Relationships between the perception of cultural ecosystem services and land cover in Central-Eastern-Europe

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Abstract

Despite of the growing number of studies related to ecosystem services, there is still a lack of deeper understanding of cultural ecosystem services (CES). CES are defined as nonmaterial benefits obtained from ecosystem, which significantly influence the quality of life. The assessment of cultural services is still challenging due to the perceived intangible nature of them, and their dependence on social background. Consequently, the evaluation requires empirical work, which is mainly carried out by surveys. Among these methods, over the last years Public Participation GIS (PPGIS) was the most frequently employed tool. Based on the former research, one can argue, that in this field there is still a lack of Central-Eastern European PPGIS studies on a regional scale.

In our previous research, we dealt with the influencing effect of accessibility and the extent of local identity related to CES perception. However, our current study focuses on the relationships of CES and biophysical features (land cover and protected areas). We investigated the following research questions:

1. Which kind of relationships exist between mapped CES and land cover?
2. Which kind of relationships exist between CES perception and protected areas?
3. How similar are the spatial patterns of the mapped CES?
4. Are these associations consistent with other studies from different geographical contexts?
5. What are the implications of the empirical findings for managing CES in the Central-Eastern-European context?

We chose 18 settlements of the micro-region of Vác located in the Budapest Metropolitan Region as the study area. Five cultural ecosystem services were defined: aesthetic, recreational and therapeutic, spiritual, cultural and historic, educational values. During the survey a total of 184 maps were made, after the data was digitized. The analyses were performed partly by GIS methods (using QGIS software) and partly by statistical analyzes (Chi-square test, Z test).

Our results showed that there are land use types with which most of the studied CES show significant positive correlation (mainly residential areas and artificial, non-agricultural green areas). Positive correlation can also be identified with surface waters, forests, and grasslands for aesthetic and recreational values. In contrast, we identified negative correlation between agricultural areas and all types of studied services. We also found, that national protected areas have positive correlation with the perceived CES, nevertheless, this relationship cannot be identified with the internationally protected areas.

1. Introduction and Literature Review

Surveys of people's perceptions, attitudes and values oriented by the landscape have taken place for decades and often with the purpose of satisfying the demand for public participation in policy making and planning (Macnaghten & Urry 1998). Since the introduction of ecosystem services in 1990s, the concept has become significant in environmental decision-making (de Groot et al. 2010) as well as in guiding surveys of people's perception of landscape values and environmental resource issues. Cultural ecosystem services (CES) defined as nonmaterial benefits obtained from ecosystems, which influence the life quality and human well-being, have in recent years received increasing attention (MEA 2005; Plieninger et al. 2013). However, despite a growing number of ecosystem services-related research, there is still a lack of deeper understanding of CES (Oteros-Rozas et al. 2018), challenges in relation to its assessment and evaluation (Brown et al. 2015) and challenges in relation to its integration with policy and planning (Blicharska et al. 2017).

Improved understanding of CES is challenging, as they can be identified and described universally, however, the relative importance of CES varies geographically (Cheng et al. 2019) and the perception of CES differs according to the socio-cultural background of the communities and individuals surveyed (Paracchini et al. 2014). CES assessment requires either indicator measures using existing database or empirical research approaches (Brown & Hausner 2017). In the latter, data collection is mainly carried out by specific survey (e.g. extensive questionnaire surveys, in-depth interviews), often using participatory mapping (Brown & Fagerholm 2015). Participatory mapping (PPGIS) is a general term used to define a set of techniques that merge modern cartographic methods with participatory methods to record and represent spatial knowledge of local communities. With such an approach, spatially explicit biophysical and perception-based data can be linked (Garcia- Martin et al. 2017).

In order to analyze and evaluate CES better, one of the most important tasks and the greatest challenge is to detect the relationship between services and biophysical features (Zoderer et al. 2016). Land cover as a physical dataset has been used most frequently in relation with CES, but other features have also been analyzed, such as roads, other built infrastructure, and protected areas (Brown 2013). During the last decades, several studies have been published from very different locations analyzing relationships between CES and landscape features (e.g Plieninger et al. 2013; Palomo et al. 2014). Despite many similarities, results also show differences that vary by geography (Garcia-Martin et al. 2017). Central-Eastern-Europe (CEE) is still lacking in CES evaluation studies, though we must expect differences in results compared to western countries due to differences in socio-cultural characteristics.

The motivation to apply PPGIS and assess CES and values is most often to inform and improve landscape planning and management (Brown & Brabyn 2012). Despite the increasing number of PPGIS applications, workshops, and publications (Brown et al. 2018), CES mapping is still underdeveloped (Oteras-Rozas et al. 2018), and the integration of them with planning and other policy areas is weak (Chan et al. 2012; Brown & Hausner 2017).

The aim of our study is twofold: to increase the understanding on how CES, on regional landscape level, are perceived in a CEE geographical context, and to compare our findings with the results of other studies to detect the differences and similarities in relation with the various socio-economic backgrounds. To explore these issues, we took Hungary as one of the most suitable examples in the

CEE region. Our study can help to better understand the effects of national/regional culture and political structure on CES perception by discovering differences and similarities with other research. In relation to the integration of CES perceptions in planning and policy making, our results contribute to a deeper understanding of what and why CES are being mapped through analysis of the relationships between CES and land cover.

2. Method and Data

The research was carried out in the micro-region of Vác, located in Central-Hungary, at the edge of the Budapest Agglomeration Region. Micro-regions in Hungary represent the level of the Local Administrative Unit (LAU) level 1 in the statistical system of Eurostat (Eurostat – Local Administrative Units 2019). Covering a total area of 36,208 ha with 69,100 inhabitants (Hungarian Central Statistical Office 2017), the study area contains 18 municipalities: 2 towns and 16 villages (Fig. 1). The center of the micro-region and the largest settlement is the town Vác.

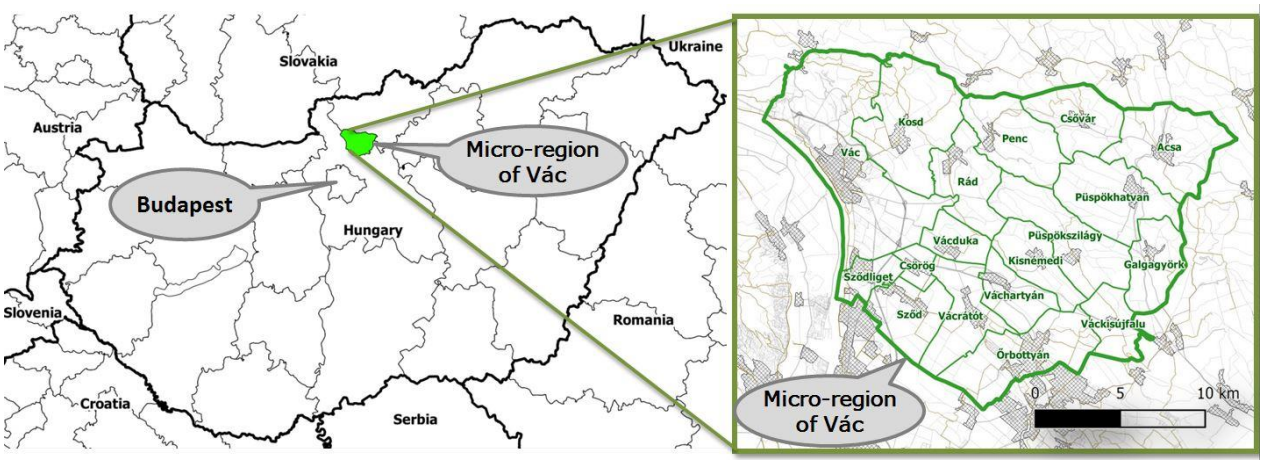

Figure 1. Location of the study area

The study area comprises a wide range of land cover types dominated by arable land (38%), forests (mainly broadleaved and mixed forests) (26%), heterogeneous agricultural areas (11%), and urban fabric with industrial, commercial and transport units altogether (9%) (Copernicus 2018). 24% of the study area is under international protection (Natura 2000 Network of protected areas), and 0.7% is under national protection (Hungarian Central Statistical Office 2017). The landscape is diverse, with the river Danube, located on the western border of the study area, and the Naszály Mountain with the highest point of the micro-region (652 m) as the most dominant landscape elements. The suburbanization and agglomeration effects of Budapest are most significant in the western (around the micro-regional center, Vác) and south-western parts (e.g. commuting effect, strong service and industry sectors, high proportion of built-up area, highly developed transport system) while the eastern part of the study region is a typical rural area (small villages, significant natural values, high proportion of agricultural and forest land uses).

For the survey five CES were selected: aesthetic, recreation, spiritual, historic, and educational services. Data collection took place in September 2017 and in April 2018 involving bachelor and master students of Hungarian University of Agriculture and Life Sciences, Institute of Landscape Architecture, Urban Planning and Garden Art. A map and a basic questionnaire about the participants written in Hungarian were used during the interviews. During the face-to-face

interviews, we used paper maps (A3 format, at 1:120,000). As a base map, a VHR satellite of Google Earth was employed that is easily understandable for non-professionals as well. The borders of the study area and the names of the settlements were marked on the map for an easier orientation. We asked the participants to use the more effective and simple point markers (Brown & Pullar 2012). These can also fit better in the base map because of the regional scale of the study area. In all types of CES, three markers were employed in order to keep an easily mappable number of points, but not to force the involved locals to use only one important point per category. During the survey, we paid attention to the geographical balance, including that the number of inquiries varied according to the size and population of the settlements (more inquiries for larger size and population). Participants were approached in many different public locations, such as cafes, parks, railway stations, bus stops, health care centers, schools, and shopping centers to get in contact with high number of persons representing a wide range of local population (Fagerholm et al. 2016).

The assigned CES were digitized in Quantum GIS (ver. 2.18) software. The database contains the geographical location of the services and the associated data collected during the survey. We used layers of CORINE Land Cover (100, EEA 2018), Natura 2000 areas (Natura 2000 Network Viewer 2019), and nationally protected areas (Ministry of Agriculture 2019) in the overlay analyses. CORINE land cover categories were merged into 11 categories suitable for the geographical context of the study area. All layers were clipped to the boundaries of Vác micro-region study area and spatially intersected with the marked CES. In this way every point of cultural services had an associated land cover class. The protected area data were also overlaid with all types of CES. In order to indicate proportional under or over representation of CES, the area of land cover types and protected areas were calculated by Quantum GIS (ver. 2.18) software. The number and type of CES, as well as the proportion of each land cover class were tabulated within every grid cell (Brown et al. 2015) (Fig. 2).

In the statistical analyses Excel 2016 and IBM SPSS (ver. 25) software were used. In order to examine the relationship between CES and landscape features, two types of statistical methods were used. In the first step, cross-tabulations, chi-square statistics, and the adjusted standardized residuals were generated. Chi-square test was performed to determine the independency between CES types and land cover classes, as well as to detect significant correlation between category-type variables. We used adjusted standardized residuals to define whether the number of mapped cultural services were over- or under-represented in a land cover class or protected area with the criteria of the adjusted standardized residual being above 1.96 or below -1.96, respectively. This method does not consider the areal proportion of CORINE land cover classes within the study area. During the first step, three land cover classes (mine, dump construction; permanent crops; wetlands) were excluded because of their very small number of tabulated CES points. As a second step, Z test for proportion comparison was performed to define whether the mapped CES type scores were distributed similarly to the landscape feature proportions. Z scores higher than +1.96 (two-tailed test, $\alpha=0.05$) show that the proportion of CES located within a given landscape feature are significantly higher than expected, while Z scores lower than -1.96 show the proportion of CES that are significantly lower than expected (Brown et al. 2015).

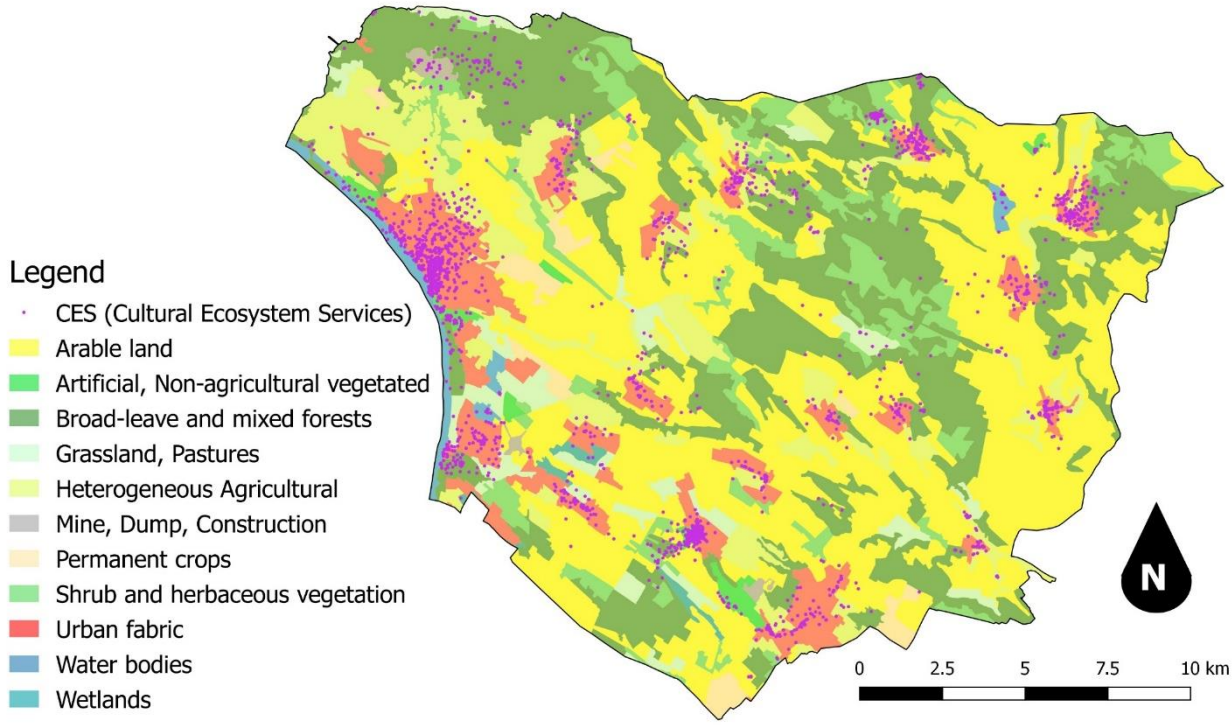

Figure 2. Spatial distribution of CES mapped over the land cover classes

3. Results

The total number of participants was 184, balanced proportionally according to the population of the 18 settlements. Women were over-represented with 67.4%, while men were 32.6% of the involved locals. In total 2700 CES points were mapped and digitized.

The distribution of CES by land cover was examined using proportional analysis. As Table 1 shows, Z scores are positive and significant for all CES in land covers related-to built-up areas (urban fabric; artificial, non-agricultural vegetated areas) with the only exception of spiritual services, where no significant spatial association was found with the artificial, non-agricultural vegetated areas. Further, water bodies have significant positive correlation with aesthetic and recreational services while significantly higher than expected aesthetic marks were identified in mine, dump and construction land cover type. The highest Z scores were for historic, spiritual and educational services in the urban fabric. In all the other land cover classes, the mapped values were under-represented or there was no significant correlation.

We also calculated the Chi-square association that does not assume that CES are distributed proportional to land cover area. Similarly to the proportional analysis, historic, spiritual and educational services were significantly over-represented in urban fabric. Several points of recreational and educational services were found in artificial, non-agricultural vegetated areas. The adjusted standardized residual values were also positive and significant in water bodies for aesthetic and recreational services. However, in almost all the other land cover classes, the results of aesthetic and recreational services were different than in the proportional analysis. They were significantly over-represented in arable land, heterogeneous agricultural areas and forests. The highest adjusted standardized residual was observed for aesthetic service in forests pointing out a

significant positive correlation. We could not find any spatial association of CES in grasslands and pastures while historic, spiritual and educational services were mainly significantly under-represented in un-built areas.

Table 1. Z-scores of CES calculated over land cover classes

	Aesthetic	Recreational	Historic	Spiritual	Educational
Urban fabric	16,50	24,40	53,15	63,04	45,94
Mine, dump, construction	10,61	-1,49	-0,81	-1,48	-0,78
Artificial, non-agricultural vegetated	16,55	27,69	8,30	1,25	27,64
Arable land	-13,95	-13,03	-16,37	-16,09	-16,06
Permanent crops	-3,06	-2,71	-3,04	-2,70	-3,01
Grassland and pastures	-3,10	-2,14	-3,76	-3,53	-2,53
Heterogeneous agricultural areas	-1,90	-1,26	-4,72	-4,99	-5,02
Forests	0,14	-5,85	-11,19	-13,33	-9,53
Shrub and/or herbaceous vegetation associations	0,35	-3,34	-1,53	-6,43	-5,20
Wetlands	-0,87	1,79	-0,86	-1,52	-0,83
Water bodies	10,94	10,63	-2,14	-2,13	-0,89

The relation between protected areas and mapped CES was also examined separately. Z scores are significant and positive for aesthetic services both in international and in national protected areas. The highest Z scores were found in the cases of recreational and educational services in national protected areas. We had the same results applying adjusted standardized residual analysis with the only exception of aesthetic services that was significantly under-represented in national protected areas (Fig. 3).

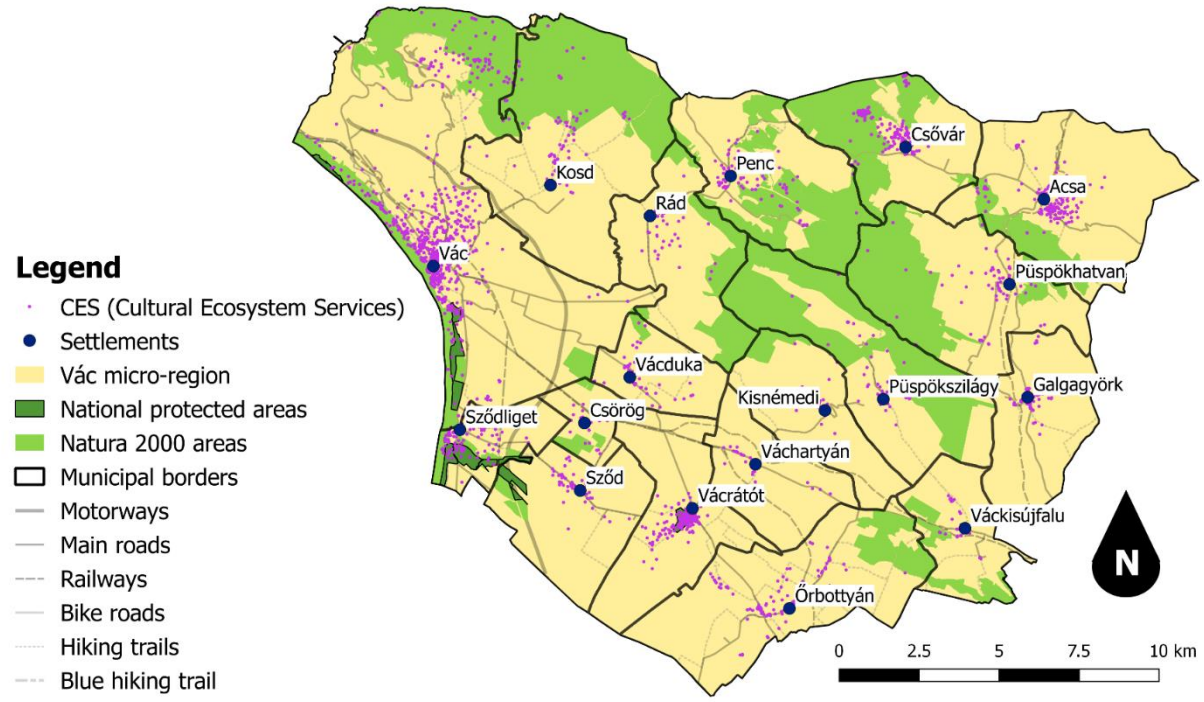

Figure 3. Spatial distribution of CES mapped over the protected areas

4. Discussion and Conclusion

With the statistical analysis we found the following similarities with previous studies: the built-up areas are associated with all types of CES (e.g. Palomo et al. 2014); forests provide high level of aesthetic and recreational services (e.g. Brown et al. 2015); grasslands and pastures are not associated with CES (e.g. Ridding et al. 2018); with the exception of aesthetic service, international protected areas neither have any spatial association with perceived CES (e.g. Fagerholm et al. 2016). Further, green areas (artificial, non-agricultural vegetated) such as greenways, parks, tree alleys, sport fields located within the settlements provide high level of CES (especially recreational and educational services). The importance of these areas is expected to increase in the future due to growing suburbanization pressure even on the peripheries of the agglomeration region. This calls for increased attention on these areas in regional planning and development (Paracchini et al. 2014).

Several differences were found. Surprisingly, aesthetic services were significantly over-represented in mine, dump and construction land cover type. The explanation of this might be the visually important location of the mine site (on the southern slope of the highest mountain) in our study area. We may therefore conclude that a diverse topography is more important than the land cover for aesthetic judgment of people. Other explanations can be that locals prefer heterogeneous structure of different land covers (Fagerholm et al. 2016), even if this heterogeneity is caused by an artificial land use.

Interestingly, in land cover types related to agriculture, aesthetic and recreational services were significantly over-represented. We also found spatial correlations between CES bundles and arable land cover type. Explanation could be that greenways, hiking trails and water bodies are integrated into the surrounding agricultural landscape and the general preference of the locals for traditionally managed landscapes (Zoderer et al. 2018), as the study area is mainly rural landscape representing the agrarian character, and the identity of the country. Despite the importance of an agriculture decrease during the almost half century long Communist era, agricultural activities still played a significant role in the Hungarians' lives. On one hand, many people, living in the countryside, was working in the agricultural sector. On the other hand, many of those, who have been employed in the industrial sector, also owned small pieces of land for their own use. After many decades, this value of the agricultural (especially arable) land still exists in people's minds. Based on these, one can argue, that not only the current political principles, but also the historically common values of societies have strong influence on CES perception.

Our internationally protected areas-related result counters with research findings in non-European contexts (Brown, Weber, & de Bie 2014). A reason might be that the study area is dominated by rural landscape and that nature conservation interest is less obvious (Garcia-Martin et al. 2017). Another explanation can be that the implementation of Natura 2000 was not completely successful. As Blicharska et al. (2016) and Maczka et al. (2019) highlighted, stakeholder involvement is a key factor for the success of awareness of nature protection. In CEE countries, that have joined the EU since 2004, the Natura 2000 implementation was too fast, and they have no tradition of a broad stakeholder inclusion and are still characterized by top-down governance (Blicharska et al. 2016). In contrast, our findings related to national protected areas showed highly significant positive spatial association (recreational and educational services). The reason can be that in Hungary the awareness and appreciation of national protection is higher than the international protection, thanks to the awareness raising activities of public authorities focused on the national protected areas.

Our study gives practitioners new knowledge about how CES are perceived and valued by locals in the CEE. The results may help planners and decisionmakers to understand better what kind of effects their decisions can have their strategies, plans, and the general socio-political background on people. Several authors complained about the lack of integration of social values into planning and management (e.g. Garcia-Martin et al. 2017), and thus they stressed a frequent need to link policy development to wider socio-cultural factors (Plieninger et al. 2013). Despite these arguments, landscape planning and management in CEE is still based on a mainly expert-led approach. Our results can help to bridge these gaps in order to reach more inclusive plans and strategies. In addition, the application of this method can improve the identity and raise the awareness of CES in the region. This effect may build trust and increase the support of future sustainable development projects. However, since every (social and cultural) context is different, the application of participatory methods is advisable in each situation. On local and regional scales, the PPGIS tool is especially important and useful during the spatial data collection process, assessment of landscape characters, and in discovering the relationships among diverse stakeholders and CES.

In our study, a PPGIS approach was used in order to better understand how CES are perceived in the CEE regional context. Our results showed some similarities with other studies from various countries. We could confirm previously discovered spatial relationships between different CES types and biophysical landscape features. However, we found several differences compare to former studies, mostly due to the CEE socio-cultural background. Compared to other studies, different spatial relationships were identified related to spiritual services. We also found higher importance of agricultural (especially arable) land cover in relation with the perception of CES, which can be explained by the traditional agricultural-oriented feature of Hungarian culture. Significantly higher appreciation of national protected areas was identified, which can be explained by the rapid and weak implementation of Natura 2000 (international protection) in the CEE. Our results highlighted, that in CEE countries (e.g. Hungary), the historically common values of societies and the current political principles have a strong influence on CES perception.

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