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New Results in Surveying Landscape Character and Urban Green Areas

Zsuzsanna Illyés
Szent István University, Department of Landscape Protection and Reclamation, illyes.zsuzsanna@tajk.szie.hu

Zsófia Földi
Szent István University, Department of Landscape Protection and Reclamation, Foldi.Zsofia@tajk.szie.hu

Dalma Varga
Szent István University, Department of Landscape Protection and Reclamation, dalmavrg050@gmail.com

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New Results in Surveying Landscape Character and Urban Green Areas

Zsuzsanna Illyés, Zsófia Földi and Dalma Varga

Szent István University, Department of Landscape Protection and Reclamation

Abstract

In the framework of the project "KEHOP-4.3.0-15-2016-00001", we had the opportunity to research the particularities of urban spatial structure. The aim of the research was to define the influencing role and parameters of the urban space with regards to the landscape character. Within the research topic, we paid accentuated attention to the role of green areas in the settlements. We attempted to characterize the types of the settlements' green space system as a supplement to the above-mentioned research and analyze in five settlements.

The results show that:

- there is significant dispersion in the field of urban space; we have delimited almost 60,000 built-in patches in the country's 93,000km^2 area, while there are 3,154 administrative areas;
- the size of the built-in patches allows a close approximated grouping into functional types;
- following the Second World War, the newly built-up areas show similarities all over the country, disregarding the characteristics of the landscape;
- "central" settlements (1,474 units) are typically loosely-built, possess a high green area ratio and have a significant tree stock, and only about 6% of Hungary's territory is partly forested green space, while densely built-up areas occupy 5% of the settlement space;
- larger green areas are typically only the constituent part of cities, while in most settlements, the partially green space with stands are the characteristics of the green space system;
- the partially forested green areas of the settlements show significant differences; and can be classified into distinct types, with the character not only being influenced by the settlement's built-up structure, but also significantly by the natural spatial system in which the settlement was established, and the continued farming traditions as well as the new functions of the settlement;
- the green space of the settlement fringe areas is a principal factor in influencing the landscape character and affects the development possibilities of the green space system within the settlement.

Introduction

The development of green space system of settlements is inseparable from the area changes of settlements. The increased pace of settlement changes, in the 20th century in Hungary, was mainly driven by the rural population's flow towards the larger centres, which in most cases resulted in robust growth of built-up areas with the characteristics of detached houses. The recreational area – the era's new settlement form – similarly developed through the characteristics of garden space built-up. On the other hand, the multi-storey or densely built-up areas only cover a small zone compared to the one mentioned above. The built-up areas of the settlements mostly grew in the regions urbanizing themselves. It is in the latter, where we can observe the significant evolution in the remodelling and densification of previously traditional settlement structures. At the same time, it is a common phenomenon that looking at it from a national level's perspective, the newly built-up areas have evolved very similarly in a way which is free of local,

traditional features due to the standardization of norms. These newly built-up areas either encircle the previously developed centre of the settlements, or are positioned independently, or are in a loose connection.

According to the basic map of the research project "KEHOP-4.3.0-15-2016-00001", green space largely dominates within the settlements, whereas the proportion of densely built-up areas is very low[1]. This dominance of green space is not only due to the changes with regards to settlements following World War II, but also to the parallel happening afforestation efforts and the vegetation's spontaneous forming processes in settlements. These are tendencies that can be observed throughout the country. Based on the tendencies of change and earlier settlement traditions, we attempted to characterize the types of the settlements' green space system as a supplement to the above-mentioned research and analyse in detail five settlements.

The capital's agglomeration is the country's fastest growing area with regards to population. The considerable construction activity associated with the influx of people to the capital, also changed the settlement structure of the areas, which (traditionally used to) serve as the capital's food-supply zones. The potential growth is limited by the natural limitations and their regulations. As a result, it is not the structure of the plotted land which determines the development, but its embracing environment.

We chose our temple areas out of the moderately transformed, smaller-populated agglomeration settlements (altering settlement structures towards agglomeration), making sure they would show significant variation in their natural conditions. This choice provided an opportunity to examine the different characteristics of the green space system of settlements, more specifically the varying characteristics of the settlement fringes. Through this, we have determined new research aspects for the study of the integrated green space system's development.

Background and Literature Review

This research paper draws from research conducted within the ongoing "KEHOP 4.3.0-15-2016-00001" research project, which itself is based on international landscape character typologies[2] as well as national research[3]. To analyse the plat, we applied geographic information system methods (ArcGIS). International research[4] was conducted before developing of the settlement fringes' analysis aspects.

[1] densely built-up areas = it's a new definition used in the KEHOP project describing settlement areas, which are densely built-up

[2] Fairclough, G., Sarlöv, H. I., & Swanwick, C. E. 2018: Routledge Handbook of Landscape Character Assessment. Current Approaches to Characterisation and Assessment: Routledge.
Simensen T., Halvorsen R., Erikstad L. 2018: Methods for landscape characterisation and mapping: A systematic review. Land Use Policy, Vol. 75. pp. 557-569.

[3] Tirászi Á., Konkoly-Gyuró É. 2018: A tájkarakter meghatározás, tájtipizálás módszerei országos és nagytérségi tanulmányok alapján. Tájműhely. p.44.

[4] Alison Farmer Associates., 2018: Settlement Sensitivity Assessment, Volume 1: Landscape Fringes of Ipswich.
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Goals and Objectives

The aim of our research is to analyse the differences in the pattern of urban green space systems – related to the characteristics of urban spatial structure – in the sample of settlements located on the agglomeration periphery of the capital city. Based on available databases, our goal was to define those green space proportions, indicators which by comparing it can be determined the relation between settlements' built-up density and green space.

During analysis in the temple settlement areas, we tend to define connection between settlements and landscape, the characteristics of these connections, and the influencing role of settlement fringe areas to the urban green space pattern.

Methods

Basic map analysis

As the first step of our research, we analysed the characteristics of urban spatial structure resulted by the landscape character typology in "KEHOP 4.3.0-15-2016-00001" research project.

Analysis of temple settlement areas based on other spatial databases

We selected 5 settlements – which have similar population, but different nature characteristics – from the agglomeration urban spatial structure. In these settlements, we specified settlement fringe areas during field survey, which were treated as the basic boundary of temple settlements analysis. We sorted those elements of the basic map, that are inside of settlement fringe areas. From these generated databases, we've analysed built-up categories, green spaces in urban environment and the typically woody areas within green spaces. We've discovered nature reservation areas, which cross the central parts of these settlements. During sorting, we compared data resulted by area analysis in ArcGIS.

Additional, functional analysis of temple settlement areas

We analysed settlements' fringe areas – regarding to settlements and landscape connection – by field surveys (2018). We considered the last built-up plot/parcel and a 200 m long landscape belt from its boundary, as the settlement fringe area. In the examined belt, we've discovered built-up characteristics of these edge areas, land use types surrounding them and their green space elements. As a result, we've analysed and compared the features of settlements' connections and their green spaces.

Results

Basic map analysis - The typology of the green space of the settlement areas

According to the data of the so-called NOSZTEP plat used for the KEHOP research, the non-densely built-up settlement areas represent 5805.64 km^2. Within the settlements, the ratio between green space and built-up areas corresponds to 55% / 45% and 20.24%. Th e amount of land in the country covered by foliage is 1,175.10$km^{2,}$ which, therefore, can be seen as afforested. All things considered, we can state that looking at the forest covering the country (24,069 km^2, representing about 25.8% of the country's territory), the settlements' green areas are less significant, yet not negligible, than the first. Green space in settlements covers 6.2% of the country, while continuous settlements stands cover 1% of the country. Therefore, they can also be regarded as an important contributor to functioning of the ecosystem.

Even though the newly built-up areas show similarities, the urban spatial system can be categorized based on combining the traditional foundations/structures and the central role it plays. Based on the 6 main types identified in the research project "KEHOP-4.3.0-15-2016-00001", we highlighted the differences within the nature of the green space system of the settlement space types. **(Figure 1) (Table 1)**

The map below depicts the areas of the urban space types of Hungary. The **black** spots (Category 7) show the location and size of the built-up settlements' space. The **yellow** batches (Category 1) represent those areas which are non- or slightly affected by settlements, are rural or natural spaces. The **red** hues (Category 2-4) characterise settlement types (homestead areas, small villages and areas rich in closed off gardens) which are distinguishable due to their different density with regards to the built-up structures. Within the densely populated settlement structures, the centre style, isolated settlements are made up of small sized patches, depicted in **maroon** (Category 4). The **blue** coloured (Category 5-6) patches illustrate the currently changing, growing, urbanizing, agglomerating areas and axes. While the **darker colour** (Category 6) shows the area, which is under the influence of the big cities, the **lighter colour** (Category 5) depicts the effects of population growth on those settlements, which are smaller, neighbouring and on rather equal level to one another. We considered the map as a good starting point for our further research, as it showed a good correlation with the settlement-types delimited between the two world wars. (Figure 1) (Table 1)

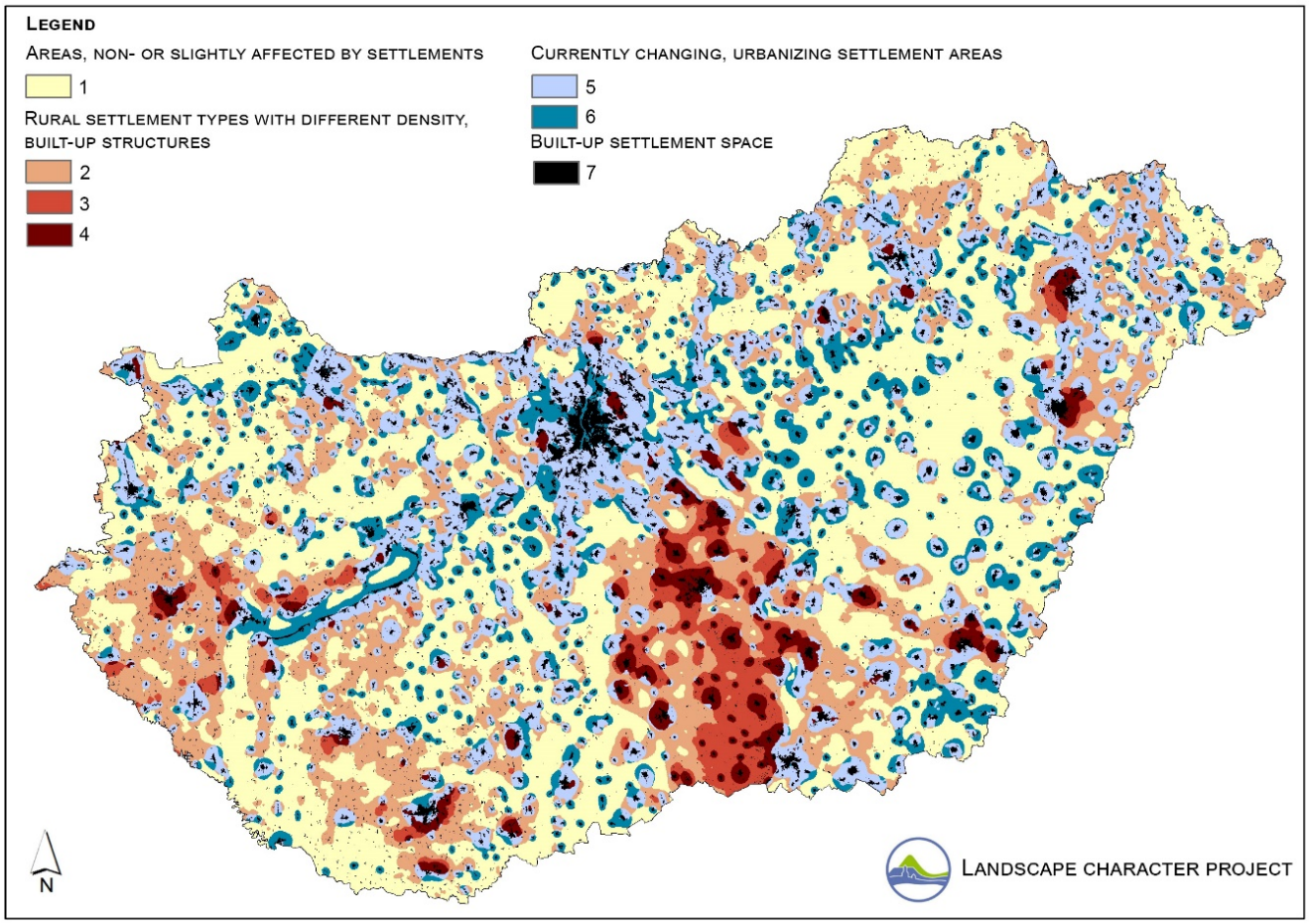


Figure 1.: Urban space types in Hungary as a result of KEHOP research project (own editing)

Category number	Category name
1	Rural, with lack of settlements, low-level built-up spatial structure
2	Transforming rural spatial structure
3	Centre lacking, dense rural spatial structure
4	Rural centres, with dense rural spatial structure
5	Transforming, agglomerating urban spatial structure
6	Centre style, with urbanely built-up, agglomeration
7	Built-up settlement space

Table 1.: The typology of urban space types in Hungary as a result of KEHOP research project (own editing)

Category 1 - Rural, with lack of settlements, low-level built-up spatial structure
The rural, with low-level built-up spatial structures with a lack of settlements, is at the same time also a deficient green space system spatial structure. The green surface connections appear within the context of the use of the agricultural area.

Category 2 - Transforming rural spatial structure
In general, the transforming rural spatial structure characterizes the complex use of agricultural areas found near the developing centre areas. The area holds the mixed of heritage of the agricultural land's use of the green area and the plantations which were created for ornamental purposes in the recreational areas. In addition to the utility gardens, fruit trees and grapes, the presence of evergreen and alien, often invasive, tree stands is also significant.

Category 3 - Centre lacking, dense rural spatial structure
The centre lacking, dense rural space structure covers the areas of the remaining farmland (the so-called tanyavilag in Hungarian). From a green space system perspective, this is perhaps the most problematic spatial system. Between the dense settlements of the homesteads which have emerged, alien plantations have appeared, surrounding the traditionally forested fringes of the homesteads.

Category 4 - Rural centres, with dense rural spatial structure
Next to the development of the rural centres, the dense rural spatial system distinctively developed in flatlands and continuous arable land. The green space structure similarly preserves here the heritage of agricultural land use; however, the spatial system is characterized by much less, but patchy green surface connections. The proportion of native tree stock is low, while non-native invasive stocks also do not form a coherent system. Of outstanding importance are the plantations following the structural lines.

Category 5 - Transforming, agglomerating urban spatial structure
Transforming, agglomerating urban spatial structure in the catchment area of central settlements, with an increasing population, but with the lack of evenly distributed transport infrastructure settlements. In many cases, the green surface heritage of agricultural land use is significantly preserved, with a high proportion of utility gardens and fruit trees, and grapes. Similarly, the role of natural elements is also significant in its green spatial structure.

Category 6 - Centre style, with urbanely built-up, agglomeration
In centre style, with urbanely built-up, agglomeration, the proportion of the industrial areas is often high, just like that of urban space, while the share of agricultural land is low. On this type of settlements, we

find larger, separated green areas with forests or natural areas often obstructing the confluence of settlement spots. Ornamental plants and spontaneous tree stock development processes play a major role in the tree stock of green areas. The spatial system is strongly linked to the primary network elements of the transport infrastructure, and as a result, the green area of the transport network also plays a decisive role for this type.

Analysis in temple settlements in transforming, agglomerating urban spatial structure

In the following, we were looking for the differences in green space characteristics of settlements, which have similarly changing population, but at the same time they are in different natural environment. We relied on the data of the plat when determining the green space indexes, then, because of the importance, we further analysed the settlement fringe areas. The selected settlements belong to the transforming, agglomerating urban spatial structure. Their location and characteristics can be seen on Figure 2 and Table 2.

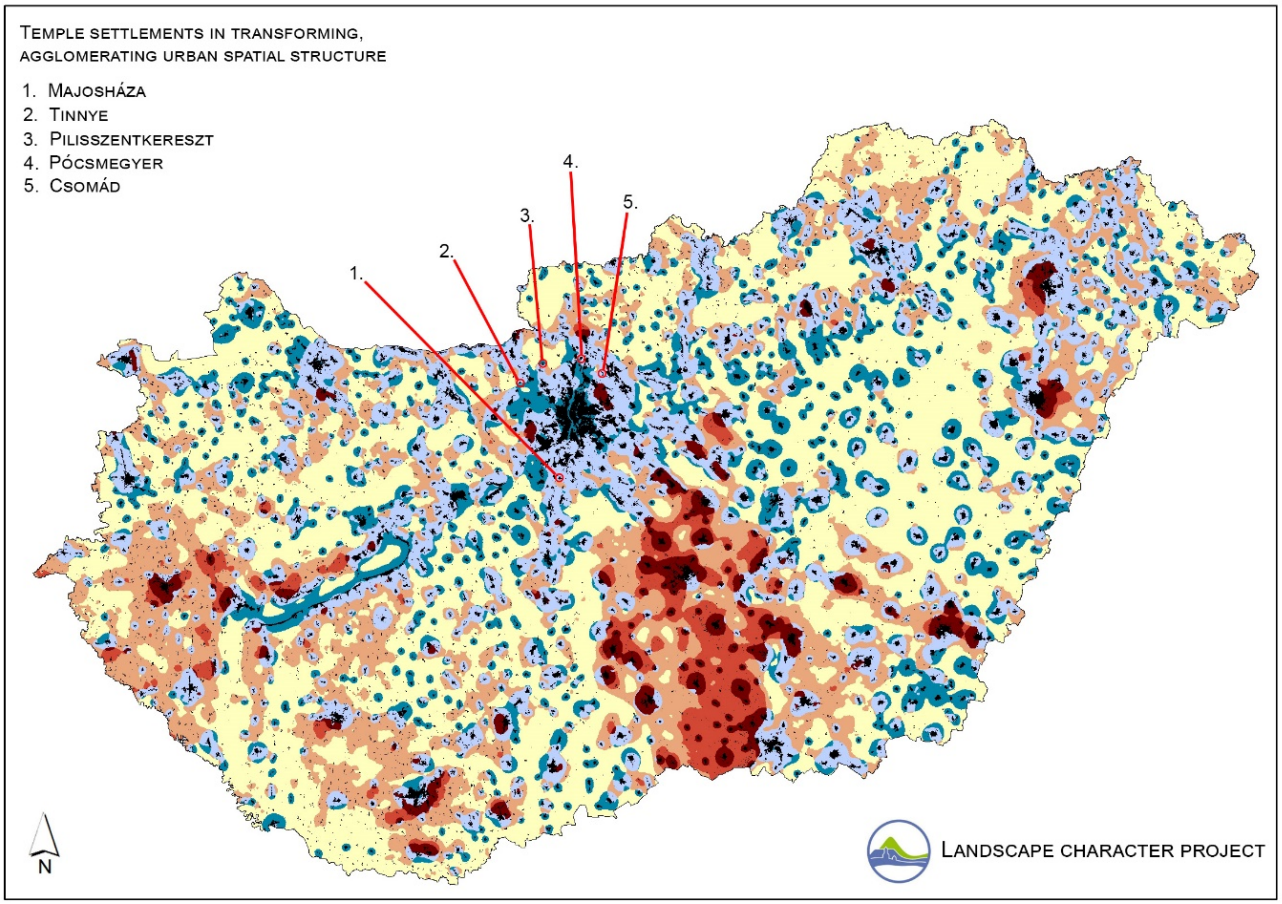


Figure 2.: Location of temple settlements in transforming, agglomerating urban spatial structure (own editing)

Settlement	Relief character	Population					
		1930	1960	1990	2018	Increase in percent 2018/1930	Increasing characteristics
Tinnye	low hill	1289	1210	1118	1758	136%	decreasing, after the change of regime
Pilisszent-kereszt	highland	1339	1820	2054	2167	162%	constant
Pócsmegyer	lowland, riverside	758	824	654	2450	323%	after the change of regime
Csomád	low hill	885	785	733	1631	184%	after the change of regime
Majosháza	lowland, riverside	750	858	1048	1676	223%	constant, accelerated after the change of regime

Table 2.: Population changes in temple settlements (own editing)

Density of built-up areas and green space areas within central settlement area						
Tinnye	Central settlement area	**140,02 hectares**	Area of built-up	**11.45 hectares**	Percentage distribution	**8.18 %**
			Area of green spaces	**110.11 hectares**	Percentage distribution	**78.64 %**
Pilisszentkere	Central settlement area	**123,96 hectares**	Area of built-up	**15.84 hectares**	Percentage distribution	**12.78 %**
			Area of green spaces	**82.69 hectares**	Percentage distribution	**66.71 %**
Pócsmegyer	Central settlement area	**296,08 hectares**	Area of built-up	**19.10 hectares**	Percentage distribution	**6.45 %**
			Area of green spaces	**211.25 hectares**	Percentage distribution	**71.35 %**
Csomád	Central settlement area	**118,38 hectares**	Area of built-up	**16.76 hectares**	Percentage distribution	**14.16 %**
			Area of green spaces	**71.45 hectares**	Percentage distribution	**60.36 %**
Majosháza	Central settlement area	**156,11 hectares**	Area of built-up	**16.02 hectares**	Percentage distribution	**10.26 %**
			Area of green spaces	**85.39 hectares**	Percentage distribution	**54.70 %**

Table 3.: Density of built-up areas and green space areas within central settlement area (own editing)

Comparative analysis of central settlement areas

Within the central settlement area of chosen settlements, the green space coverage dominates, which can be related to their suburban, residential character, in some cases to their resort role. From these settlements Pócsmegyer has the largest central area, to which a high ratio of green spaces associate. In the connection between built-up areas and green spaces, Tinnye received the highest value. In case of other settlements, the green space coverage is about 50-60%. In the central settlement areas, the percentage of built-up areas are about 10% in all listed settlements, which shows a significant difference compared to national average. (Table 3)

The urban green space system can be categorized by its spatial structure in the next ways: island, ring, radial, radial-ring, zonate green space system. All of these can be the basis of primarily urban settlement structure. However, in Hungary a significant part of settlements can be characterised by other features, so analysing green space areas, we should rely on other aspects. The green space system can be analysed by its woodstock structure, character and its connection to settlements' fringes. Based on this, our results can be seen on Table 4, 5 and Figure 3.

Green space areas covered with woodstock within central settlement areas				
Tinnye	Area of green spaces: **110,11 hectares**			
	Green space areas covered with woodstock	**41,54 hectares**	Percentage distribution	**37,73 %**
Pilisszentkereszt	Area of green spaces: **82,69 hectares**			
	Green space areas covered with woodstock	**18,40 hectares**	Percentage distribution	**22,25 %**
Pócsmegyer	Area of green spaces: **211,25 hectares**			
	Green space areas covered with woodstock	**118,59 hectares**	Percentage distribution	**56,14 %**
Csomád	Area of green spaces: **71,45 hectares**			
	Green space areas covered with woodstock	**7,76 hectares**	Percentage distribution	**10,86 %**
Majosháza	Area of green spaces: **85,39 hectares**			
	Green space areas covered with woodstock	**12,93 hectares**	Percentage distribution	**15,14 %**

Table 4.: Green space areas covered with woodstock (own editing)

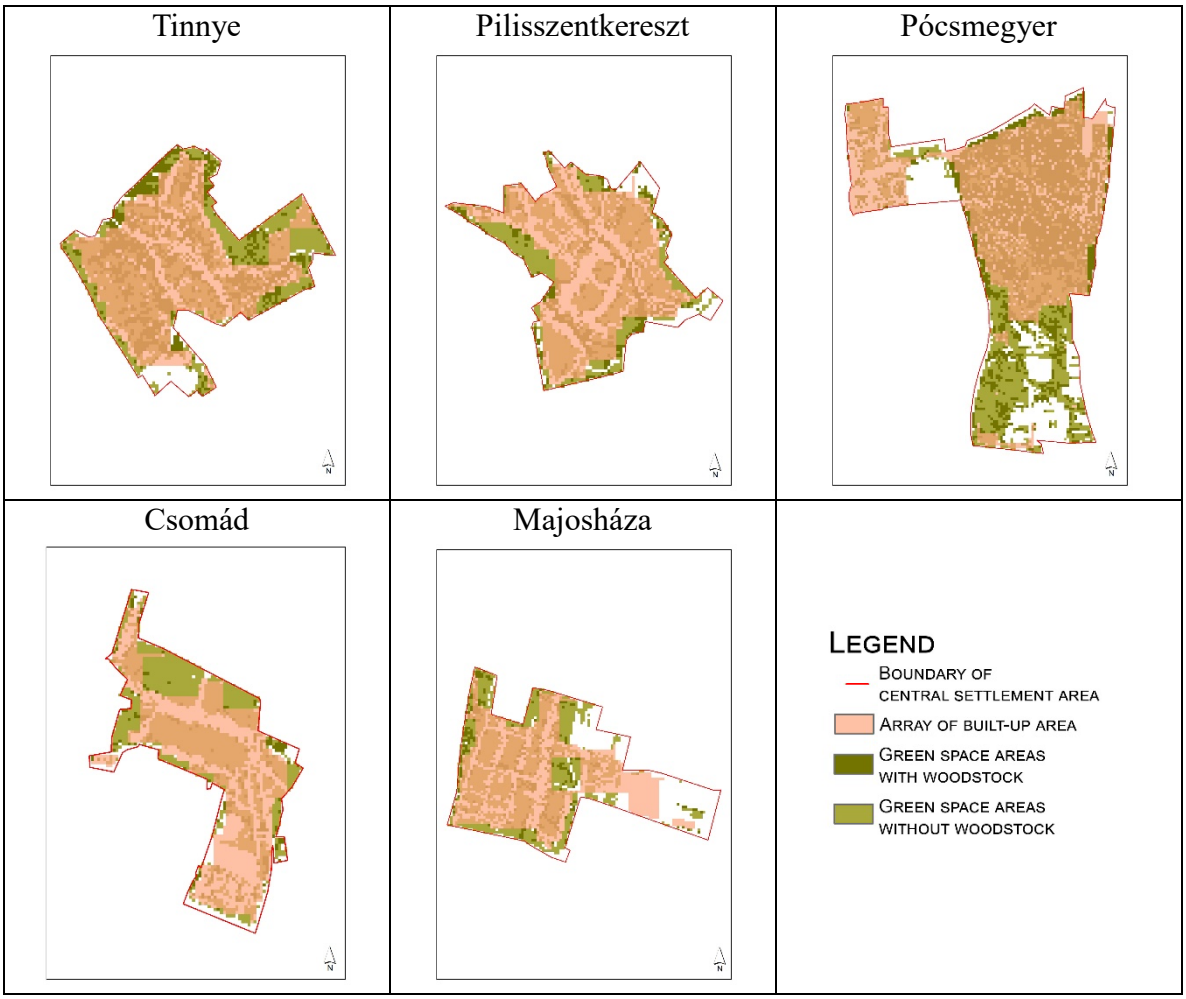


Table 5.: Green space areas within the boundary of central settlement areas (own editing)

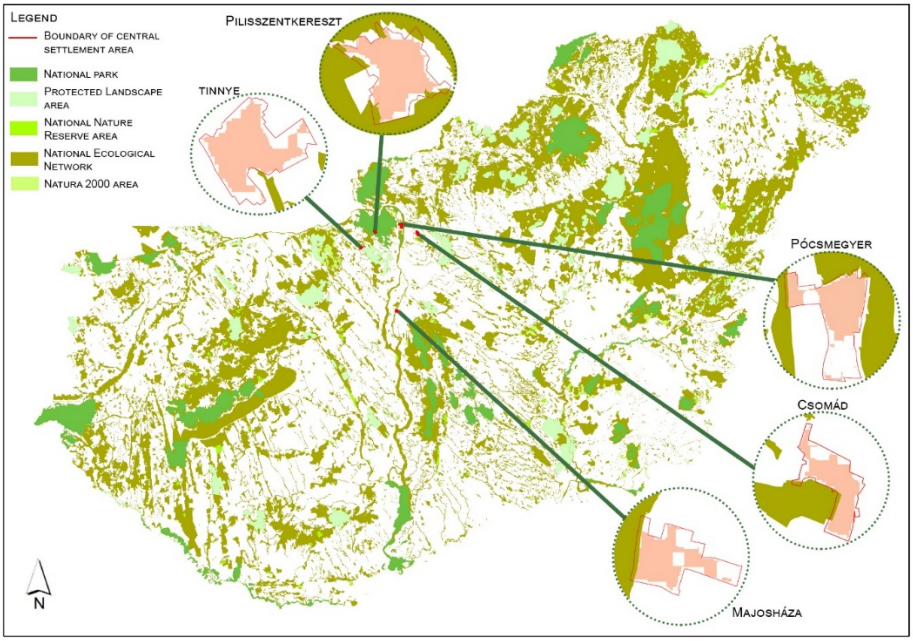


Figure 3.: Areas under nature reservation within central settlement areas (own editing)

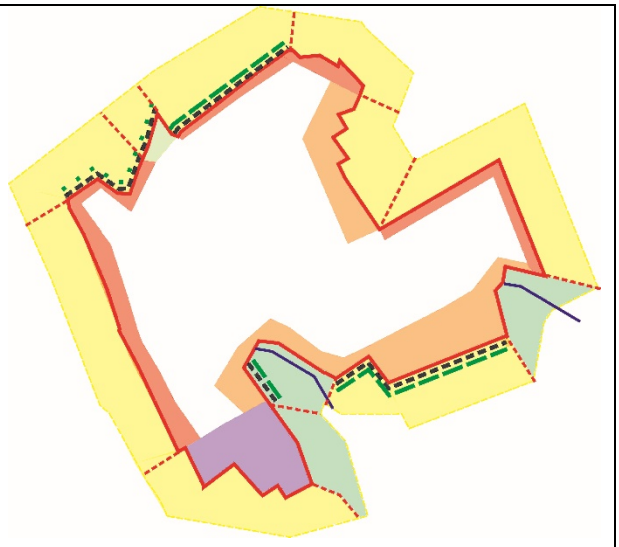
It can be seen that the area of green spaces covered with woodstock change on an altering scale: 10-56%. Based on structural features, the following types can be determined:

- Woodstock flocking inside urban spaces – Tinnye
- Uniform covering woodstock inside urban spaces – Pócsmegyer
- Low woodstock covering inside urban spaces – Majosháza, Csomád
- Along riverside, linear woodstock inside urban spaces - Pilisszentkereszt

A comparative study of settlement fringes

In the five sample settlements, 65 fringe sections can be delineated based on the varying connection characteristics, which themselves can be subdivided into 33 different patterns.

residential/ detached houses		**arable**	**37%**
residential/ detached	road trees	arable	11%
public green area	road	arable	3%
residential/ traditional		arable	12%
residential/ traditional	road	arable	11%
residential/ traditional	creek	grassland semi-nature	5%
residential/ traditional	road forest belt	grassland semi-nature	2%
industrial		grassland semi-nature	7%
industrial		arable	12%

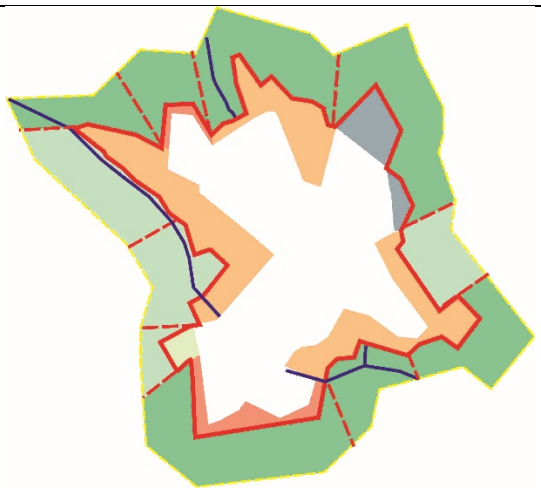


land use legend see below **(Figure 4)**

Table 6.: Connection patterns of Tinnye (own editing)

The typical connection patterns of Tinnye is: residential/detached houses - arable land.
The fringes are decisively characterized by arable land and detached house areas. Further, it is poor in green surface elements, and the gardens of the detached houses are responsible for its characteristics **Table 6**.

residential/ traditional	creek	grassland semi-nature	12%
residential/ traditional		**forest/semi-nature**	**38%**
residential/ traditional	creek	forest/semi-nature	9%
residential/ traditional		grassland semi-nature	11%
residential/ detached		forest/semi-nature	17%
residential/ mixed		forest/semi-nature	10%
public green area		grassland semi-nature	2%

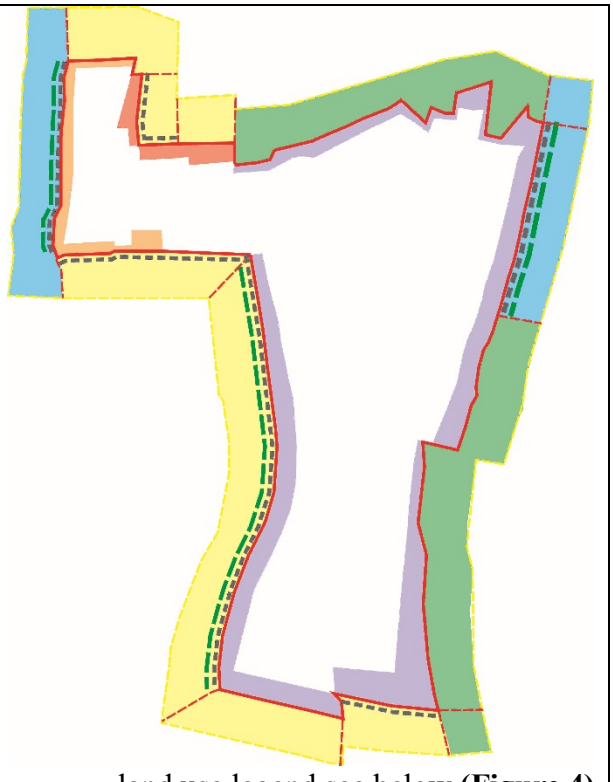


land use legend see below **(Figure 4)**

Table 7.: Connection patterns of Pilisszentkereszt (own editing)

The typical connection pattern of Pilisszentkereszt is: traditional residential area – semi nature (forest). The local natural conditions strongly influence the settlement fringe. The entirety of the fringe touches on semi-natural areas and natural elements. This means that its green surface elements are part of the existing natural space system (**Table 7**).

residential/ traditional	road forest belt	water/semi nature	8%
residential/ traditional	-	arable	3%
residential/ traditional	road	arable	5%
residential/ detached	road	arable	8%
recreational	**-**	**forest, semi nature**	**38%**
recreational	road forest belt	water/semi nature	8%
recreational	road forest belt	arable	20%
recreational	-	arable	5%
recreational	road	arable	6%

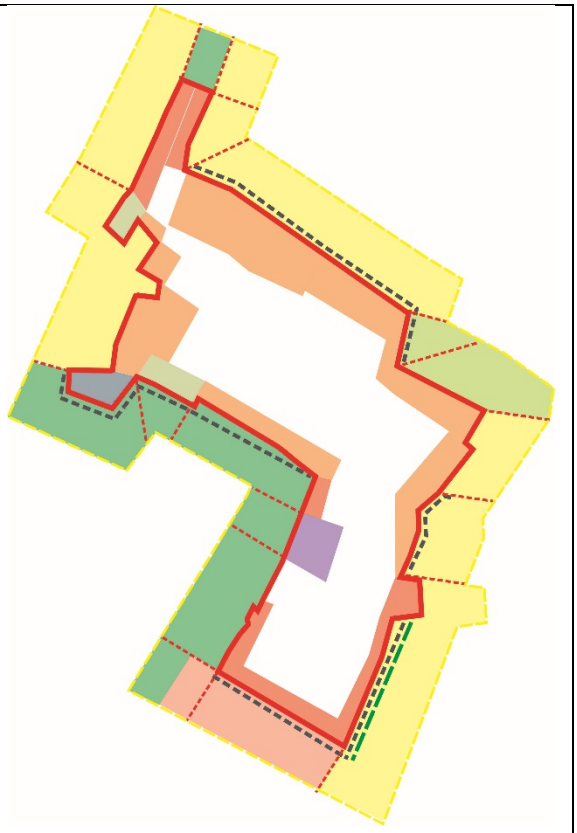


land use legend see below **(Figure 4)**

Table 8.: Connection patterns of Pócsmegyer (own editing)

The typical connection pattern of Pócsmegyer is: recreational area – road with forest belt – semi nature (forest). Due to its location, its fringes are determined by the natural conditions. The inner periphery is characterized by recreational areas, but the town is a good example of a settlement with a complex role, also preserving its agricultural traditions. Its inner periphery and the settlement fringe are also dominated by green space. The recreational gardens' dense vegetation and the high proportion of natural elements characterize the fringe, which fades into the bordering natural areas **(Table 8)**.

residential/ traditional	**road**	**arable**	**22%**
residential/ traditional	-	arable	5%
residential/ traditional	road	forest	3%
residential/ traditional	road	forest, semi nature	8%
residential/ traditional	-	forest	10%
residential/ detached	road forest belt	arable	7%
residential/ detached	road	vineyard	8%
residential/ detached	-	forest, semi nature	2%
residential/ detached	-	arable	14%
residential/ detached	-	forest	4%
industrial	-	forest, semi nature	4%
public	road	forest, semi nature	2%
residential	road	forest, semi nature	7%
public	road	arable	3%

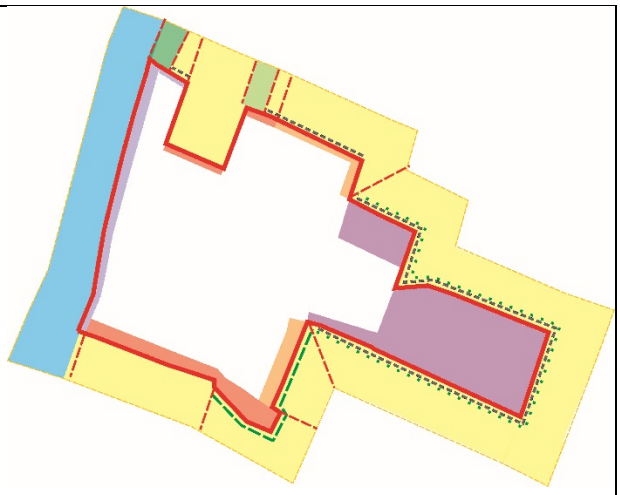


land use legend see below **(Figure 4)**

Table 9.: Connection patterns of Csomád (own editing)

The typical connection pattern of Csomád is: traditional residential area - arable land. Due to its isolated, peripheral location, it mainly preserves the traditional residential characteristics on its fringe. Its green surface elements on the fringe show a varied picture with elements of the transport network and natural elements occurring in patches **(Table 9).**

residential/ detached	-	arable	14%
residential/ detached	forest belt	arable	6%
residential/ detached	road	forest	1%
residential/ traditional	forest belt	arable	7%
residential/ traditional	road	arable	7%
industrial	**road trees**	**arable**	**43%**
recreational	road	arable	2%
recreational	-	forest, semi-nature	1%
recreational	-	water body semi-nature	19%



land use legend see below **(Figure 4)**

Table 10.: Connection patterns of Majosháza (own editing)

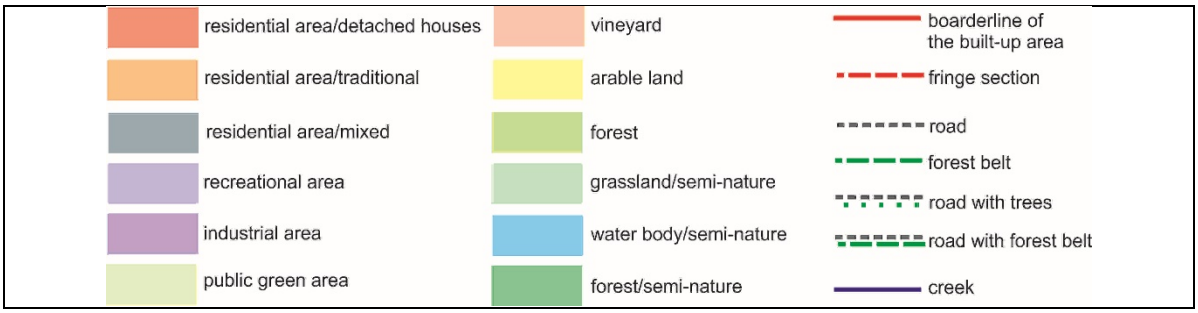


Figure 4.: Land use legend

The typical connection pattern of Majosháza's is: industrial area - road with tree - arable land.
The fringe is characterized by the high proportion of detached housing areas, industrial area, and arable land. While its spatial system is determined by the transport infrastructure, natural conditions influence it less. The green space of its fringe is mainly made up of the gardens of the inner periphery and the elements of the transport network appearing in patches **(Table 10).**

The analysis shows that fringes of the sample settlement areas differ significantly. Fringe differences are also the result of different traditions, functions, and natural features of the sample settlements. Based on the study of the sample area, the following settlement fringe features can be described:
- oriented towards the surrounding natural environment, basing itself on natural elements (Pilisszentkereszt)
- sectionalized, with patchy green space elements (Csomád, Majosháza)
- poorly featured, with the inner periphery's gardens giving the characteristics of the green space (Tinnye)
- fading into bordering semi natural spaces, with the inner and outer peripheral areas also being green space like elements (Pócsmegyer)

The results of the settlement fringe study also highlight that settlement fringes play a prominent role in the settlements' green space's system due to their shaping character.

Discussion and Conclusion

The results of analysing the settlements' central area show that the settlement fringe areas play an important part with their character forming role. These areas' connection forms with inlot woodstock determine urban green space system. The urban green space system's traditional categorization should be renewed because of the different, mostly transforming settlement structure forms. This methodology can be used in most settlement types in Hungary.

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