the period of 1991–2001. According to their findings urbanized areas increased by 2% in the study period due to low-density urban sprawl. They note that the speed of land conversion was significantly lower than in some Western European countries (i.e. Germany, France) and it took place mainly at the expense of intensive agricultural use in the vicinity of major cities of the region. Based on land registry data [Šveda and Vigasová \(2010\)](#) analysed land use changes in the hinterland of the largest Slovak cities, with > 50 thousand inhabitants. Data referred to 847 municipalities in the functional urban regions (FUR) of eleven cities for the period of 2000–2008. According to highly accurate data the most extensive changes in land use occurred in the category of built-up areas in the monitored FURs. The extent of built-up areas increased by 5.66% due to suburbanization causing a series of spatial and environmental conflicts.

An alternative method for identifying urban sprawl around major Polish cities was used by [Lityński \(2016\)](#) who based his analysis on local data of the Central Statistical Office of Poland and Google Earth. The level of urban sprawl was calculated for 2011 according to five indicators: density, continuity, concentration, clustering and centrality of built-up areas for surrounding municipalities of Poznań, Łódź, Wrocław and Kraków. The degree of sprawl was contrasted with local economic performance. According to his findings smaller degree of urban sprawl is accompanied by higher levels of local economics. [Grigorescu et al. \(2012\)](#) measured the spatial-temporal dynamics of land cover changes in the metropolitan areas of four Romanian cities (Bucharest, Constanța, Iași and Oradea) with the combination of topographic maps, aerial photographs and satellite images. Their study revealed significant changes between 1990 and 2006, where the main trend was the conversion of arable land to urban, industrial and commercial uses, especially in the proximity of the core-cities, and around the capital city Bucharest.

All these studies suggest that land conversion due to suburbanization became a hot issue in post-socialist countries. However, common in these studies that they focus on land use changes exclusively in the post-socialist era and they do not assess changes over a longer time span what would enable the comparison of changes in the socialist and post-socialist periods. They also miss deeper analysis of the governance aspects of urban expansion that would improve our understanding of the driving forces and their relationships. Therefore, the main goal of this study is to analyse and assess the spatial and temporal changes of land use in the wider metropolitan region of Budapest in a historical perspective shedding light on the role of different drivers during socialism and after.

### 3. Research design and methodology

#### 3.1. Study area

Budapest is the symbolic heart of Hungary as far as its political, economic, and cultural functions are concerned ([Egedy, Kovács, & Kondor, 2017](#)). As a gateway of the country, more than one third of the national GDP is produced in the city, and nearly half of the foreign direct investment arriving into the country after 1989 was realized here. The city was affected by intense suburbanization after 1990 ([Brown & Schafft, 2002](#); [Kok & Kovács, 1999](#); [Kovács & Tosics, 2014](#); [Tosics, 2006](#)), and the boundaries of the functional urban region have shifted outwards from the urban core. Government Decree 89/1997 identified the so-called Budapest Agglomeration with Budapest and 78 independent settlements, but this delimitation became outdated very soon due to excessive suburbanization and urban expansion. In the light of this, we defined our case-study area, the BMR, as a region consisting of central Budapest and 185 surrounding suburban municipalities in which at least 15% of the working population were employed in the city on the eve of the 2001 census. In the delimitation of functional urban regions, the 15% travel-to-work threshold has been applied by [EUROSTAT \(2016\)](#) and it is also used by the literature on post-socialist cities

**Table 1**

Main socio-economic indicators of the Budapest Metropolitan Region (BMR).  
Source: National Censuses 1990 and 2011.

	Census 2011	Ratio within Hungary (%)	Change of share 1990–2011
Surface area (km <sup>2</sup> )	6077	6.5	–
Total population BMR (thousand)	2880.10	28.98	+1.05
Budapest	1729.04	17.39	–2.07
Metropolitan region	1151.06	11.59	+3.13
Population 0–15 (thousand)	404.33	27.92	+2.55
Number of jobs (thousand)	1239.20	33.44	+3.86
Budapest	917.026	24.75	+0.71
Metropolitan region	322.174	8.69	+3.15
Number of dwellings (thousand)	1347.15	30.68	+2.00
Number of daily commuters (thousand)	383.577	28.36	+2.82

(see Leetmaa et al., 2014; Szabó, Szabó, & Kovács, 2014).

The Budapest Metropolitan Region (BMR) constitutes a single, large functional spatial organization covering a total area of 6077 km<sup>2</sup>. On the eve of the last census (2011) nearly 60% of commuters living in the suburban zone worked in Budapest, and 52% of commuters residing in Budapest worked in the suburban zone. Table 1 summarizes the most important socio-economic indicators of the BMR. Occupying 6.5% of the territory of Hungary the study area is the home of nearly 30% of the country's population. Since 1990 the weight of BMR has clearly increased within the country as it has absorbed a large share of new residential, commercial and industrial developments. As a consequence, in 2011 already 33% of the jobs in Hungary were concentrated in the BMR, being mostly well-paid jobs in a competitive service economy. Due to suburbanization the share of Budapest's core city has decreased from 70% to 60% within the metropolitan region since 1990.

### 3.2. Data sources

Since the main aim of this study is to assess land cover changes on a longitudinal basis we had to combine different methods and data sources that are difficult to compare. First, the 1959 military-surveyed topographic map of 1:10,000 was interpreted for the case-study area and transformed into GIS vector data with on-screen digitizing in ArcGIS software. Basis of interpretation was the „Mapping Guide for a European Urban Atlas” (EU, 2016) which provided the framework for a standardised database that is compatible with the Urban Atlas maps. The raster map provided sufficient basis for the identification of urbanized areas (both residential and industrial) with high accuracy, however, agricultural land, forests and semi-natural land use categories could not be precisely differentiated.

Land use data for 1990 were obtained from the EEA's Corine Land Cover programme (CLC 90), whereas for 2012 the European Urban Atlas was used, in order to maximize the comparability with the digitized topographic map. The two datasets are very similar especially in data collection and interpretation methods, but they have different land cover classes and spatial resolution (Mucsi et al., 2017). False transformations could occur due to the following differences:

- different resolution and geographical accuracy;
- different classification systems;
- different interpretations of the same categories;
- earlier (or later) categorization mistakes.

Since these false transformations could have seriously hindered the identification of the real land use changes the two databases had to be harmonised. To minimize errors, the same person carried out interpretation and delineation of land-use polygons for each map. Harmonization followed previous practices described in the literature (Salvati et al., 2013) and it consisted of the following steps:

- 1) Correction of the artificial surfaces of the CLC 90 with the use of CLC

50 and CLC Change 1990–2000 databases. The CLC 50 is an additional Corine Land Cover database for Hungary. It is based on satellite image from 1998 to 1999 and has a better spatial resolution than the CLC 90, which made it ideal for geometric corrections.

- 2) Correction of the artificial surfaces of the CLC 90 with the use of Urban Atlas 2006 database. To achieve a better comparability, we refined the results with the use of the Urban Atlas 2006. With the use of the earlier Urban Atlas, false transformations caused by mismatches in geometry could be completely eliminated.
- 3) Reproduction of the urban density categories of the Urban Atlas for 1990. In the Urban Atlas nomenclature the ‘Discontinuous Urban Fabric’ category is divided into four subcategories according to percentages of soil sealing. To achieve similar subcategories for the CLC90 dataset we used normalized difference vegetation index (NDVI) data derived from Landsat satellite images, which was also used in the mapping process of the Urban Atlas datasets (EU, 2011) and partly analogous solutions were applied for this problem by other authors too (e.g. Akay & Sertel, 2016; Gangkofner et al., 2010; García, Pérez, & Guerra, 2014; Kampouraki, Wood, & Brewer, 2006).
- 4) Replacing the agricultural and natural land cover categories of the Urban Atlas with the Corine Land Cover 2012 categories. Unlike with artificial surfaces, in the case of the agricultural and natural surfaces, the Corine Land Cover categories are more specific, so we used the CLC 2012 database to overwrite the non-artificial surfaces of the Urban Atlas.

Using this method we were able to delineate new urbanized surfaces that emerged during 1959–1990 and 1990–2012. Furthermore, delimited urbanized patches were divided into two categories: residential and industrial. For the sake of analysis of long-term land use changes we tested four possible dimensions of sprawl – density, centrality, concentration and clustering (Galster et al., 2001) – with the following indicators:

- 1) Density
  - a. Annual growth of urban fabric (km<sup>2</sup>)
  - b. Proportion of very low density urban fabric (11240) and isolated structures (11300) in total area of urban fabric (%)
  - c. Average size of newly sealed residential areas (ha)
  - d. Number of new dwellings per 1 sq km newly sealed residential land
- 2) Centrality (simplified)
  - a. Average distance of newly sealed urban land from the centre of Budapest (Adam Clark square from which all distances are measured in Hungary)
- 3) Concentration
  - a. Average distance of newly sealed urban land from each other (m)
  - b. Number of 1 kilometre square grids where new residential development occurs (The 1 km<sup>2</sup> grid system was elaborated by the Hungarian Central Statistical Office for the whole country, and

BMR is covered by 6440 grids)

4) Clustering

- a. Moran coefficient calculated for 1 kilometre square grids (the value ranges from -1 to +1 where zero means random scattering and any positive value indicates a tendency towards clustering in space)
- b. Z-score calculated in a hypothesis test to determine the significance of the Moran coefficient (a positive Z-score with a statistically significant p-value means that high or low values in a dataset exhibit spatially clustered patterns)

**4. Land use changes and urban sprawl in the study area before and after 1990**

The late 1950s is a good starting point for the analysis of long-term land use changes in the study area at least for three reasons: (1) Greater Budapest as a new political-administrative unit was created in 1950 with the amalgamation of 23 previously independent suburban municipalities with Little-Budapest. The enlarged city started to develop new spatial relations with its hinterland in this period (Egedy et al., 2017; Kok & Kovács, 1999). (2) The forceful collectivization of land was completed in Hungary by 1961 which brought about not only ownership changes but also robust migration waves from villages to cities, especially towards Budapest (Enyedi, 1996). These rural-to-urban migrants often settled on the urban fringe in single family homes of lower quality resulting land conversion (Enyedi & Szirmai, 1992). (3) As a consequence of the communist industrialization programmes the spatial pattern of economy also transformed quickly in the 1950s, new – mainly industrial – spaces were developed by the state on greenfield sites (Kovács & Tosics, 2014). All these factors had profound impact on land use changes in the BMR, yet we assume that the land cover of late 1950s is fairly representative of the conditions in the pre-socialist period.

In 1959 artificial surfaces covered 11.8% of the whole metropolitan area. It was well above 50% in the core city, but some neighbouring municipalities (e.g. Erdőkertes, Érd, Budaörs, Dunakeszi) had also similarly high values reflecting that they had already been affected by massive land conversion beforehand (Table 2).

From 1959 to 1990 the amount of urbanized land in the BMR increased by 1% annually. Over 60% of the new artificial areas were residential, whereas the remaining 40% industrial, commercial and transport. The expansion of urbanized land was especially prevalent on either side of the administrative boundaries of Budapest, however, for quite different reasons (Fig. 1). Within the city limits residential developments occurred mainly in the form of compact, high-density housing estates the so-called ‘socialist suburbs’ (Slaev et al., 2018). Within Budapest mass housing construction was launched after passing the so-called ‘15-years Housing Development Plan’ in 1960. In the subsequent decades large number of standardised dwellings were completed in Budapest mainly in the form of high-rise housing estates.

In suburban areas, residential developments also fostered land conversion. In state socialist countries people seeking a better life in large cities often had to stop at the suburbs because of registration

problems. This was also the case in Budapest where administrative measures were introduced by the communist regime in 1958. Only those got permission to settle down in Budapest who had worked and lived at least five years in the city (Enyedi & Szirmai, 1992). Many people used the surrounding suburban municipalities for residency in order to gain access to jobs and urban services in the hope that one day they could settle in the city permanently (Tosics, 2005). This process was also observed in other socialist cities (Slaev et al., 2018) and it was called ‘stepping-stone suburbanization’ by Ioffe and Nefedova (1999). Between 1959 and 1990 the area of artificial surfaces increased by 40.6% in the suburban zone and by 16.9% in the core city.

Due to methodological limitations the area of agricultural and natural surfaces could not be precisely classified on the 1959 military map, however, additional information could be gained on land use changes from the statistical yearbooks of Hungarian counties. Data indicate that the extent of vineyards and arable land radically, and that of the grassland moderately decreased around Budapest between 1959 and 1990, while forested land expanded.

After the political changes land absorption speeded up. Between 1990 and 2012 the annual growth rate of urbanized land was 1.12% in the BMR. The total area of urbanized surfaces grew by 24.6%. This rate of land absorption is particularly impressive when compared to the modest population growth of 1.05% in this period. By contrast Slaev et al. (2018) found 23.5% growth of urbanized area in Belgrade's urban region, and 4,5% in Sofia in the years 1990–2012, with a population growth of 3.8% and 8.5% respectively. In the functional urban region (FUA) of post-socialist Prague Stanilov and Sýkora (2012) recorded 14.9% growth of built-up area between 1989 and 2008. In their study on land cover transition in the Olomouc region (Czech Republic) Václavík and Rogan (2009) identified an increase of 2% of urbanized land between 1991 and 2001. This means that irrespective of the demographic factors land cover changes around Budapest were more robust compared to other post-socialist city regions. The rate of urban expansion was 7.6% in the core city and it was 34.2% in the suburban zone (Fig. 2).

Next, we examine the spatial features of newly sealed patches to test the presence of sprawl. As shown in Table 3 the annual growth of urbanized land increased after 1990 and the size of patches and their residential density decreased. The degree of concentration became lower and indicators on clustering reflect also more random dispersal of units. Thus, our analysis confirms the growing presence of urban sprawl after 1990.

Finally, we analyse the shifts among different land use categories after 1990. The class of ‘urban fabric’ (i.e. residential areas) contributed most significantly to the expansion of urbanized land (with almost 100 km<sup>2</sup>, i.e. 42%). This was the outcome of residential suburbanization which started in the early 1990s, and its peak was at the turn of the millennium (Kovács & Tosics, 2014). The main targets of suburban migration were rural communities in the hilly areas north and west of Budapest, which offer high-quality residential environments in attractive natural settings (Fig. 3). This coincides the findings of Slavik et al. (2011) who recorded the fastest population growth around Bratislava in those hilly areas that are considered environmentally most attractive

**Table 2**  
Expansion of urbanized land in the Budapest Metropolitan Region (BMR) 1959–2012.  
Source: Military topographic map of Hungary 1959, CORINE 1990 and Urban Atlas 2012.

	Area (km <sup>2</sup> )		Urbanized land						
			1959		1990		2012		Change 1959–2012 (%)
	Area (km <sup>2</sup> )	Percentage of area (%)	Area (km <sup>2</sup> )	Percentage of area (%)	Area (km <sup>2</sup> )	Percentage of area (%)	Percentage of area (%)		
Budapest	525.20	291.04	55.41	340.29	64.79	366.25	69.73	125.84	
Suburban zone	5551.00	427.75	7.71	601.36	10.83	807.14	14.54	188.69	
Total BMR	6076.20	718.79	11.83	941.65	15.50	1173.39	19.31	163.24	

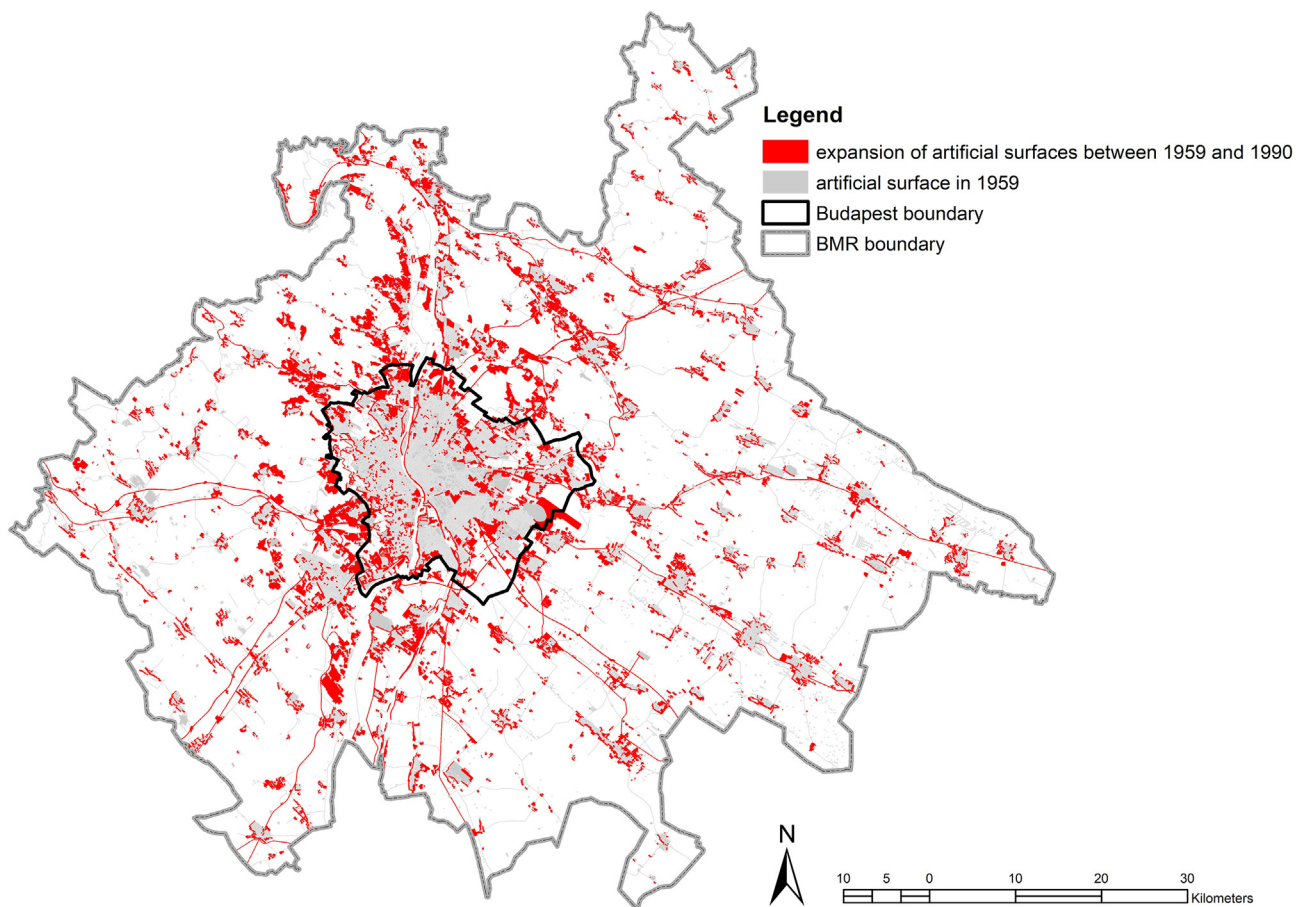


Fig. 1. Expansion of urbanized land in BMR, 1959–1990.

within the suburban zone.

The expansion of residential surfaces also gradually shifted from the core towards the periphery within the metropolitan region. In the 1990s municipalities located in the vicinity of Budapest were most affected by residential suburbanization, after 2000 the outer ring of suburban settlements became the main targets of migration. The speed of residential suburbanization started to decline after 2007–2008, partly as an outcome of the global financial crisis (Egedy, 2012).

In addition to new residential areas municipalities around Budapest have also absorbed a large share of new commercial and industrial developments since 1990 (Tosics, 2006). The suburbanization of industry and services started somewhat later than residential suburbanization. From the late 1990s it was fuelled primarily by the establishment of new industries, shopping centres, business parks, logistic and office complexes, usually located on greenfield sites (Kovács & Tosics, 2014). These new developments contributed to the rapid expansion of suburban enterprise zones and new economic clusters beyond the urban edge, especially along the M0 ring motorway and the M1-M7 intersection on the western side of the city.

Land conversion affected the various non-artificial land use categories differently (Table 4). On the one hand, the category of arable land decreased by 264 km<sup>2</sup>, and nearly 10% of the total arable land surfaces disappeared between 1990 and 2012. The proportion of vineyards and fruit cultivations as well as heterogeneous agricultural areas also dropped significantly. On the other hand, the total area of forests and grassland increased. Due to the long-term national afforestation policies (e.g. Long-term Forestation Concept in 1996, National Forest Programme since 2004), the largest increase in the share of the forested areas occurred in the Danube-Tisza Interfluvium south-east of Budapest, while the increase of the grassland areas was most notable in

the north-western and northern sectors of the metropolitan region.

## 5. Discussion

The main aim of this study was to explore long-term land use changes in the metropolitan region of Budapest, with special attention to the impacts of post-socialist suburbanization. Considering the general trends of land use changes in the BMR certain continuity can be traced in the socialist and post-socialist periods. Despite considerable decentralization of housing and jobs the average annual growth rate of urbanized land increased only moderately after 1990 (1% before 1990, and 1.12% after). On the other hand, empirical results confirmed that the focus of land conversion shifted clearly to the suburban areas due to suburbanization (1.3% annual growth before 1990, and 1.55% after the political changes). Even though data of land consumption show certain persistence over time, the mechanisms of urban expansion and the causes of land conversion differed considerably in the two epochs.

During state-socialism macro-economic and demographic factors were the main drivers of urban sprawl. The socialist state enjoyed monopoly over urban development, large-scale industrial and housing developments were allocated in urban space. One of the obsessions of state-socialist politics was the forceful development of heavy industry in order to catch up with the West (Hirt, 2013). The result was oversized industrial areas in the core city and in suburban areas (Enyedi & Szirmai, 1992). The socialist state tried to handle urban population growth by building mass housing complexes. Population growth was also fuelled by mass migration towards Budapest underpinned by industrialization and the collectivization of agricultural land. In the suburban areas large monofunctional dormitory settlements expanded, with masses of uniform and low quality housing, providing home for

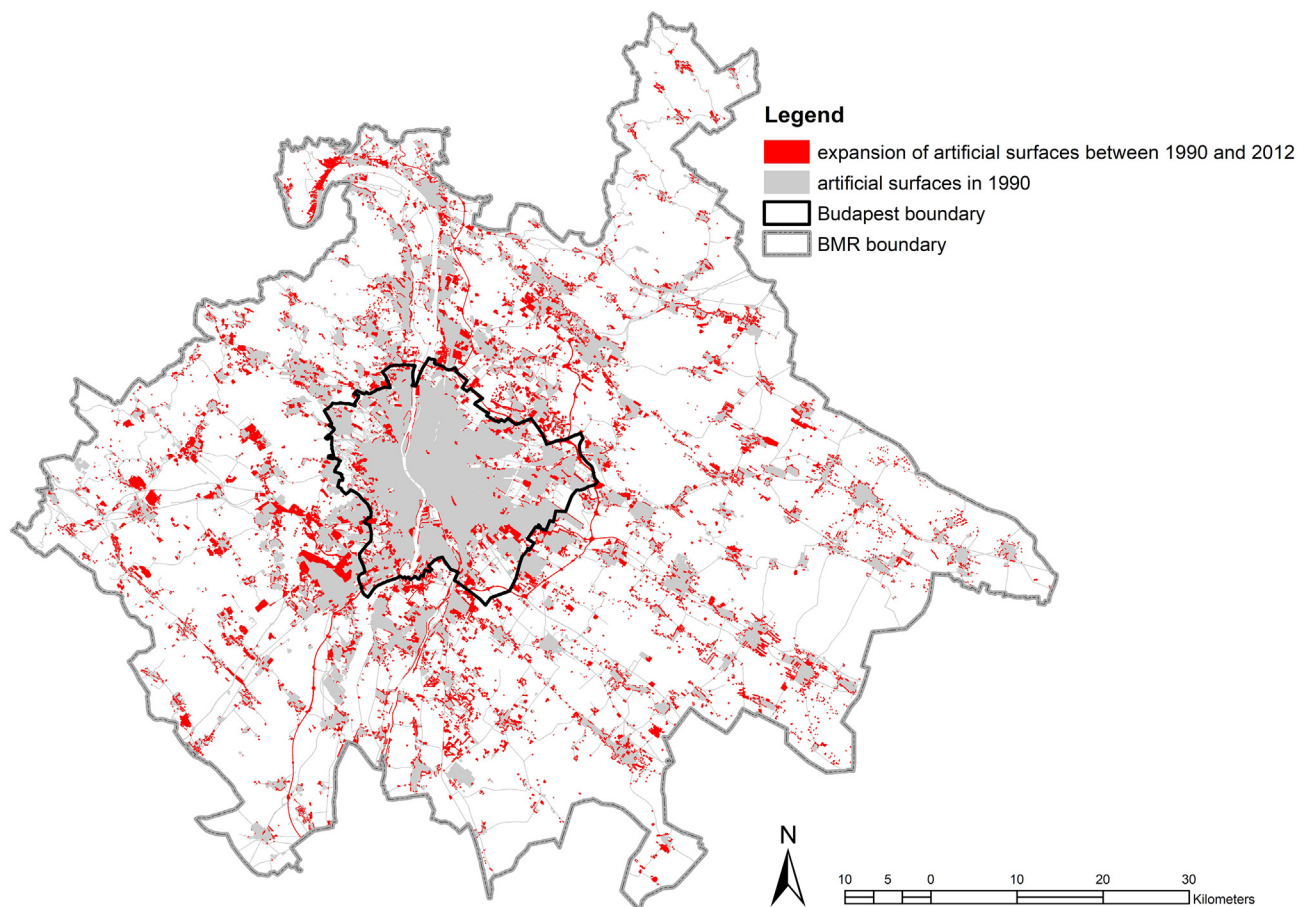


Fig. 2. Expansion of urbanized land in BMR, 1990–2012.

blue-collar workers (Enyedi & Szirmai, 1992). The growth of artificial surfaces in the suburban zone was, therefore, not the result of decentralization of people and services as in the West, but the combination of large-scale state investments in industry and housing, and rural-to-urban migration. The extension of built up areas was also fostered by the expansion of privately owned second-homes (*dacha*) from the 1960s (Hirt, 2013).

After the collapse of state-socialism the determinants of urban sprawl changed significantly. Population growth became terminated in the 1980s, the demographic factor lost its importance in urban spatial development. At the same time, the macro- and micro-economic frameworks changed completely. Centrally planned economy was replaced by market principles, the shift from state to private land ownership dismantled the obstacles of urban sprawl (Kohlheb & Kraussmann, 2009). As part of the privatization process large state owned agricultural estates were broken up into smaller plots and land

was transferred to private persons. However, large part of the new landowners could not, or did not want to continue agricultural activities. Thus, the privatization of land induced the mass conversion of land from agricultural to residential and business uses (Kovács & Tosics, 2014).

From the late 1990s economic growth brought about increasing income and purchasing power for certain social groups, especially for the younger and better educated people. Central state subsidies also boosted sprawl when in January 2000 a very favourable housing loan system was introduced in Hungary (Pósfai & Nagy, 2017). This system made the access of the middle class to state housing subsidies easier and resulted in an upswing in new housing construction, concentrating mainly on re-zoned land (Kovács & Hegedűs, 2014). The level of car ownership rapidly increased, the number of private automobile per 1000 inhabitants grew from 239 to 335 in the BMR between 1992 and 2012. In addition, the road network around Budapest was excessively

**Table 3**  
Changes of sprawl indices in the Budapest Metropolitan Region (BMR) between 1959 and 1990 and 1990–2012.

Dimension of sprawl	Indicator	1959–1990	1990–2012
Density	Annual growth of urban fabric (km <sup>2</sup> )	2.99	4.41
	Proportion of very low density urban fabric (11240) and isolated structures (11300) in total area of urban fabric (%)	0.39	13.97
	Average size of newly sealed residential areas (ha)	1.42	1.25
Centrality (simplified)	Number of new dwellings per 1 sq km newly sealed residential land	3096	2210
	Average distance of newly sealed urban land from centre of Budapest (km)	24.3	28.7
Concentration	Average distance of newly sealed urban land from each other (m)	98.6	313.5
	Number of 1 sq km reference grids where new residential development occurs	2148	2558
Clustering	Moran coefficient	0.11	0.09
	Z-score	27.07*	26.85*

\* p-Value < 0.01.

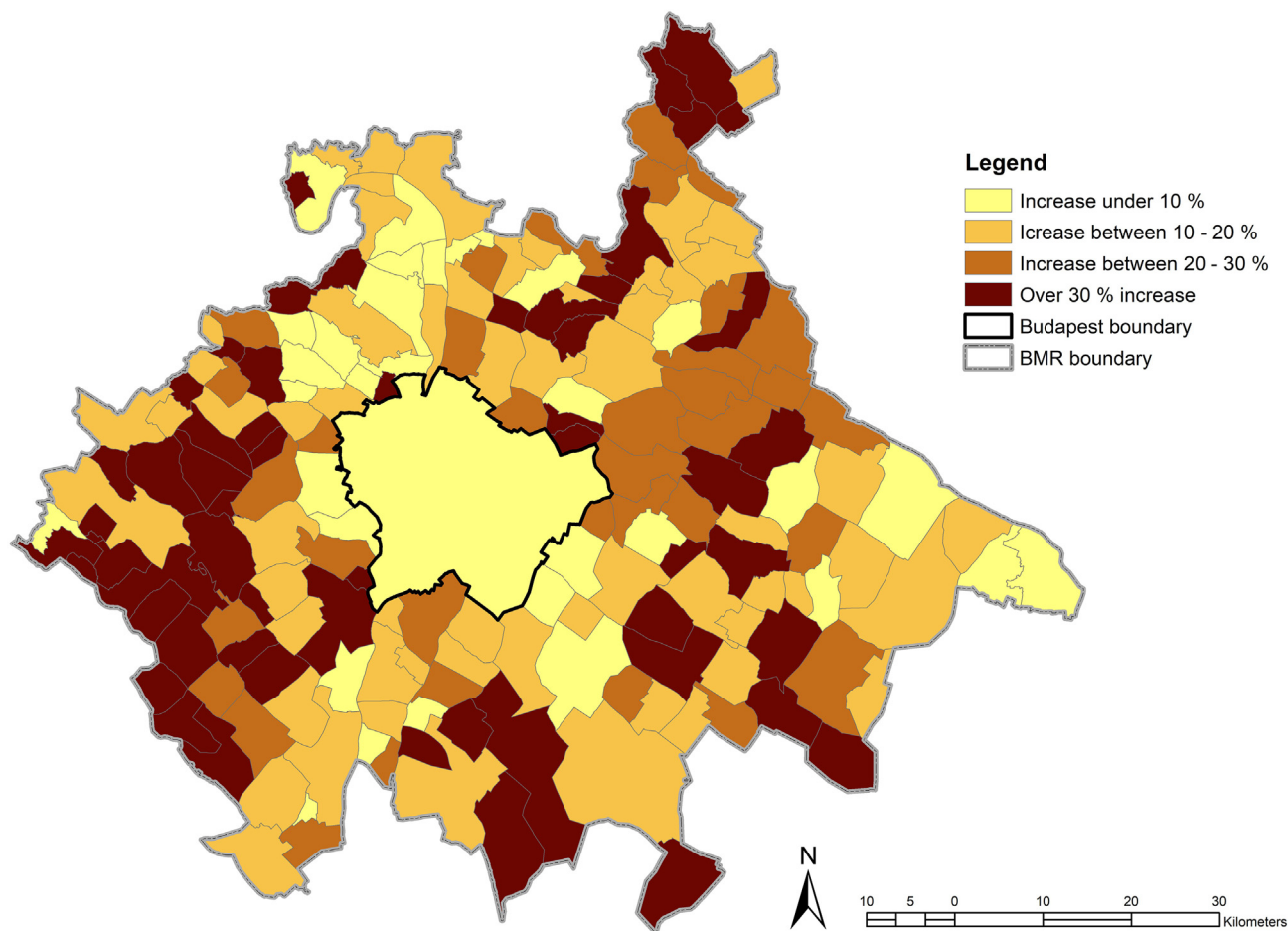


Fig. 3. Growth of residential areas in BMR, 1990–2012.

Table 4

Land use changes in the Budapest Metropolitan Region (BMR) by main categories, 1990–2012.

Source: CORINE 1990, Urban Atlas 2012.

	1990 (km <sup>2</sup> )	2012 (km <sup>2</sup> )	Change (km <sup>2</sup> )	Change (%)
Artificial surfaces	941.65	1173.39	231.74	24.61
• Urban fabric (predominantly residential)	<b>578.44</b>	<b>675.43</b>	96.99	16.76
• Industrial, commercial areas	142.17	179.52	37.35	26.27
• Transport areas	119.03	132.99	13.96	11.72
• Other artificial areas	101.99	185.43	83.44	81.81
Arable land	2857.00	2592.86	-264.14	-9.24
Vineyards and fruit cultivations	142.59	101.21	-41.38	-29.02
Heterogeneous agricultural areas	292.86	216.01	-76.85	-26.24
Grasslands	419.90	515.61	95.71	22.79
Forested areas	1295.44	1340.06	44.62	3.44
Other natural surfaces	39.23	31.48	-7.75	-19.75
Water bodies	87.53	105.58	18.05	20.62
<b>Total</b>	<b>6076.20</b>	<b>6076.20</b>	-	-

Data in bold and italics is the total surface area of the studied urban region which has not changed over time.

extended by new highway developments. On the demand side, housing preferences of Budapest's residents also changed, single family homes in peri-urban location became the dream of many (Kok & Kovács, 1999). All these factors opened the way to suburbanization and concomitant urban sprawl, similar to other East Central European countries (Bański, 2017; Bičík & Jeleček, 2009; Roose et al., 2013; Tammaru et al., 2009; Václavík & Rogan, 2009).

Among the drivers of suburbanization and sprawl changes in the regulatory environment are of great importance (Oueslati et al., 2015; Slaev et al., 2018; Stanilov & Sýkora, 2012). After 1990, the municipal system became extremely decentralized and fragmented in Hungary (Egedy et al., 2017). High degree of independence was granted to local municipalities by the new Local Government Act of 1990, thus, the central-state control over land use was almost completely abolished. On the one hand, previous top-down national policies suddenly disappeared and they were replaced by local municipal policies. On the other hand, local municipalities became interested in attracting wealthier population groups and businesses mainly in the light of increasing tax revenues (Kok & Kovács, 1999; Kovács & Tosics, 2014).

In the suburban zone, the conversion of agricultural land and private housing construction was supported by local governments not only for common financial goods, but it became a widespread phenomenon, that new landowners were elected to the local board of representatives who had direct impact on the conversion process. Under these circumstances pro-growth coalitions were set up by landowners, developers and local authorities that played a significant role in shaping the patterns of urban sprawl and metropolitan growth around Budapest (Kondor, 2016; Kovács & Tosics, 2014). Similar processes were reported from other post-socialist cities like Sofia (Slaev et al., 2018; Stanilov & Hirt, 2014), Warsaw (Lisowski et al., 2014), Belgrade (Slaev et al., 2018) or Bratislava (Šveda et al., 2016).

As far as land use planning is concerned, although the legal framework of regional and urban development in Hungary was gradually established after 1990 (e.g. Act on Regional Development and Physical Planning in 1996; Act on the Formation and Protection of the Built Environment in 1997, National Spatial Development Concept in 1998),



**Fig. 4.** Luxury villa on rezoned land in Budajenő, West of Budapest.  
Source: T. Egedy.

coordinated land use policy at the metropolitan level could not evolve (Kovács & Tosics, 2014). The development of the suburban zone around Budapest, and local policies on land use were determined mainly by the interplaying interests of local governments and investors. The robust rezoning, wasteful land conversion and suburbanization processes caused a lot of land use conflicts (Kondor, 2016), requiring some kind of new spatial regulation (Egedy et al., 2017).

After several years of political negotiations, the Act on Spatial Development Concept and Strategic Programme for the Budapest Agglomeration was passed by the Hungarian Parliament in 2005. In this legal document, the borders of the settlement areas, which could be built in the future, were designated precisely. Although the legal regulation seemed to be a significant achievement, the act only legalized the existing situation and it had little effect on the real processes. Due to fear of new legal rules, a number of local governments around Budapest hastily rezoned vast, mainly agricultural land into potential built-up area before 2005, and this rezoning was already incorporated in the act (Fig. 4.). Although the size of land for potential development was slightly reduced in the amended concept in 2011, ca. an additional 250 km<sup>2</sup> vacant land is still available for future development, i.e. approximately the same amount of land that was consumed between 1990 and 2012.

A vast literature has documented the socio-economic effects of suburbanization and urban sprawl in post-socialist cities (Hirt, 2007; Leetmaa et al., 2009, 2014; Leetmaa & Tammaru, 2007; Ouředníček, 2007; Slaev et al., 2018; Stanilov & Hirt, 2014). The invasion of younger, better educated, and more affluent families into the suburbs has also resulted in significant changes in the social and demographic makeup of Budapest's suburban communities. Census data indicate that between 1990 and 2001 the proportion of people with a college degree living in the suburban zone has increased from 3.2 to 12.7% (Kovács & Tosics, 2014). At the level of municipalities suburbanization led to greater socio-spatial segregation which was articulated in new upscale residential forms (e.g. gated-communities) strongly dividing the society of the once modest villages around Budapest (Kovács & Hegedűs, 2014).

The list of negative environmental consequences of urban sprawl is also evident. Among the general impacts we can mention land abandonment, the loss of prime agricultural land, the fragmentation of natural habitat.

In his study on local conflicts in 12 municipalities around Budapest Kondor (2016) found that about one third of the 686 instances recorded by protocols of local governments between 2013 and 2015 was related to the natural environment (e.g. unauthorized construction, illegal



**Fig. 5.** Illegal waste disposal in Pomáz, North of Budapest.  
Source: T. Egedy.



**Fig. 6.** High-density unauthorized housing construction in Pomáz, North of Budapest.  
Source: T. Egedy.

landfill and waste disposal etc.) and could be linked with suburbanization (Figs. 5 and 6).

One of the devastating outcomes of suburbanization and sprawl is commuting. Due to the spatial splintering of urban functions, the growing decentralization of people and jobs daily commuting increased by 38% in the BMR between 2001 and 2011. This has brought about increasing congestions along the main radial roads of Budapest (see Baji, 2018), with a series of negative economic (e.g. wasted work time) and environmental (e.g. carbon-dioxide emission) consequences. As Kovács, Szigeti, Egedy, Szabó, and Kondor (2017) pointed out in their study not only the volume and average distance of daily commuting increased in the BMR between 2001 and 2011, but also the share of vehicles using fossil fuel (private car and bus), all these resulting in 32% higher carbon footprint per journey in 2011 as compared to 2001.

## 6. Conclusions

Land use conflicts due to urban sprawl and rural restructuring have clearly intensified worldwide (Da Silva Machado, 2017; Haase & Nuissl, 2007; Zhao, 2017). This is certainly true for post-socialist cities which arrived at the second stage of urbanization in the 1990s, when spatial development became characterized by mass movements of people and

jobs from the core-cities to the suburbs generating excessive urban sprawl (Hirt, 2013; Ianos et al., 2012; Schmidt et al., 2015; Stanilov & Sýkora, 2014). The main questions posed at the beginning of this paper were: Did Budapest remain really a compact city during state-socialism? How has suburbanization transformed the land use in the urban periphery since the transition? What have been the main causes of urban sprawl? What have been the main socio-economic and environmental consequences of urban sprawl since the change of regime?

This study has clearly demonstrated that urban sprawl in the metropolitan region of Budapest started well before the political and economic changes of 1989–90. With regards land cover changes data showed that a gradual shrinkage of natural and agricultural surfaces took place already from the late 1950s. This was mainly the result of top-down policy measures affecting the location of infrastructure, industry and housing. Consequently, Budapest as a typical socialist city was not at all a compact city on the eve of transition as suggested by the bulk of the literature (e.g. Enyedi, 1996; Hamilton, 1979; Hirt, 2013; Sýkora, 2009; Szelenyi, 1996).

It was also shown by our data that after the collapse of state-socialism the tempo of land conversion speeded up, especially in the wider peri-urban zone. This was, the result of a complex interplay of socio-economic and political factors, a process driven by free choice of residents, firms, as well as national policies and local land management practices. Although agricultural and natural surfaces generally decreased in the metropolitan region in the investigated period, this affected the various land use categories differently: the extent of arable land and vineyards significantly dropped signaling the marginalization of agricultural production, whereas the total area of forests increased, thanks to state-financed afforestation programmes. These national programmes were aimed at primarily solving the problem of land abandonment that became widespread after privatization of agricultural land.

In terms of policy making we can observe a duality in East Central European countries as it has been clearly demonstrated by the case of Budapest. On the national level there is a high level of compulsive adaptation to European policies in order to access EU funds, but local lobbying, individual interests and institutionalized corruption often override the objectives of European and national strategies (Jávör & Jancsics, 2016). On the one hand, before joining the Union Hungary also accepted the recommendations of the European Spatial Development Perspective (ESDP) in 1999 which recommended that EU member states and regional authorities should pursue the concept of the ‘compact city’ in order to have better control over further expansion of the cities (Pichler-Milanović et al., 2008). On the other hand, the implementation of the EU policy document completely failed in the practice of local land management and land use planning. In order to enlarge meagre and barely available resources local governments became actively engaged in re-zoning and land conversion. Development mostly occurred alongside the least resistance–strongest lobby lane coupled with the principle of short-term political gains. This is why urban sprawl and suburbanization took place in a haphazard manner around Budapest, in accordance with the conflicting interests of different actors.

Regarding the socio-economic and environmental consequences of suburbanization and urban sprawl, our study clearly demonstrated its negative effects. The trends observed in the metropolitan region of Budapest are consistent with the findings of previous studies on post-socialist suburbanization and sprawl (Ianos et al., 2012; Leetmaa & Tammaru, 2007; Lisowski et al., 2014; Pichler-Milanović, 2005, 2014; Slaev et al., 2018; Stanilov & Sýkora, 2012; Šveda et al., 2016). Land cover data also confirmed that via urban sprawl new functions appeared in the suburban belt of Budapest after the change of regime, whereupon its monofunctionality inherited from the state-socialist past significantly decreased. The residential suburbanization starting in the early 1990s and the industrial and commercial suburbanization from the late 1990s reshaped the suburban zone of the city and the

metropolitan region has become strongly *heteropolitanized* (Gentile, Tammaru, & van Kempen, 2012). An important question for future research whether the described process of suburbanization and concomitant sprawl can be understood as the initial stage of a greater urban growth cycle model. In this model the first phase of deconcentration generates low-density growth (i.e. sprawl) in peri-urban areas. But if suburbanization slows down and infrastructure development follows strict economic efficiency principles, in the next phase higher densities are reached. This hypothesis, based upon Fee and Hartley (2011) findings in US cities, however, needs further testing.

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