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AZ URBANIZÁCIÓS FOLYAMATOK KÖRNYEZETI HATÁSAI KECSKEMÉT ÉS GYŐR VÁROSRÉGIÓJÁNAK PÉLDÁJÁN / ENVIRONMENTAL IMPACTS OF URBANIZATION PROCESSES ON THE EXAMPLES OF KECSKEMÉT AND GYŐR FUNCTIONAL URBAN AREAS

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Összefoglalás

Az elmúlt évtizedek városodási és városiasodási folyamataiban az elővárosok gyors fejlődése, valamint a városok szétterjedése – urban sprawl – voltak a meghatározó jelenségek (Tímár, 1999; Gardi, 2017; Szirmai, et al. 2011), melyek jelentős gazdasági, társadalmi és környezeti változásokat indukáltak az érintett térségekben (Kovács, 2014; Kahn, 2000). Kutatásunk alapvetően környezeti-ökológiai irányultságú, amin belül elsősorban a földhasználat/felszínborítás konverziójára és az ezzel szoros összefüggést mutató térségi demográfiai átrendeződésre helyeztük a hangsúlyt. Ennek oka, hogy a lakóterületek térfoglalása átalakítja a területhasználatot, visszaszorítja a természetes növénytakarót, adott esetben tájesztétikai problémákat is okoz (Antrop, 2004). Emellett a városok és az elővárosi területek növekedése maga után vonja a közúti forgalom intenzitásának fokozódását, amely magasabb károsanyag-kibocsátáshoz és fosszilis energia-felhasználáshoz vezet, így összességében negatívan befolyásolja a klímaváltozás elleni küzdelmet is. E rövid logikai okfejtés is mutatja a vizsgált folyamatok néhány környezeti szempontból negatív hatását, holott a városokból történő kiköltözés hátterében a zsúfolt és szennyezett levegőjű nagyvárostól való szabadulás, a természet közelsége iránti vágy, összességében a jobb életminőség iránti igény áll.

Az elmúlt két évtizedben az urbanizációs folyamatokat és következményeiket a közép-kelet-európai viszonylatban középvárosnak nevezhető magyar települések – pl. Kecskemét, Győr, Szeged – esetében is megfigyelhetjük. Jelen tanulmányban a napjainkban gyors ipari fejlődéssel jellemezhető Kecskemét és Győr példáján keresztül világítunk rá a folyamat néhány környezeti vonatkozására.

Kulcsszavak: funkcionális várostérség, környezeti hatások, szuburbanizáció, városi szétterjedés

JEL kód: Q51

Abstract

The rapid development of suburbs and the urban sprawl were decisive phenomenon in the urbanization process (Tímár, 1999; Gardi, 2017; Szirmai, et al. 2011), which has many economic, social and environmental impacts in the last decades (Kovács, 2014; Kahn, 2000). Our research focuses on the environmental-ecological aspects of the changes, mainly because it is relatively less explored but it has important lessons and consequences. While the main motivations to move out of cities are the closeness of nature and to have a better quality of life, ultimately it leads to negative environmental impacts because the growth of built-up areas, decrease in natural plant cover and the arise of landscape aesthetic problems (Antrop, 2004). Migrating out to suburbs causes intensive road traffic, which leads to bigger air pollution and greater fossil energy consumption; overall it has a negative impact on the fight against climate change.

In the past two decades, urbanization processes and their consequences have been identified in Central and Eastern Europe, such as in Hungarian cities; for example in case of Kecskemét, Győr, or Szeged. In our study, we highlight some of these environmental changes and outcomes through the examples of Kecskemét and Győr, which are characterized by rapid industrial development nowadays.

Keywords: functional urban areas, environmental impacts, suburbanization, urban sprawl

Bevezetés / Introduction

Urban sprawl is a common phenomenon both in developed and undeveloped countries in the last decades. There is a difference in the scale: while it is affecting many people for example in the USA, but in some countries the sprawl is in an initial state. For instance, in the post-socialist countries the process started with the market economy after the regime change. Now we can follow it in Estonia (Samarüütel et al., 2010), Romania (Carrière et al., 2018), Poland (Różańskaa – Zadworny, 2016), etc., and of course, in Hungary.

The rapid urban changes are challenge for spatial planning and urban development, which are often unable to control processes even in the developed countries, not to mention the least advanced ones, and so the environmental impacts are intensifying. The European, especially Eastern European researches have primarily focused on the suburban zones of the capital cities and other big cities, and paid little attention to the processes of the rural centres and areas (Bajmócy, 2012; Csapó – Balogh, 2012; Leetmaa – Tammaru, 2007; Hirt, 2007).

Over the past decade and a half, peri-urban development has enormously changed the traditional cultural landscape, land use, and settlement-functions of villages around regional centres and around many other cities in Central Europe (Székely – Michniak, 2009; Antrop, 2004). This process has intensified in the former socialist countries after the 2000's and it caused problems, which are similar to the ones Western countries had in the eighties and nineties, or USA had in the fifties-sixties.

Urban sprawl causes numerous environmental and landscape-ecological problems. Among environmental problems, international literature focuses especially on traffic-based pollution. Spreading cities are found to be suffering from increasing air pollution problem (Dulal et al., 2011). The connection between land use and transportation is driven by the distribution of activities (residential, employment, shopping areas, recreational areas, and leisure facilities) over an urban area (Wegener – Fürst, 1999). Rapid growth of cities has led to expansion in residential, employment and recreational activities.

Pollution from transportation manifests mainly as air pollution with increasing CO2 emissions along with many other gases. The statistical analysis shows that wherever sprawl occurs in the EU, it results in a strong increase of transport-related CO2 emissions. Bart (2010) found that correlation between transport CO2 emissions and the increase of artificial land area is much stronger than the correlation between CO2 emissions and GDP or population data. An increase in urban areas increases individual trip lengths, and most newly urbanised areas are fully car-dependent with no public transport. According to our previous empirical

research in the agglomeration of Győr one of the most important consequences of this process is that traffic needs growing faster than the population. The lifestyle of the suburban population (changing working time, scattered services etc.), the physical structures of the new built areas less and less allows choosing the public transport for their daily moving. The new settler families have significantly more cars than the traditional local families (Hardi – Nárai 2005). Therefore, these areas are responsible for the growth of road traffic, which increases transport realated emissions. That is why sprawl is not a climate friendly way of urban development, that cannot be eliminated by better transport policies – it needs better land use policies (Bart, 2010).

The 'compact city' concept is a kind of answer to these problems. It has been increasingly perceived as a model to reduce urban air pollution. Borrego et al. (2006) performed the air quality assessment of three idealized city structures which were created considering different land use patterns from the scenario of urban sprawl to the opposite scenario of a compact city with mixed land use. They found that compact city concept not only reduces air pollution but it has multiple benefits. A related idea is to reduce the need to travel (particularly by car), to encourage greater use of public transport (and walking and cycling), and to reduce travel distances (Banister, 2011). Besides this, Banister (2011) finds that the desire for low density car based lifestyles has become dominant. In this way, significant reductions of CO2 emissions in transport in the EU can only be achieved through behavioural change.

Many researchers (see below) are focusing on ecosystem fragmentation when examining the environmental problems of urban sprawl. Basically the history of human settlements is the story of the fragmentation of the landscape. This fragmentation is growing dramatically with urban sprawl. The process involves microclimate changes and rapid rearrangement of vegetation (Margules – Meyers, 1992). Over time, fragments will operate on the principles of island biogeography. It means decreasing number of species, growing number of individuals, impoverished vegetation and anthropogenic disturbance. Concepción and his colleagues (2016) found that the increases of ruderal plants and common generalist birds are highly related to the intensity of urban land use, whereas the spread of non-native plants was strongly related to urban dispersion.

Ecosystem fragmentation closely related to land cover changes. Many researchers agree that one of the most negative effect of urban sprawl is the land use change (Canedoli et al., 2018; Mohammady – Delavar, 2016; Dupras – Alam, 2015). These investigations of land use – land cover changes are based on GIS methods with the use of CORINE Land Cover data. In our paper we also use this method to evaluate the changes in the case of Győr and Kecskemét Functional Urban Areas.

Urban sprawl is one of the most common drivers for land use change generating a variety of impacts on natural and agro-systems. It leads to multiple impacts on land use change, including loss of sensitive natural areas and farmlands, which negatively impact the production of a wide range of ecosystem services (Dupras – Alam, 2015). In addition, land use effects on travel behaviour tend to be cumulative and mutually reinforcing (Hickman, 2007; Litman, 2007).

Johnson (2001) summarized environmental impacts of urban sprawl which have been identified in the literature. On the basis of this, the environmental impacts are the following:

- loss of environmentally fragile lands,
- reduced regional open space,
- greater air pollution,
- higher energy consumption,
- decreased aesthetic appeal of landscape,
- loss of farmland,
- reduced diversity of species,
- increased runoff of stormwater,
- increased risk of flooding,
- excessive removal of native vegetation,
- monotonous (and regionally inappropriate) residential visual environment,
- absence of mountain views,
- presence of ecologically wasteful golf courses,
- ecosystem fragmentation

From the above mentioned impacts in our paper we focus on loss of environmentally fragile lands, increasing traffic load (which has strong connection to greater air pollution) and loss of farmlands. Later on, in the future, we continue our work with investigate structural (e.g. excessive removal of native vegetation) and visual transformation of suburban settlements, together with studying the effects of lifestyle and environmental demand of the population on landscape. These results will show not only the (negative) environmental consequences but the aesthetic and social changes also.

The strength of the urban sprawl process in Hungary is not as strong as it is in the USA for example, but we can detect it in different cities. In our paper we analized land use changes around Győr and Kecskemét to evaluate transformations in the last decades. In addition, we investigated the changes in the population, which also refers to urban sprawl based on the migration balance of the surrounding settlements. We deal with the development of transport in the last ten years. The diffusion of urban expansion results in higher emissions of global warming gases,

especially CO_2, because urban sprawl eventuates in specifically higher energy use in transportation. It means, increasing traffic is one of the most serious consequences of this process.

Anyag és módszer / Material and methods

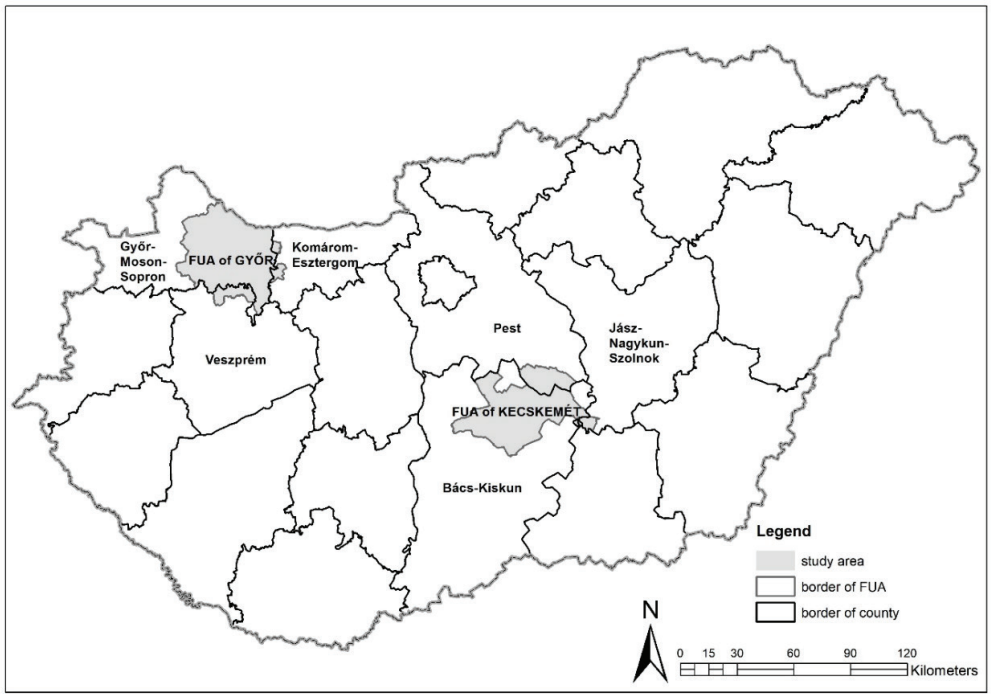
In our analysis we used the Corine Land Cover and Urban Atlas products of the Copernicus Land Monitoring Service (https://land.copernicus.eu). Corine is an acronym which means 'Coordination of information on the environment', and it is part of the European environmental monitoring system. The program started in 1985, and it provides a common methodological framework to collect and analyse environmental data. The Corine Land Cover (CLC) and Land Cover Change (CHA) datasets are available from 1990 to 2018 at five dates: 1990, 2000, 2006, 2012 and 2018. In this analysis we mainly used the CHA datasets, which have a 5 hectares minimum mapping unit, which defines the theoretical minimum area of land cover changes in the database. We also used the Urban Atlas database (UA), which has a different, urban thematic focus in land cover monitoring than the CLC. It has larger map scale, therefore higher resolution, but only available for two years: 2006 and 2012. The timeframe of our research is much longer so we used UA only to define the functional urban areas (FUA) of the analysed Hungarian cities Győr and Kecskemét. We chose this solution to ensure compatibility with UA, because when UA2018 will be released we plan to get involved it in our later analysis.

Győr is regional centre of Western Transdanubia NUTS2 region, and an automotive assembly centre (Audi and Rába) with significant university background. Kecskemét is the capital city of Bács-Kiskun County, a former agro-market town with new industrialization processes, which can be connected to the arrival of Mercedes Benz Manufacturing Hungary Ltd. in 2008. The most important data of the two FUA's are summarized in Table 1. Fig. 1. shows the base map of the two areas while Fig. 2. is the current land cover of Győr and Kecskemét FUA's.

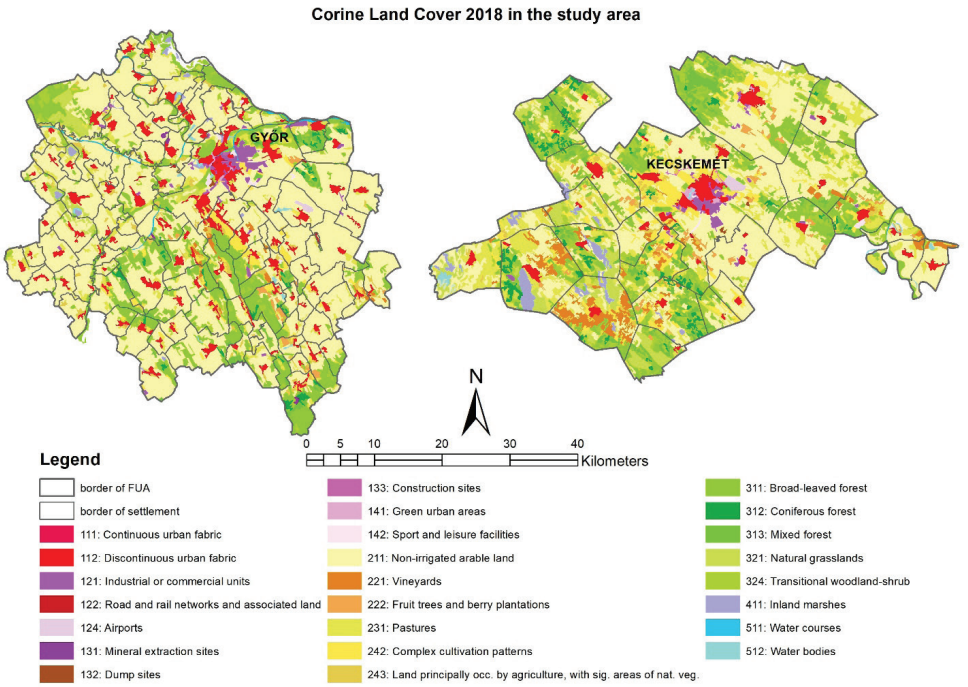
We also used demographic data in our analysis to compare them to land cover changes. The datasource of these indicators is the "National Spatial Development and Spatial Information System" (TeIR), which is managed by Lechner Knlowedge Centre. TeIR is a constantly expanding collection of databases from which we used the Hungarian Central Statistical Office census data from 1990, 2001 and 2011, and also used the yearly settlement data tables (T-STAR).

Indicators	**Kecskemét FUA**	**Győr FUA**
Total area (sqkm)	1819.49	2046.71
Population (person)	186782	251317
Population density (person/sqkm)	102.65	122.79
Number of settlements in FUA	24	93
Area of centre (sqkm)	322.57	174.62
Population of centre (person)	110638	130094
Population density of centre (person/sqkm)	342.98	745,01
Area without the centre (sqkm)	1496.92	1872.09
Population without the centre (person)	76144	121223
Population density without the centre (person/sqkm)	50.86	64.75

1. táblázat: A kiválasztott városrégiók alapadatai /
Table 1. Basic data of the selected FUA's
Forrás / source: TeIR, HCSO T-STAR, 2017



1. ábra: A kutatási terület / Figure 1. Overview map about the study area locations
Forrás: saját szerkesztés az Urban Atlas adatai alapján / Source: own construction on the bases of Urban Atlas database



2. ábra: Győr és Kecskemét Funkcionális Városrégiójának felszínborítási kategóriái 2018-ban / Figure 2. Land cover categories of Győr and Kecskemét FUA's in 2018
Forrás: saját szerkesztés CORINE CLC alapján / Source: own construction on the bases of CORINE CLC

Road traffic utilization data was also used to measure the traffic growth between the centres and suburbs. The data is available from the Hungarian Public Road Non-profit Co. (Magyar Közút Non-profit Zrt.).

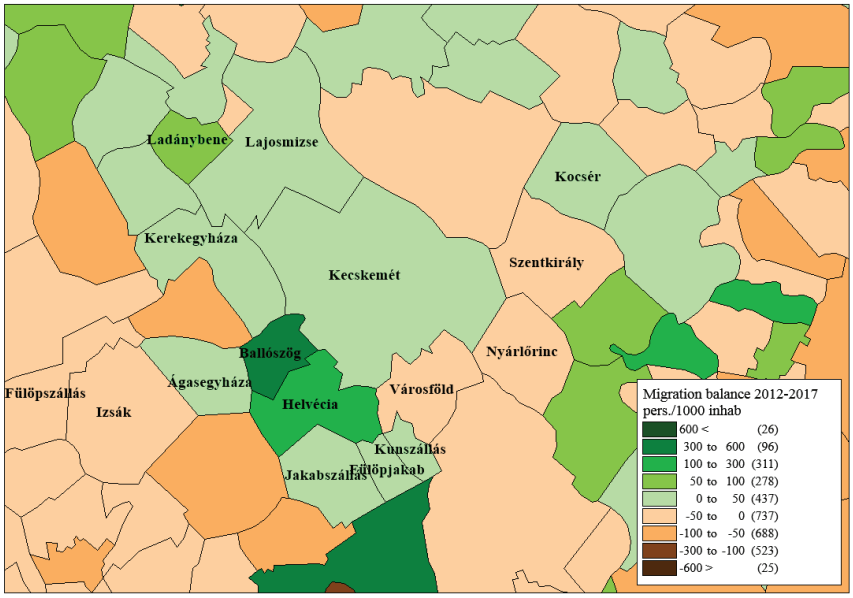
We used GIS and statistical methods in our analysis. We prepared the CLC and CHA databases in ArcGIS, which means we clip the datasets to the exact area of the two FUA's. After data export, we summarized and analysed the data in MS Excel. We also used MS Excel to statistically analyse migration and road traffic utilization data.

Eredmények / Results

The FUA of Kecskemét contains 24 settlements, while the FUA of Győr has 93 settlements. These are all administratively independent settlements, but the centre cities have some settlement parts (satellite settlements) within their administrative area too, which are basically considered to be suburbs of the central area (e.g. Kadafalva, Hetényegyháza, Katonatelep – in case of Kecskemét –, or Győrszentiván, Ménfőcsanak, Bácsa, Gyirmót – in case of Győr).

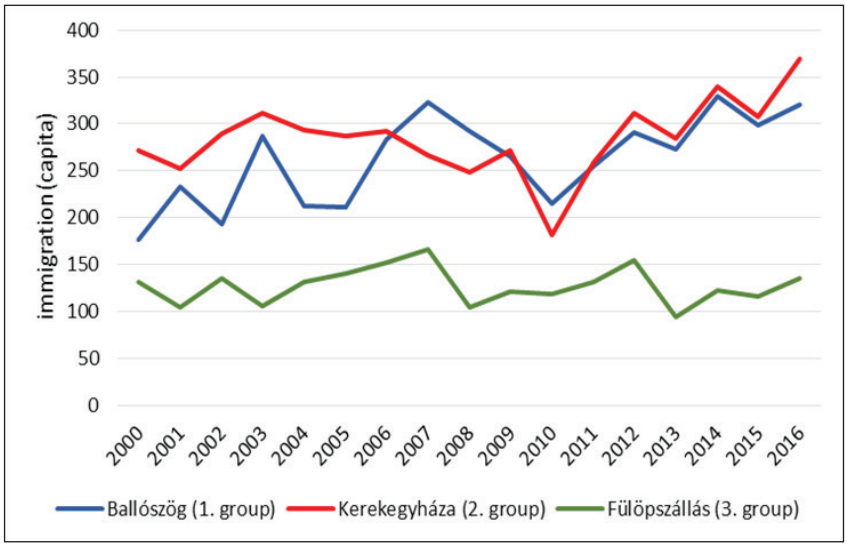
Three settlement groups can be identified in the selected Functional Urban Areas. The first one consists of settlements (some of them within the administrative boundary of the centre), which are very close or conurbate into the central city. They have rapidly growing populations because of the intensive outmigration from the centre and immigration from other areas. The second settlement group is a little bit farther from the centre, and also affected by immigration. The third group of settlements inside the FUA's has the smallest number of inhabitants and probably characterized by a decline of population.

In case of population changes, the population of the suburban zone around Kecskemét stagnated or slightly increased in the case of settlements closer to the city center, while it decreased in farther settlements between 2012 and 2017. The population of Kecskemét has increased until 2013, and since then a slight decrease has occurred. Stagnation or increase in the population primarily refers to immigration, because the demographic feature of the country is the natural population loss. Kecskemét is a classical example of suburbanisation, where the settlements closer to the centre have a relatively significant extra population on an annual basis, because of the outmigration from the centre. But there is a significant difference between Győr and Kecskemét. In case of Győr, the population growth of the villages and the urban periphery remained almost uninterrupted during the last economical crisis. Moreover, in the second half of the examined period, significant areas were built, which have been so far semi-natural or agricultural areas. This dynamic transformation was caused by migration from other parts of the country, and only partly by outflow from the city. Examples of the population changes can be seen on Fig. 3-6.



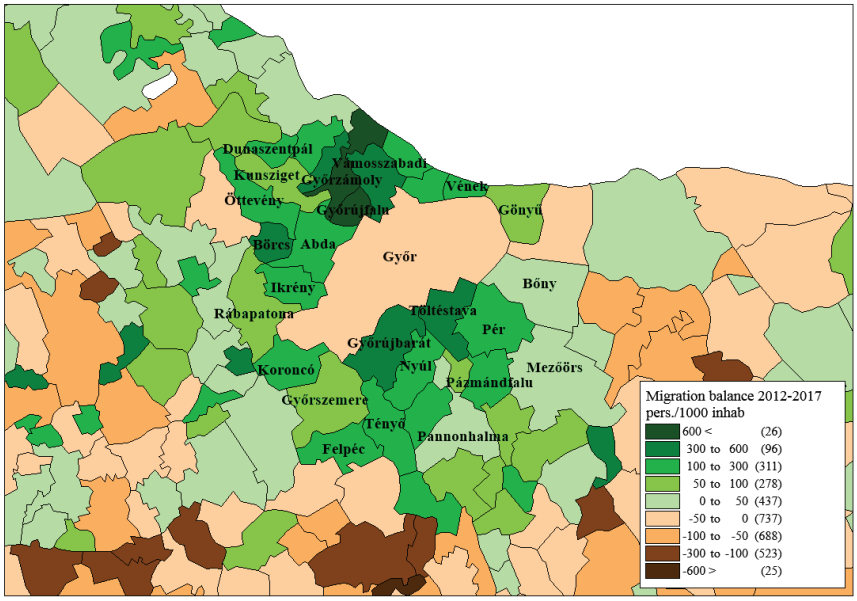
3. ábra: Kecskeméti környéki települések vándorlási egyenlege (2012-2017) / Figure 3. Migration balance of some settlements around Kecskemét (2012-2017)

Forrás: TEIR / Source: National Spatial Development and Spatial Information System



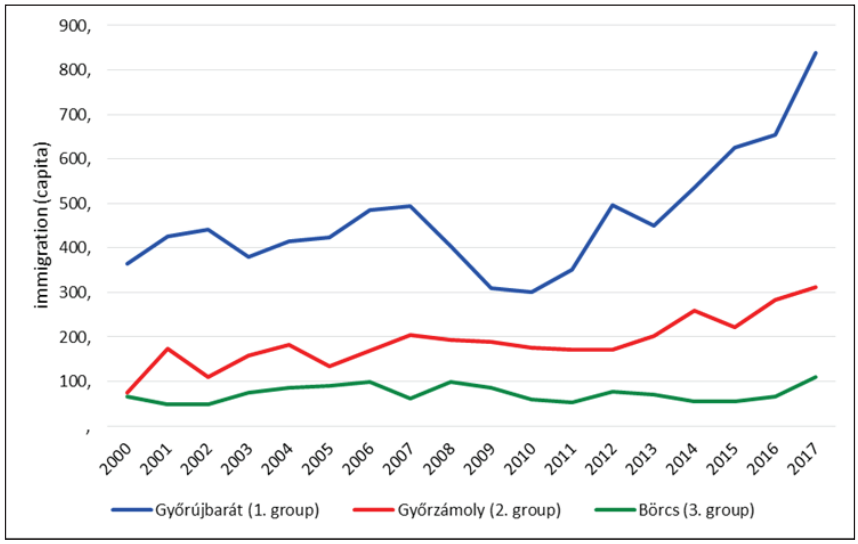
4. ábra: A három településcsoportot jellemző bevándorlási értékek Kecskemét környékén (2000-2016) / Figure 4. Immigration values typical of the three settlement groups around Kecskemét (2000-2016)

Forrás: TEIR / Source: National Spatial Development and Spatial Information System



5. ábra: Győr környéki települések vándorlási egyenlege (2012-2017) / Figure 5. Migration balance of some settlements around Győr (2012-2017)

Forrás: TEIR / Source: National Spatial Development and Spatial Information System



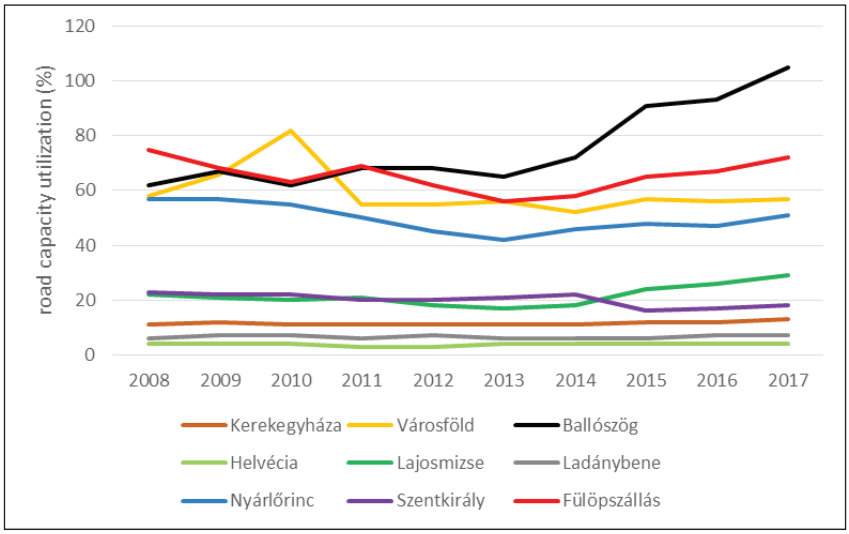
6. ábra: A három településcsoportot jellemző bevándorlási értékek Győr környékén (2000-2017) / Figure 6. Immigration values typical of the three settlement groups around Győr (2000-2017)

Forrás: TEIR / Source: National Spatial Development and Spatial Information System

In case of the migration balances, we can see relatively large differences between settlements. Especially around Kecskemét we can find settlements (e.g. Ágasegyháza) which has very high and low migration balance within one or two year. Apart from this, most of the settlements characterized by a positive net migration balance in average in the examined one and a half decades. In case of Győr, the migration balances are also changeable, but we can not find such negative values as around Kecskemét. Fig. 5. shows, more settlements have considerable migration surplus than in case of Kecskemét (e.g. Győrzámoly, Győrújfalu, Győrújbarát).

If we concentrate only to immigration values, we can see a clearer picture. We can separate the three settlements groups on the basis of the immigration, especially in case of Győr (Fig. 6.). In the first group there is remarkable immigration, particularly in the last 6-7 years. A rapid industrial growing is in the background of this process (see Mercedes-Benz Manufacturing Hungary Kft. in Kecskemét and its suppliers from 2012).

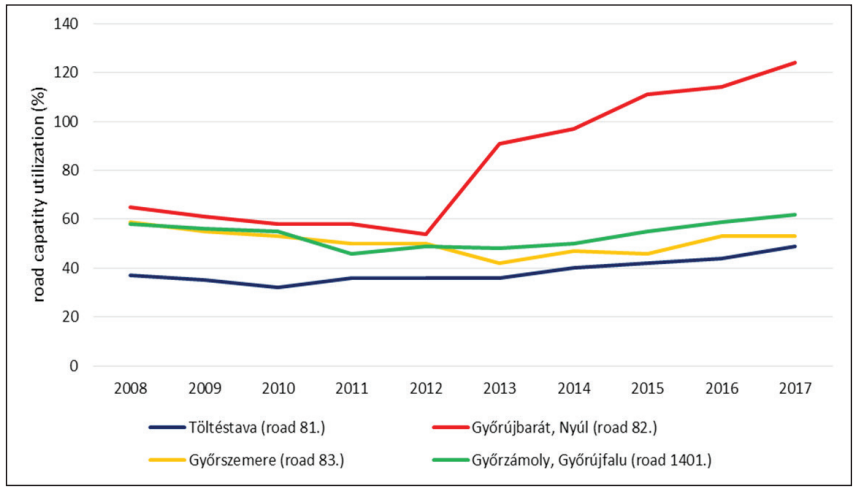
It is worth comparing demographic data with changes in road traffic. Its slight upward trend in Ballószög has been transformed into significant growth, in parallel with overcapacity in the driving route (Fig. 7.). Ballószög, which characterized by the largest immigration, and a positive migration balance every year, is also the settlement with the highest road traffic around Kecskemét – compared to the planned capacity of the road.



7. ábra: A Kecskemét környéki településekre vezető utak kihasználtsága (%) (2008-2017) / Figure 7. Road capacity utilization leading to settlements around Kecskemét (%) (2008-2017)

Forrás: Magyar Közút Nonprofit Zrt. / Source: Hungarian Public Roads Non-profit Co.

In Győr, there is also a significant increase in traffic on all introductory routes (Fig. 8.). Szigetköz direction is prominent as the most dynamic growth of the agglomeration took place along the Moson-Danube. At the same time, the vicious circle of transport can be seen: the agglomeration is growing faster along the new roads that have been built, and predictably will be more dynamic in the future.



8. ábra: A Győr környéki településekre vezető utak kihasználtsága (%) (2008-2017) / Figure 8. Road capacity utilization leading to settlements around Győr (%) (2008-2017)

Forrás: Magyar Közút Nonprofit Zrt. / Source: Hungarian Public Roads Non-profit Co.

In some cases we can see more than 100% road capacity utilization, which means, the traffic is higher than the original planned capacity. This is the situation on the road to Ballószög or Győrújbarát. In case of Győrújbarát (road Nr. 82.) we have to note that this traffic also includes traffic to shopping centers in Győr.

The land conversion data from Corine CLC shows similar changes in the two study areas. Between 1990 and 2018, the proportion of artificial surfaces in the city region of Győr has increased from 7,18% to 8,35%, in Kecskemét from 4,3% to 5,14% (Table 2. 3.).

	area (ha) 1990	area (%) 1990	area (ha) 2018	area (%) 2018
artificial	**14728,62**	**7,18**	**17044,31**	**8,35**
arable lands	129336,73	63	121488,41	59
vineyards	2775,77	1,3	957,49	0,46
fruit tree plantations	339,44	0,16	1081,82	0,5
pastures	10001,57	4,88	8970,98	4,37
other agricultural lands	7497,56	3,6	8964,65	4,3
forests	29155,31	14,2	34556,04	16,8
other nature-close areas	7627,96	3,7	8192,77	4
wetlands and water bodies	2989,61	1,46	2914,39	1,42

2. táblázat: Földhasználati kategóriák változása a Győri Városrégióban / Table 2. Land use changes in the Győr City Region

Forrás: saját szerkesztés CORINE CLC alapján / Source: own construction on the bases of CORINE CLC

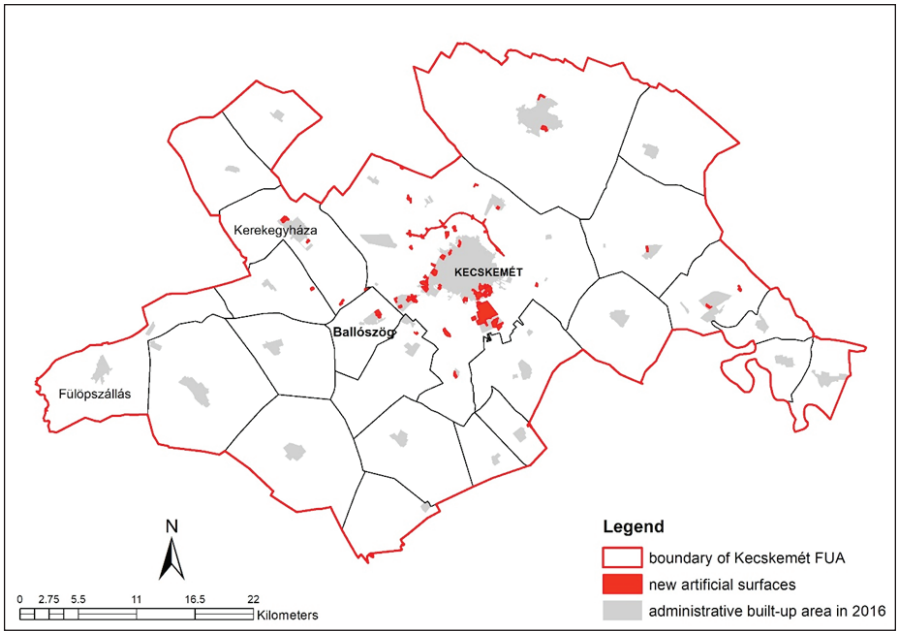
According to the CORINE database, artificial surfaces have increased at the expense of agricultural lands. Increase in artificial surfaces occurred at the expense of arable lands, vineyards and pastures. All together it means 11% decrease in Kecskemét and 8% decrease in Győr. At the same time some land use categories (mainly forests) increased because of afforestation.

	area (ha) 1990	area (%) 1990	area (ha) 2018	area (%) 2018
artificial	**7846,48**	**4,3**	**9340,37**	**5,14**
arable lands	76882,25	42,24	68426,26	37,6
vineyards	10053,18	5,5	6585,17	3,6
fruit tree plantations	4630,16	2,5	2537,31	1,4
pastures	18839,57	10,35	19856,14	10,9
other agricultural lands	17994,44	9,88	14461,37	7,9
forests	25505,15	14	35786,27	19,6
other nature-close areas	15637,42	8,6	20914,88	11,5
wetlands and water bodies	4766,95	2,6	3900,16	2,1

3. táblázat: Földhasználati kategóriák változása a Kecskeméti Városrégióban / Table 3. Land use changes in the Kecskemét City Region

Forrás: saját szerkesztés CORINE CLC alapján / Source: own construction on the bases of CORINE CLC

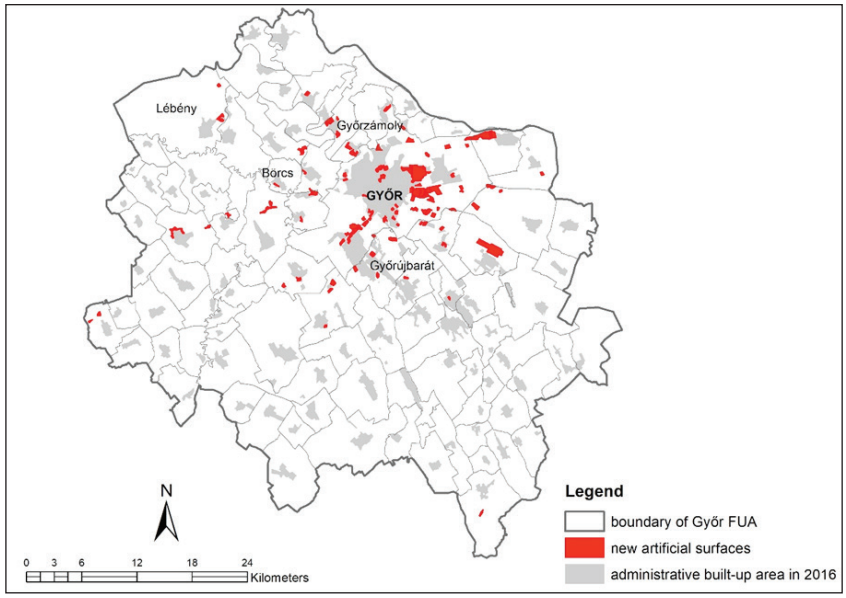
If we illustrate the changes of land use categories on maps, we can see the biggest changes close to the central cities. These changes mean not only new housing estates but infrastructural investments (new roads, industial fieds etc.) also (Fig. 9. 10.).



9. ábra: Mesterséges felszínek növekedése a Kecskeméti Városrégióban (1990-2018) / Figure 9. Increase of articicial surfaces in Kecskemét City Region (1990-2018)
Forrás: saját szerkesztés CORINE CLC alapján / Source: own construction on the bases of CORINE CLC

On Fig. 9. and 10. we can see the example settlements from the three groups. Ballószög (near Kecskemét) and Győrújbarát (near Győr) from the first group characterized by significant artificial surface growth, but in case of Győrzámoly (second group) the growth is also significant. In Börcs and especially in Fülöpszállás there was no growth in artificial surfaces. In case of Kecskemét the biggest change is the industrial area growth south of the city between 1990 and 2018 (Mercedes-Benz Manufacturing Hungary Kft. and its suppliers).

It should be noted that the annual growth rate of built-up areas in the Kecskemét City Region has decreased while in city of Kecskemét it has increased. In addition to the expansion of industrial areas, it suggests, that urban sprawl occurred primarily within the administrative boundaries of the city (in the area of attached settlements: Kadafalva, Hetényegyháza etc.). There is a similarity between Kecskemét and Győr. In case of Győr, growth is more dynamic within the city boundary – like in Kecskemét –, but the annual growth rate of built-up surfaces decreased in Győr after mid 2000's. This shows the delayed industrial development of Kecskemét and generally the south-eastern region of Hungary.



10. ábra: Mesterséges felszínek növekedése a Győri Városrégióban (1990-2018) / Figure 10. Increase of articicial surfaces in Győr City Region (1990-2018)
Forrás: saját szerkesztés CORINE CLC alapján / Source: own construction on the bases of CORINE CLC

Következtetések / Conclusions

According to the international literature, urban sprawl is a delayed process in Eastern and Central Europe, including Hungary. As a result, changes and environmental consequences are not as pronounced such as in Western Europe. However, we are witnessing striking changes, especially in some frequented settlements. The most conspicuous changes are ecosystem fragmentation, increasing traffic load (with greater air pollution) and loss of farmlands. Greater air pollution is a very harmful consequence of urban sprawl which can be managed not only by a better transport policy but by a better land use policy.

Tracking land use changes be considered one of the most important investigation in this topic. As we have seen, spectacular transformations are taking place around Győr and Kecskemét in the last decade and a half. The process is primarily driven by rapid industrial growth and the paralel demographic and transport changes have long-term consequences. Industrial growth and economic crises alternate, but the process itself is a long-lasting factor in the landscape, in the transportation and in the pollution of the environment.

The processes of urban sprawl and suburbanisation are major factors in the environmental changes of the selected cities and their FUA's in the last decades. We can conclude that the examined processes affect mainly the settlements near to the centre, or in many cases they are within the administrative boundaries of the cities. The consequences are wide-spread from the decline of green surfaces to the negative micro-climatic changes. The effects go beyond the environment and bring significant changes to both the economy and to the everyday life of local societies in various forms, such as more intensive and spatially expanding urban heat islands or increasing number of heat waves (Landsberg, 1981; Oke et al., 2017).

For the latter phenomenon microclimatic measurements are good example from Kecskemét. The data from the four measuring points operated by our institute show that daytime overheating and night cooling are similar to the city center in one of the city's most prominent expansion directions (Hoyk, 2018). Due to the dense built-in environment and increasing of the covered surfaces, the urban heat island extends towards the city boundary. This suggests that due to urban sprawl, overheating of surrounding settlements is intensifying, which means a negative microclimatic change in the future. These changes are increasingly challenging for the society; both for inhabitants and decision-makers. All these draw attention on the increasing importance of adaptation to the climate change. In order to mitigate the above mentioned negative trends, it would be desirable to handle more consciously the processes of urban sprawl and suburbanisation in the future.

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