🏆 *reviewed paper*

The Contribution of Peri-Urban Characterisation to the Development of Sense of Place Indicators

Vita Žlender, Rok Brišnik

(Dr. Vita Žlender, Urban Planning Institute of the Republic of Slovenia, Trnovskipristan 2, Ljubljana, Slovenia, vita.zlender@uirs.si)
(Rok Brišnik, Urban Planning Institute of the Republic of Slovenia, Trnovskipristan 2, Ljubljana, Slovenia, rokbrisnik@gmail.com)

1 ABSTRACT

Peri-urbanisation is a phenomenon taking place worldwide and affecting not only large cities but also smaller towns and settlements. The diverse set of activities, land uses and processes, which are characteristic for peri-urban landscape, are often poorly regulated and planned by the spatial planning and development policies. This may give way to interests of individual investors, which are rarely supportive of preserving green open spaces to serve the population for their leisure and recreational purposes. In this paper, we focus on the unbuilt spaces of the peri-urban landscape and their role for retaining a sense of place of local inhabitants who use this landscape for their leisure and recreational purposes. This study approaches the sense of place (SOP) as a category of the cultural ecosystem service framework. SOP has previously been highlighted as a specifically difficult category to be directly quantified and assessed with standardised procedures, and is therefore poorly integrated in landscape and management plans. Accordingly, this study is an attempt to set a basis for the SOP indicators development in the peri-urban landscape by (1) exploring and clarifying the notion and spatial characteristics of the peri-urban landscape, (2) identifying spatial planning actions and their influence on the peri-urban land use and functioning, and (3) exploring possibilities for the cartographic representation of SOP in the peri-urban landscape. We conducted a literature review, document analysis and spatial analysis in three case study cities in Slovenia: Ljubljana, Kranj and Koper. Then we developed a framework for peri-urban landscape characterisation and applied it to case studies. We compared results with the characterisation of the peri-urban landscape in formal documents and identified spatial actions and their influence on the peri-urban land use and perception. Finally, we evaluated whether the proposed framework could help in identifying areas according to their SOP potential and in developing SOP indicators for preserving peri-urban open spaces for its users. Our findings can facilitate incorporating information on SOP in a format that can be used by city authorities and spatial planners in the formulation of spatial planning measures and guidelines.

Keywords: cultural ecosystem services, sense of place, peri-urban landscape, mapping approaches, Slovenia

2 INTRODUCTION

Peri-urban landscapes, located at the city's edge, are a collection of ecosystems supporting biodiversity, wildlife habitat, flood protection, local climate regulation, oxygen production, recreation and other regulating, provisioning, supporting and cultural ecosystem services, as MEA(2005) defines benefits which are provided to humans by nature. There is evidence that people value these areas for various reasons, including the naturalness and spaciousness of peri-urban green open spaces (Neuvonen et al. , 2007), and leisure and recreation (Cadieux, 2008; Neuvonen et al. , 2007; Palang et al. , 2011; Tyrväinen et al. , 2007), which has become even more evident during the COVID-19 lockdown when people, measures allowing, fled to the semi-natural green spaces for outdoor recreation and leisure as a substitute for closed-down indoor recreation centres. In Slovenia, too, when the strictest measures limited people to movement inside the municipality of residence only, the semi-natural green spaces outside towns became popular destinations for outdoor recreation (Ugolini et al. , 2020; Žlender & Gemin, 2023). Clearly, people migrate from urban centres to urban edges to be closer to green open spaces (Piorr, Ravetz, Tosics, et al. , 2011). However, unless such actions are planned and regulated, they can lead to negative consequences such as overcrowding of green spaces for leisure use, diminishing peri-urban biodiversity and even accelerating peri-urbanisation.

This study is focused on the unbuilt spaces of the peri-urban landscape and their role in sense of place (SOP) of local inhabitants who use this landscape for their leisure and recreational purposes. It investigates SOP as a category of the cultural ecosystem service (CES) framework. SOP has previously been highlighted as a specifically difficult category to be directly quantified and assessed with standardised procedures, used for other ecosystem services (ES), and is therefore poorly integrated in landscape and management plans. To investigate the problem of poor inclusion of SOP in formal spatial plans, we set the following research question: Can characterisation of the peri-urban landscape help in recognising spatial patterns indicating valuable places for SOP as a CES category?

Accordingly, this study is an attempt to set a basis for indicating valuable places for SOP in the peri-urban landscape by (1) exploring and clarifying the notion and spatial characteristics of the peri-urban landscape, (2) identifying spatial planning actions and their influence on the peri-urban land use and functioning, and (3) exploring possibilities for the cartographic representation of SOP in the peri-urban landscape. We conducted a literature review, document analysis and spatial analysis in three case study cities in Slovenia: Ljubljana, Kranj and Koper. We then present the framework we developed for the characterisation of the peri-urban landscape and its application to the case studies, results obtained, and an evaluation of the proposed framework for developing SOP indicators of peri-urban open spaces. This paper is the first step in a project which will explore CES in the peri-urban landscape and develop a valuation framework for landscape planning and policy.

3 LITERATURE REVIEW AND RESEARCH APPROACH

3.1 Approaches to characterising peri-urban landscape

The peri-urban landscape is a complex and multifunctional system with specific features and several dimensions which should be taken into account in planning of this space (Filyushkina et al. , 2022; Gottero et al. , 2023). To achieve a clearer definition of the peri-urban landscape, scholars to date have explored issues of terminology and understanding the difference between different spatial entities (Simon et al. , 2006), the driving forces behind peri-urbanisation(Aalbers & Eckerberg, 2013; Piorr, Ravetz, & Tosics, 2011), the peri-urban issues occurring due to different stakeholders' interests, such as land ownership conflicts, land consumption, decreased biodiversity and lack of public services (Cattivelli, 2021; Dadashpoor & Ahani, 2019; Kristensen & Primdahl, 2020) and its low identity and recognisability (Qviström & Saltzman, 2008; Shoard, 2000). The latter, especially, is important for the exploration of sense of place of different stakeholders and its role in characterisation of the peri-urban landscape.

In the Slovenian context, Marušič et al. (1998) have prepared a division of the whole Slovenian territory based on landscape patterns, which reflect spatial units with relatively homogeneous landscape features. Their criteria were based on the level of nature preservation, variety of landscape features, spatial order and harmony. In their division, the peri-urban landscape is characterised as a "generic pattern, which has been altered by human interventions to the extent that it does not reflect any local specifics anymore"(Marušič et al. , 1998 p. 64). Reviewing further literature, different interpretations of the peri-urban landscape and approaches to peri-urbanisation can be found. Increasingly popular are studies which deal with defining physical boundaries. Scholars have taken different criteria to demarcate the peri-urban landscape, among the most popular being population density (Piorr, Ravetz, & Tosics, 2011), land use (Aguilera et al. , 2011), a combination of land use and population density (Gonçalves et al. , 2017; A. Wandl et al. , 2017) or an addition of several more specific criteria such as experts' opinions (Gottero et al. , 2023). It should be noted that consensus regarding such demarcation has not yet been reached and, according to Mortoja et al. (2020) is not even possible. Accordingly, we focus our efforts on characterising the peri-urban landscape in identifying patterns of peri-urbanisation rather than trying to fix its borders. Planning the peri-urban landscape greatly refers to planning its open spaces, which (will) form green infrastructures of cities and the production of goods and ES. These, together with planning of built-up tissue, require holistic policies and regulations (Gottero et al. , 2023). For these reasons, understanding, identifying and defining peri-urban spatial patterns through place-based approach is necessary to understand the complexity of peri-urban landscapes (Gottero et al. , 2023). Specifically, establishing land use rules for peri-urban areas is crucial for ES preservation. Accordingly, we developed a replicable method to identify peri-urbanisation in a spatial planning context of municipal and supra-municipal spatial planning.

3.2 Sense of place as a category of cultural ecosystem services

SOP has been suggested as a valuable approach to assess and understand the complex subjective relation between people and place (Stedman, 2016) and it has been proved useful in the exploration of peri-urban green open space users and SOP too (Žlender & Gemin, 2020). One of the most widely used definitions of SOP comes from Tuan(1977) who defined it as the meanings and attachments people attribute to place. It addresses the emotional, symbolic, and spiritual aspects of places. According to Relph (1976), SOP is about a person's understanding of a place; it involves experience and a subjective dimension. Conversely, Stedman (2003), Twigger-Ross and Uzzell (1996), and Hidalgo and Hernández (2001), among others, argued that the

construction of meaning is, beside individual, also a composition of social interaction and the physical characteristics of the environment. We propose the definition of SOP as a complex affective bond between people and a specific location. The specific location, the place, is determined by geographical location, material form and investment with meaning and value (Gieryn, 2000).

A number of factors can influence the formation of SOP and have been explored, among which the attributes of a place, such as (lack of) accessibility to a place and geomorphology (Koohsari et al. , 2023; Žlender & Gemin, 2020), arrangement of architectural elements in the streetscape(Hu & Chen, 2018) or level of shoreline development (Stedman, 2003). Other studies used different methodologies to measure people's attitudes towards planned changes in the landscape which can be negative or positive. Examples include coastal restoration(Hawthorne et al. , 2022), dam construction (Ganzevoort & van den Born, 2019), and changes in water quality (Mulvaney et al. , 2020).

The reviewed literature indicates the value of the spatial assessment of SOP for informing spatial planning of the peri-urban landscape. The integration of spatial, social and perceptual data into land use planning can enhance the understanding of reasons and impacts of change (Ryan, 2011) and improve people's pro-environmental attitude (Žlender & Gemin, 2020). Such information can thus help spatial planners to integrate social values in spatial planning, which is usually based on biophysical indicators (Gottwald et al. , 2021) and prioritises effective policy responses to ensure the sustainable future of the peri-urban landscape.

The ecosystem services framework is an attempt to introduce both biophysical and individual, subjective perceptions in landscape planning. Accordingly, some international classification systems, such as MEA (2005) or CICES (2013) include also CES which refer to the non-material benefits people obtain from ecosystems. Although the ES framework has been present in research and used in spatial planning and policy for a number of years now, the integration of CES categories in landscape planning and policy, especially categories such as sense of place, spirituality and identity, has fallen short, the main problem being the ambiguity and lack of clarity in defining these concepts (Cheng et al. , 2019; Feld et al. , 2010; Plieninger et al. , 2013). While acknowledging definitional vagueness as one reason for the neglect of some categories of CES, we suspect that the key reason is that many instances of CES cannot be directly quantified and assessed with standardised procedures and are therefore poorly integrated in landscape and management plans. The literature confirms the lack of quantifiable CES data, and that the small number of available indicators cannot be measured directly (Feld et al. , 2010; Layke et al. , 2012), with consequent difficulties for mapping.

CES has received even less attention in investigations of peri-urban issues, especially with regard to the attitudes of local users to peri-urban open spaces. The problem is compounded by the indeterminate character of the peri-urban landscape and the ensuing lack of interest in peri-urban issues. Previous research highlighted two difficulties that experts encounter in developing guidelines and policies in relation to peri-urban space(Žlender, 2021b, 2021a): the diversity of terms used to demarcate the peri-urban landscape, and the lack of knowledge of what is perceived as a transient landscape that will be developed in the future by the government, the planning profession and the general public. In combination with weak land use planning, the lack of interest in the current state of these spaces exacerbates the consequences of urban densification, as the shortage of ES in cities exerts increasing pressure on peri-urban landscapes.

In this study, we investigate SOP as a category of CES, but we do not emphasise the non-materiality, intangibility and subjectivity of CES which reflect the difficulty of incorporating CES into the ecosystem framework, where the use of quantitative methods prevails (Ryfield et al. , 2019). As emphasising this weakness may inhibit the ES framework as a decision-making tool, we focus here on finding different patterns and work towards defining a tangible and measurable component to understand the people-nature relationship(Gottwald et al. , 2021; Stedman, 2016). In developing our conceptual and methodological approach, we rely on the CES definition of Fish et al. as "a concept around which researchers and decision makers can understand ecosystems in terms of their life-enriching and life-affirming contributions to human well-being. . . encompassing a broad symbolic, experiential and virtuous realm of human interactions and understandings of the natural environment"(Fish et al. , 2016, p. 208). Accordingly, we examine SOP as a material phenomenon, which reflects the relationship between determining biophysical conditions of a particular location and social and cultural conditions of human habitation (Ryfield et al. , 2019).

ISBN 978-3-9504945-2-5. Editors: M. SCHRENK, V. V: POPOVICH, P. ZEILE, P. ELISEI, C.BEYER, J. RYSER, H. R. KAUFMANN – Ljubljana, Slovenia

Operationally, we do this by drawing upon the identification of land use characteristics, spatial patterns and planned actions in the peri-urban landscape, as described below.

3.3 Research approach

We built our methodology on three main steps. First, based on the predefined criteria, we identified patterns of peri-urbanisation in each of the case study cities and identified areas with different SOP. Secondly, we analysed the municipal spatial plans of each city to identify the peri-urban landscape and meaningful parts of the peri-urban landscape for its users and local residents. Finally, we compared the outcome and selected measures which can be useful in developing SOP indicators for each case study.

4 METHODOLOGY AND ANALYSIS

4.1 Case study cities

We selected Ljubljana, Kranj and Koper as all three cities have been previously identified as being affected by peri-urbanisation. Ljubljana is the capital and largest city of Slovenia, and a subject to peri-urbanisation due to in-migration and a consequent need for new housing, along with the expansion of economic activities and infrastructure on the city edges. The city-region is threatened by sprawled development and other negative effects of urbanisation and peri-urbanisation in the absence of comprehensive planning. Kranj and Koper represent average-sized Slovenian towns with a historical city centre and (sub)urban growth after the second world war. Both are considerably smaller than Ljubljana, but regional cores and thus important economic, cultural and social centres. Both Kranj and Koper are faced with housing and infrastructure development pressures, which mainly affect agricultural land (K. Nilsson et al. , 2013; Spyra et al. , 2021). All three cities have been also a subject to various projects investigating peri-urban issues (for details, see Piorr, Ravetz, Tosics, et al. , 2011; RENATUR: Improving Regional Policies to Better Protect Natural Heritage of Peri-Urban Open Spaces, 2023; Žlender, 2021a).

4.2 The content analysis of spatial plans

In Slovenia, the importance of recognising (C)ES in spatial planning and policy is stressed in several strategic documents on national and regional level. e. g. : Spatial Planning Strategy of Slovenia 2050; Regional Development Programme of the Ljubljana Urban Region, 2020; Spatial Planning Strategy of Slovenia, 2004, mostly in connection to green infrastructure and referring to EU Green Infrastructure Strategy (European Commission, 2013). In Slovenia, spatial planning on the local level is regulated with municipal spatial plans (OPNs). These plans should be prepared by each municipality and revised within certain time periods; however, a considerable number of municipalities is still without a valid OPN. In existing OPNs, the peri-urban landscape is rarely mentioned and (C)ES even less (Žlender, 2021a), despite above-mentioned strategic documents stressing the importance of recognising (C)ES in spatial policy. The problem often lies in lack of data and expert knowledge for envisioning long-term sustainable development. For the analytical purposes of this paper, we performed a content analysis of OPNs of all three case study cities.

4.2.1 Ljubljana

With 293,820 inhabitants (Statistični urad RS, 2023) the municipality of Ljubljana is the most populated Slovenian municipality, although geographically, most of its population is concentrated in the city of Ljubljana, while its eastern part is of rural character. The city of Ljubljana has a star-shaped morphology with development along the main roads and five green wedges in between, connecting the green hinterland to the city centre. Its structure reflects the historical development of the city, with visible traces on the urban structure and tissue of all main historic periods (MOL, 2010). Throughout the 1990s, Ljubljana has been subject to sprawled development, mainly in a form of large shopping centres, hypermarkets, outlets, leisure activities (multiplex cinemas, restaurants, specialised shops),housing and transport, due to the absence of yet to be established new spatial legislation and market-driven economy. Primarily affected were city-edge greenfield and arable land (Pichler-Milanović, 2005). The Municipal Spatial Plan (OPN)(MOL, 2010)entered into force in 2010. The OPN recognises several problems in relation to past sprawled development of Ljubljana, among which, most relevant for this study, are the loss of local and national identity of settlements due to new (sprawled) development that often ignores natural forces as well as

traditional settlement characteristics, together with privatisation of open space. The OPN specifies four peri-urban areas and their future development. First is the Sava river area, its hinterland and the Ljubljana plain, which, due to its role as a main air ventilation corridor of the city, should preserve its open space and limit the urban development. The development of recreation within the two green wedges located on this area, the preservation of the cultural landscape and the Zajčja Dobrava landscape park should be emphasised. Secondly, the use of Ljubljanskobarje (Ljubljana marsh) for (mainly extensive) agriculture should be preserved, and spatial interventions around solitary hills should be monitored since they are an important identity element of Ljubljanskobarje. Urbanisation should be limited, if not prevented. The development of the third area, Posavskohribovje, should be based on agricultural activities, alongside the development of tourism and recreation and new urban development should be limited. The emphasis on the agricultural development is foreseen also for the fourth area, the Polhograjskohribovje. It should be noted that terminologically the OPN understands the peri-urban landscape as the recreational and semi-natural hinterland of the city. Cultural landscape areas surrounding Ljubljana city, solitary hills, parks, Ljubljana circular path (PST) and water bodies are identified as elements and areas which should be preserved due to their important role for people's identity and sense of place.

4.2.2 Kranj

With its area of 151 km2 and a population of 56,780 (Statistični urad RS, 2023) the municipality of Kranj is the third largest municipality in Slovenia in terms of population. Around two thirds of its population lives in the city of Kranj. Its medieval town centre is laid out in a narrow area between the Kokra and the Sava rivers in a characteristic pyramidal shape and prominently planned height dominants. In time, the city has spread out towards the suburban settlements on the Kranjsko-Sorško polje (plain) east of Kokra towards the northeast and on the right bank of river Sava. The city is divided into several distinct areas due to the morphology of the terrain(MOK, 2014). The Municipal Spatial Plan of Kranj (MOK, 2014) understands the peri-urban landscape as a multifunctional space which accommodates both urban and rural uses. More specifically, the development of Kranjsko polje should be focused on the preservation of the cultural landscape by interlinking agricultural and forestry activities, and accommodating housing and commercial activities/The Sorško polje should preserve its peri-urban characteristics, which combine the distribution of smaller settlements with the interlinkage of arable fields and forests. Due to its vicinity to the city, the development should emphasise the recreational functions of Sorško polje. Škofjeloškohribovje should develop multifunctionally in the areas around the Sava river, while areas further from the city should preserve their rural character, alongside with the development of tourism, sports and recreation. The OPN does not mention any specific areas, elements or measures regarding the presence or importance due to sense of place or identity, but it does specify quality natural and cultural structures and elements which should be preserved. These pertain to the cultural landscapes of Sorško polje, Škofjeloškohribovje, and the northern part of Dobrave, cultural heritage of historical settlement cores, and natural preservation areas.

4.2.3 Koper

With an area of 304 km2 and a population of 53,440 (Statistični urad RS, 2023) the municipality of Koper is a coastal municipality surrounded by the Adriatic sea on its western side. The sea, the hills and the karst edge are important carriers of landscape identity and, alongside the geostrategic importance of the city of Koper, main factors to influence spatial development of the municipality (MOK, 2022; Pintar et al. , 2013). The city of Koper accommodates about half the municipal population and is characterised by a compact medieval town centre, historically dating from Venetian times, the port area and the former area of salt planes which were filled in between the wars to join the island town centre with the mainland. There has been high pressure for urban growth in the municipality due to the attractiveness of the coastal area and the presence of the port. The challenge is how to balance urban expansion and the protection of open space for agricultural and leisure purposes(Pintar et al. , 2013). Sub-urbanisation is most evident in the urban fringe and in settlements close to Koper, mainly due to lack of sufficient housing capacity, a higher living standard and a changing socio-economic situation in the urban zone. Conversely, the rural hinterland has been struggling with a shrinking population in settlements, abandonment of agricultural activities and consequent forest overgrowth (Pintar et al. , 2013). Within the PLUREL project, three main land use issues have been identified: land pressure due to housing and industrial development, pressure on agriculture from built development, and possible deterioration of high value nature areas (Pintar et al. , 2013). The recently

ISBN 978-3-9504945-2-5. Editors: M. SCHRENK, V. V: POPOVICH, P. ZEILE, P. ELISEI, C.BEYER, J. RYSER, H. R. KAUFMANN – Ljubljana, Slovenia

enforced OPN(MOK, 2022) divides the territory into three belts to direct future spatial development of the municipality. First is the urban belt, encompassing the city, its immediate vicinity and the coast. Second is the peri-urban belt, which should accommodate further development of housing, retail and industry, but also preserve agricultural activities and space for recreation. The third belt refers to settlements in the rural hinterland with lower density. The spatial and cultural identity of the municipality should be strengthened by preserving the cultural landscape, heritage and natural protected areas.

4.2.4 Summary

All three municipalities divide the space into three areas: city centre, suburban/peri-urban landscape with recreational hinterland, and countryside. In all three cases, the city centre is the most precisely defined area. Koper has the most precisely defined peri-urban landscape, but the terminology used is not consistent throughout the document and geographically some areas overlap. Both Ljubljana and Kranj define their peri-urban landscape as an area of settlements with denser development that has merged due to suburbanisation, and their recreational hinterland as an area with rural-urban functions with emphasis on the preservation of the cultural landscape. The recreational function coincides with agricultural and forest areas close to the cities, with emphasis on the importance of non-conflicting uses and ecological functions.

4.3 Spatial extent of peri-urbanisation

This study builds its methodology upon Žlender (2021b), Wandl et al. (2014) and Gottero et al. (2023), who had developed methodologies to delineate the peri-urban landscape. Their methodology is refined in this study and adjusted according to some specific spatial characteristics of Slovenia: e. g. , very high forest cover and Natura 2000 areas, high permeability (even in the cities), relatively low population density in comparison with other EU countries. Furthermore, actions of data combination were selected in line with the purpose of this study, i. e. , to identify spatial patterns with potential SOP of peri-urban landscape users.

The peri-urban landscape was spatially characterised in a multiple-step procedure. We developed it through GIS tools (QGIS Desktop version 3. 28), by overlapping, merging, weighting, and interpreting the most recent and openly accessible spatial data. In selecting data sources, we strived to use formally valid datasets, but due to lack of some information, we also used data from Open Street Map (OpenStreetMap Contributors, 2023). Before inputting data into the model, we inspected its quality and adjusted possible deficiencies such as coordinate system, spatial index, geometry. We also cleaned the data's inconsistencies and inaccuracies in data collection by excluding polygons of less than 10 m2. We processed this data using the "Query Builder" tool before starting the analysis. This tool provides an interface for defining filters to create feature subsets within a layer. The use of logical commands enables the construction of complex queries(QGIS project, 2023). Using this tool, we obtained refined data suitable for our analysis, thereby reducing the possibility of preserving methodological inconsistencies of the original data.

A pre-condition to the whole procedure was a grid creation. Based on Wandl et al. (2014), we divided the whole territory into a 500 m x 500 m grid cells. Then we applied all the data onto the grid layer. To eliminate methodological errors that occurred during the transfer of input data to the grid (the grid cut the input data, which resulted in the appearance of some very small polygons and lines), we first removed, within each cell, polygons with a size of less than 1% of the cell size and lines of less than 0,1% of cell size. We thematically generalised land cover datasets (e. g. , we combined all hydrological layers into a single "Water bodies" layer), which enabled the consolidation of data from different sources, simplifying the complexity of data sets, and facilitating spatial analysis of similar data.

We included data on population density, infrastructure network, current land cover, mix of the built and unbuilt areas, nature and culture protection regimes. In our selection of data sets, we attempted to capture the specific characteristics of the peri-urban landscape, such as the mix of urban and rural land uses, intermingling of built and unbuilt, the presence of specific land uses such as waste and sewage treatment plants, logistic centres and others. Accordingly, we grouped our data in primary and secondary conditions for peri-urbanisation. Primary conditions were: areas with population density of 150-500 persons/km2; areas with population density of less than 150persons/km2 which intersect with transport infrastructure (main roads and railway); and imperviousness density areas (European Environmental Agency, 2020) of less than 45%. As the second conditions, we added land cover classes, which we divided into two sub-groups: one encompassing land cover of predominately rural character – arable fields; meadows, pastures, and

grasslands, bare land or scarce vegetation, overgrown areas, wetlands, conservation areas, water bodies, forests; the other of predominately urban character - infrastructure nodes; mining and brownfield sites, artificial vegetation areas and paths, cultural heritage, power lines, other infrastructure, non-inhabitable buildings, but excluding multi-residential buildings (for more information, see Appendix 1).

In the first step, we selected grid cells indicating areas with population density of 150-500 persons/km2and added grid cells with imperviousness density areas of less than 45%. To this new layer we added grid cells indicating areas with population density of less than 150 persons/km2that intersect with transport infrastructure. In the second step, we calculated the sum of all grid cells indicating predominantly rural land covers and predominantly urban land covers, the condition being the presence of at least one layer with land cover for each urban and rural land cover in each cell. In the third step, we intersected primary and secondary indicators, to demonstrate main patterns of peri-urbanisation. Due to the latter action, the results were restrained to populated areas. To achieve a more continuous area, which would also include open spaces for leisure activities, accessible to people by foot from their residencies, we added a buffer to these cells indicating main patterns of peri-urbanisation. Finally, we aligned the resulting indications of the peri-urban landscape with a layer indicating peri-urban area as defined in the OPN of each case study municipality in locations where the differences were not great.

4.4 The spatial patterns of SOP

To define the spatial pattern for SOP denotation, we used the method developed by Burkhard et al. (2009), which proposes assessing the capacities of the various land cover types to provide ecosystem services. Apart from the land cover types, we included also natural and cultural regimes, which were found to be important for SOP development (Kopperoinen et al. , 2014). We scored the layers of cells with generalised land cover types and regimes from -3 to 3 according to their prerequisite of being either favourable or harmful to supply SOP for local users. The scale was developed and scores were given based on selected literature (Adem Esmail et al. , 2023; Campagne & Roche, 2018; Kopperoinen et al. , 2014; Luiza Petroni et al. , 2022; Ribeiro & Hribar, 2019; Zhang & Muñoz Ramírez, 2019) and expert assessment. The results are shown in Table 1.

Id	Generalised land cover types and regimes	Score given
1	Arable land (e. g. , fields, gardens, greenhouses, vineyards, orchards)	2
2	Permanent crops	2
3	Meadows, pastures and grasslands	1
4	Bare/sparse vegetation	-1
5	Overgrowth	-1
6	Wetlands (swamp, saltpans)	2
7	Water bodies (river, lake, sea)	3
8	Forest	2
9	Road infrastructure lines and nodes (roads, rail, airport, port)	-3
10	Energy and environmental infrastructure (areas of energy production, power lines, waste management areas, etc.)	-3
11	Non-inhabitable buildings and accompanying areas of exclusive use (industry, logistic, military, etc.)	-2
12	Non-inhabitable buildings and accompanying areas for wider use (retail, education, etc.)	0
13	Mine, degraded and brownfield sites	-3
14	Maintainedgreen areas and paths for public use (parks, leisure facilities, hiking and cycle paths, etc.)	2
15	Maintained green areas and accompanying infrastructure for sport and tourist use (sports facilities, stadiums, camp sites, hippodromes, etc.)	1
16	Predominantly residential and/or residential-agricultural compounds	0
17	Mixed use areas of housing and, services, retail, tourism, etc.	1
18	Nature conservation areas (Natura 2000, landscape parks, etc.)	3
19	Cultural landscapes (archaeological areas, cultural landscape, outstanding landscapes, monuments, etc.)	3
20	Cultural heritage settlements (historic cores of villages and towns)	3
Effect of land cover types and regimes on the prerequisites for potential SOP supply: 3 = very favourable; 2 = favourable; 1 = slightly favourable; 0 = no connection between the land cover type or regime, and the capacity to provide the SOP or no relevant capacity to provide the SOP; -1 = slightly harmful; -2 = harmful; -3 = very harmful		

Table 1: Potential SOP supply values.

5 RESULTS

5.1 The peri-urban landscape of Ljubljana, Kranj and Koper

The images 1, 2 and 3 present the final output of spatial characterisation of peri-urban landscape. The newly defined peri-urban landscape coincides with the peri-urban landscape as defined in OPNs, but not always consistently. The results for each case are discussed below.

ISBN 978-3-9504945-2-5. Editors: M. SCHRENK, V. V: POPOVICH, P. ZEILE, P. ELISEI, C.BEYER, J. RYSER, H. R. KAUFMANN – Ljubljana, Slovenia

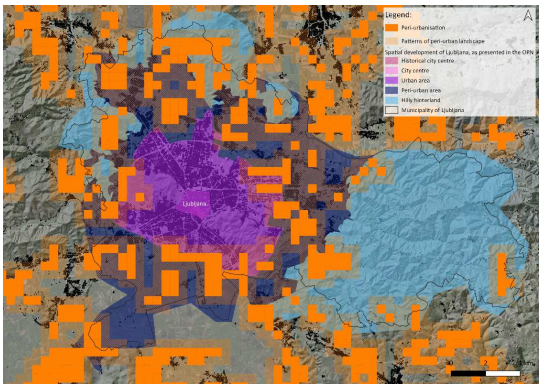

Fig. 1: The peri-urban landscape of Ljubljana. Data and background image sources: ARSO; DRSV; EEA; Geofabrik GmbH, OpenStreetMap Contributors; GURS; MK; MKGP; MNVP; MO Koper; SURS; Uradni list; ZGS

The results indicating the peri-urban landscape of Ljubljana coincide with the OPN's definition of the peri-urban landscape in the north, where the settlements of Šentvid, Polje and Črnuče are located, although our analysis indicated the extension of peri-urbanisation beyond the municipal border. The hills of Polhograjskohribovje on the west and Posavskohribovje on the east have restricted peri-urbanisation to spread to the west and to the east. Our results align with the OPN on the south, where peri-urbanisation occurs along Ižanskacesta (road), Tržaškacesta (road) and Črna vas (settlement). Barrier for peri-urbanisation on the south are hills Krimskohribovje. However, according to OPN, the peri-urban landscape covers the whole southern part of the municipality, where the Ljubljanskobarje (marsh) is located.

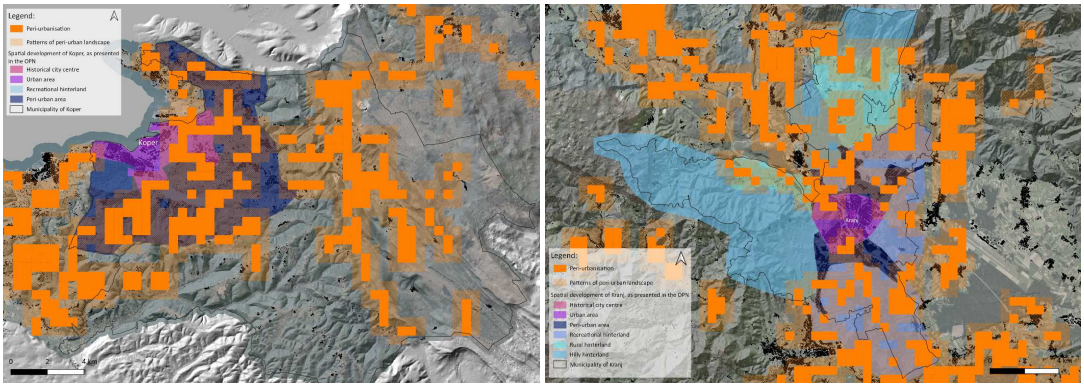

Fig. 2: The peri-urban landscape of Koper. Data and background image sources: ARSO; DRSV; EEA; Geofabrik GmbH, OpenStreetMap Contributors; GURS; MK; MKGP; MNVP; MO Koper; SURS; Uradni list; ZGS. Fig. 3: The peri-urban landscape of Kranj. Data and background image sources: ARSO; DRSV; EEA; Geofabrik GmbH, OpenStreetMap Contributors; GURS; MK; MKGP; MNVP; MO Koper; SURS; Uradni list; ZGS

Our results of the peri-urban landscape of Koper coincide with the OPN's characterisation of the peri-urban landscape in the north-eastern part which covers the settlements of Dekani, Pobegi, Sv. Anton and Škofije. The OPN indicates as peri-urban also Semedela and the Vanganel valley while our results indicate as peri-urban also the Šalara area and the coastal part towards the western side which belongs to the municipality of Izola.

In Kranj the analysis shows a tendency for peri-urbanisation developing along the main roads: to the north, in the thermal belt of Kranj below the mountains and around the highway junction, at train stops and the national airport. In the south, the whole plain (Kranjsko-Sorško polje) shows peri-urban characteristics, which is in alignment with the definition of this area in OPN as a multifunctional peri-urban area.

5.2 The spatial patterns of SOP provision potential in three case studies

In the three case studies, we identified spatial areas relative to the degree of SOP provision capacity by assigning scores of SOP provision capacity to various land cover types and protection regimes. Here it should be noted that we used the grid of cell size 100 by 100 metres because it showed better results as a grid of 500 by 500 metres cells. The images 4, 5 and 6 show results for each case study.

In the peri-urban landscape of Ljubljana, the resulting distribution of spatial patterns regarding SOP provision potential score from 'favourable' to 'slightly favourable' occurs in most of the open green land,

which aligns with green system hinterland from OPN. 'Very favourable' score was practically not present. Roads and larger settlements clusters exhibit 'no connection to provide SOP'. There are only few areas with a score of 'very harmful'. These are larger areas of built up and infrastructure use, such as the main shopping, business and leisure centre on the east (BTC City), mining areas and the city bypass.

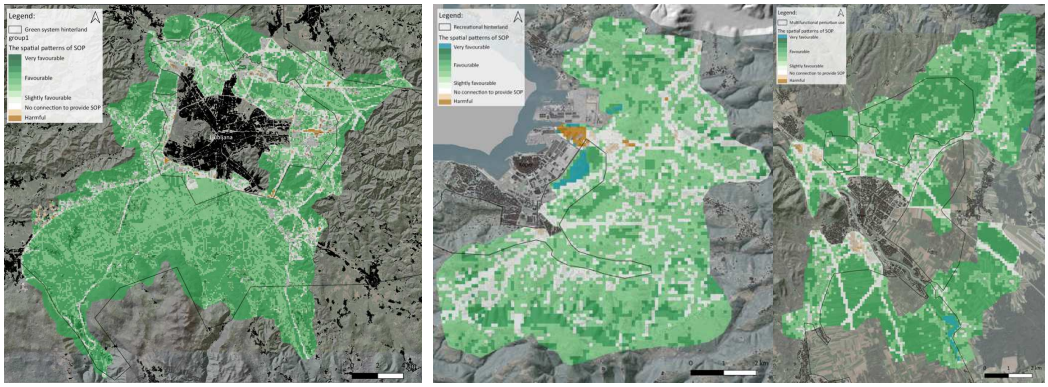

Fig. 4: The SOP provision potential map of Ljubljana. Data and background image sources: ARSO; DRSV; EEA; Geofabrik GmbH, OpenStreetMap Contributors; GURS; MK; MKGP; MNVP; MO Koper; SURS; Uradni list; ZGS. Fig. 5 and 6: The SOP provision potential map of Koper (left) and Kranj (right). Data and background image sources: ARSO; DRSV; EEA; Geofabrik GmbH, OpenStreetMap Contributors; GURS; MK; MKGP; MNVP; MO Koper; SURS; Uradni list; ZGS.

In the peri-urban landscape of Koper, the 'very favourable' spatial patterns occur in costal wetlands, especially in Škocjanski bay nature reserve. Spatial patterns of 'favourable' score are mainly exhibited along ridged hills and on the Karst edge. This is a very distinctive landscape because it is a geological and climatic border, where the Karst plateau turns into the flysch landscape of Slovenian Istria. Due to the scattered settlements, which show 'no connection to provide SOP', the border between 'very favourable' to 'no connection to provide SOP' is not clearly visible. Spatial patterns exhibiting the score of 'harmful' to 'very harmful' occur in the port of Koper and in industrial zones.

In the peri-urban landscape of Kranj, spatial patterns of 'very favourable' conditions can be observed on the lake Trboje on the south of the area. Spatial patterns of 'favourable' to 'slightly favourable' occur mostly on the open green land, indicating generally positive environmental characteristics. This evaluation aligns with green system hinterland from OPN. Railway, some small roads, transmission lines and settlements clusters show 'no connection to provide SOP'. Industrial, shopping, retail and leisure centres exhibit 'harmful' to 'very harmful' conditions.

In summary, we contend the analysis as being very illustrative of areas regarding their potential for SOP provision. We acknowledge that taking cells size of 100 by 100 metres improves the accuracy of the analysis (compared to taking cells size of 500 by 500 metres), since many land cover types are not necessarily large in size but can still have a distinctive effect on SOP. This may be especially relevant for identifying areas with 'harmful' conditions, which in none of studied cases appeared to be very extensive, when taking 500 by 500 metres cells. We also acknowledge that the use of different statistical analyses affects the results considerably. The summation method exposes water bodies, while the arithmetic mean method used exposes infrastructure and natural elements.

6 DISCUSSION AND CONCLUSION

6.1 Future actions for SOP in the peri-urban landscape

Taking the undetermined and ambiguous character of the peri-urban landscape as a challenge, our study demonstrated a scientifically guided method for indicating patterns of peri-urbanisation and assessing areas important for SOP of peri-urban landscape users.

Our results showed that the peri-urban landscape to support CES should not include only specific features such as population density or urbanisation, but also open spaces that have often multifunctional role in the peri-urban landscape. These open, unbuilt spaces therefore require unitary policies and integrated tools and regulation (Filyushkina et al. , 2022; Gottero et al. , 2023). We attempted to do this by including a variety of land cover types in the analysis and creating a buffer around the peri-urbanised areas to present peri-urban landscape more holistically.

ISBN 978-3-9504945-2-5. Editors: M. SCHRENK, V. V: POPOVICH, P. ZEILE, P. ELISEI, C.BEYER, J. RYSER, H. R. KAUFMANN – Ljubljana, Slovenia

Furthermore, our assessment of the potential of land cover types and regimes to provide SOP generated new insights into the spatial distribution of areas according to their SOP provision capacity, in three case studies. The used method allowed the presence of multiple land cover types and regimes in one cell. and the summed value indicated the interrelation of individual land cover types and regimes. We consider such an analysis more relevant in assessing SOP than the assessment of individual land uses, as suggested by Burkhardt et al. (2009)since SOP may be more likely manifested in a holistically perceived landscape(Ryfield et al. , 2019). This is especially relevant for Slovenia since finely structured land uses and covers are characteristic of the whole country's territory. Moreover, a mosaic of cultural landscapes of intermingling land covers and uses of arable fields, meadows and forest patches are recognised as valuable and a carrier of Slovenian national identity (Golobič & Lestan, 2016). This is emphasised also in the OPNs of all three case studies. Based on our results, we argue that the preservation of cultural landscape should be promoted due to its high potential for SOP capacity.

Our study provides valuable material for designing future policies with a direct impact on CES to enhance sustainable management of areas with high capacity to provide SOP. Of highest importance among them are the future regional spatial plans, as foreseen by the national Spatial Management Act (Uradni list 199/2021). The study can also be a starting point for a wider assessment of ecosystems and their services and consequent identification of land suited for future development based on its ES potential. That is to say that the peri-urban landscape is defined by high multifunctionality, thus not only conservation but also space for future urban development should be allocated there. The combination of different land cover types and regimes provides spatially explicit indication of meaningful places, which could be indicators of SOP (Knaps et al. , 2022). Spatial planners and managers can shape and foster place meanings by making these places accessible and allowing specific uses, thus encouraging the development potential of places to elevate their meaning and achieve more pro-environmental behaviour (Gottwald et al. , 2021; Žlender & Gemin, 2020). We are aware that not all land cover types or regimes within generalised land cover types and regimes support the same level of SOP. Assessing more specific land cover types and regimes, adding landscape features, points of interest and other elements may put additional values to the assessment of SOP provision. Nevertheless, we can evaluate the ecosystem service framework as having the capacity to capture evidence of SOP.

6.2 Evaluation of the methodological approach

This study was primarily scientist-driven and low stakeholder engagement is its main limitation. We are aware that the values used for the SOP supply assessment area theoretical estimation. However, we contend that the study contributes to much in demand capacity building. A natural progression of the study is the exploration of the perceptions of ES provision with the engagement of relevant stakeholders, to examine the extent to which the perceptions and opinions of different stakeholders may differ from each other, and compare those with literature-based values and those derived from modelling. Involving key stakeholders, especially the spatial planners and experts, collecting and confronting their opinions can culminate in producing more accurate assessments and new shared knowledge, which can elaborate an approach of both development and conservation plans and policies that build consensus among stakeholders, while supporting the concept of ecosystem services (Adem Esmail et al. , 2023; Filyushkina et al. , 2022).

Finally, we contend that the needs of peri-urban open space users and local residents are crucial in ecosystem management and spatial planning. In line with this, the actual supply of CES and use can be determined, rather than considering only the potential capacity. Thus, our future investigations will put efforts in engaging different stakeholders in our research of peri-urban landscape.

7 ACKNOWLEDGEMENT

The authors would like to thank Simon Koblar for his GIS technical guidance. This research was made possible with the financial support from the Slovenian Research Agency (grant numbers Z5-4589 and V5-2232).

8 APPENDIX

Dataset (model type)	Spatial data used	Source	Date
High Resolution Layer: Imperviousness Density (IMD) 2018 (raster, area)	Areas of imperviousness of below 45%	European Environment Agency (EEA)	August 2020
Population density 500mx500m (vector, polygon)	Population density	Statistical Office of the Republic of Slovenia (SURS)	2022
Economic public infrastructure (vector, line)	Highway and main roads, railways, sewage, oil, thermal energy, natural gas, waste, large power lines	Surveying and Mapping Authority of the Republic of Slovenia (GURS)	November 2022
Records of the actual use of agricultural and forest land (vector, polygon)	All groups except built-up and related land and water	Ministry of Agriculture, Forestry and Food (MKGP)	March 2023
Ecologically important areas (vector, polygon and point)	All ecologically important areas	Slovenian Environment Agency (ARSO)	July 2018
Protected areas (vector, point)	All protected areas	Slovenian Environment Agency (ARSO)	May 2010
Protected areas (vector, polygon)	All protected areas	Slovenian Environment Agency (ARSO)	August 2018
Register of natural features (vector, polygon)	All natural features	Slovenian Environment Agency (ARSO)	April 2015
Natura 2000 (vector, polygon)	All Natura 2000 areas	Slovenian Environment Agency (ARSO)	July 2018
Hydrography - surface waters (vector, line)	All surface water lines	Slovenian Water Agency (DRSV)	July 2021
Hydrography - objects and other (vector, line)	All hydrography objects and other lines	Slovenian Water Agency (DRSV)	July 2021
Hydrography - surface water (vector, polygon)	All surface water areas	Slovenian Water Agency (DRSV)	July 2021
Cadastre of Protective Forests (vector, polygon)	All protective forests	Slovenia Forest Service (ZGS)	December 2021
Cadastre of Forest Reserves (vector, polygon)	All forest reserves	Slovenia Forest Service (ZGS)	December 2005
Cultural Heritage Protection Regime (eVRD) (vector, polygon)	All cultural heritage protection regime areas	Ministry of Culture (MK)	December 2021
Open Street Map (vector, polygon)	college, graveyard,publicbuilding, school, kindergarten, university, bandstand, sauna, naturereserve, outdoorseating,schoolyard, campsite, picnicsite, themepark, viewpoint	Geofabrik GmbH, OpenStreetMap Contributors	2023
Building land records (vector, polygon)	All building land records areas	Ministry of Natural Resources and Spatial Planning (MNVP)	2023
Real property records (vector, polygon)	All real property records areas	Surveying and Mapping Authority of the Republic of Slovenia (GURS)	2023
Decree on the Municipal Spatial Plan of the Municipality of Ljubljana	Areas of spatial development	The Official Gazette of the Republic of Slovenia	October 2010
Decree on the strategic spatial plan of the municipality of Kranj	Areas of spatial development	The Official Gazette of the Republic of Slovenia	October 2014
Decree on the municipal spatial plan of the municipality of Koper	Areas of spatial development	Municipality of Koper (MOK)	January 2022
Base maps			
Digital orthophoto	Orthophoto	Surveying and Mapping Authority of the Republic of Slovenia (GURS)	2023
European Digital Elevation Model (EU-DEM), version 1. 1	Terrain	European Environment Agency (EEA)	April 2016
Real estate cadastre	Distribution of all built-up structures	Surveying and Mapping Authority of the Republic of Slovenia (GURS)	2023

9 REFERENCES

Aalbers, C. B. E. M., & Eckerberg, K. (2013). Governance and Sustainability of Peri-Urban Areas: A Comparative Analysis of the PLUREL Case Studies. In K. S. B. Nilsson, S. Pauleit, S. Bell, C. Aalbers, & T. A. Sick Nielsen (Eds.), Peri-urban futures: Scenarios and models for land use change in Europe. Springer Publishing Company.

Adem Esmail, B., Cortinovis, C., Wang, J., Geneletti, D., & Albert, C. (2023). Mapping and assessing ecosystem services for sustainable policy and decision-making in Eritrea. Ambio. https://doi.org/10.1007/s13280-023-01841-4

Aguilera, F., Valenzuela, L. M., & Botequilha-Leitão, A. (2011). Landscape metrics in the analysis of urban land use patterns: A case study in a Spanish metropolitan area. Landscape and Urban Planning, 99(3), 226–238. https://doi.org/10.1016/j.landurbplan.2010.10.004

Burkhard, B., Kroll, F., Müller, F., & Windhorst, W. (2009). Landscapes' capacities to provide ecosystem services—A concept for land-cover based assessments. Landscape Online, 15–15. https://doi.org/10.3097/LO.200915

Cadieux, K. V. (2008). Political ecology of exurban "lifestyle" landscapes at Christchurch's contested urban fence. Urban Forestry & Urban Greening, 7(3), Article 3.

Campagne, C. S., & Roche, P. (2018). May the matrix be with you! Guidelines for the application of expert-based matrix approach for ecosystem services assessment and mapping. One Ecosystem, 3, e24134. https://doi.org/10.3897/oneeco.3.e24134

Cattivelli, V. (2021). Planning peri-urban areas at regional level: The experience of Lombardy and Emilia-Romagna (Italy). Land Use Policy, 103, 105282.

Cheng, X., Van Damme, S., Li, L., & Uyttenhove, P. (2019). Evaluation of cultural ecosystem services: A review of methods. Ecosystem Services, 37, 100925–100925.

Dadashpoor, H., & Ahani, S. (2019). Land tenure-related conflicts in peri-urban areas: A review. Land Use Policy, 85, 218–229.
COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS Green Infrastructure (GI)—Enhancing Europe's Natural Capital, no. COM(2013)249 (2013). https://eur-lex.europa.eu/resource.html?uri=cellar:d41348f2-01d5-4abe-b817-4c73e6f1b2df.0014.03/DOC_1&format=PDF
European Environmental Agency. (2020). Imperviousness Density (IMD) 2018 [Data set]. https://land.copernicus.eu/pan-european/high-resolution-layers/imperviousness/status-maps/imperviousness-density-2018?tab=metadata
Feld, C. K., Sousa, J. P., Da Silva, P. M., & Dawson, T. P. (2010). Indicators for biodiversity and ecosystem services: Towards an improved framework for ecosystems assessment. Biodiversity and Conservation, 19(10), Article 10.
Filyushkina, A., Komossa, F., Metzger, M. J., & Verburg, P. H. (2022). Multifunctionality of a peri-urban landscape: Exploring the diversity of residents' perceptions and preferences. Ecosystems and People, 18(1), 583–597. https://doi.org/10.1080/26395916.2022.2131911
Fish, R., Church, A., & Winter, M. (2016). Conceptualising cultural ecosystem services: A novel framework for research and critical engagement. Ecosystem Services, 21, 208–217. https://doi.org/10.1016/j.ecoser.2016.09.002
Ganzevoort, W., & van den Born, R. J. G. (2019). Exploring place attachment and visions of nature of water-based recreationists: The case of the longitudinal dams. Landscape Research, 44(2), 149–161. https://doi.org/10.1080/01426397.2017.1415316
Gieryn, T. F. (2000). A Space for Place in Sociology. Annual Review of Sociology, 26(1), 463–496. https://doi.org/10.1146/annurev.soc.26.1.463
Golobič, M., & Lestan, K. A. (2016). Potential impacts of EU policies on cultural landscape diversity: Example of Slovenian coastal landscapes. Annales : Anali Za Istrske in Mediteranske Študije = Annali Di Studi Istriani e Mediterranei = Annals for Istrian and Mediterranean Studies. Series Historia et Sociologia, 26–2. https://doi.org/10.19233/ASHS.2016.16
Gonçalves, J., Gomes, M. C., Ezequiel, S., Moreira, F., & Loupa-Ramos, I. (2017). Differentiating peri-urban areas: A transdisciplinary approach towards a typology. Land Use Policy, 63, 331–341.
Gottero, E., Larcher, F., & Cassatella, C. (2023). Defining and Regulating Peri-Urban Areas through a Landscape Planning Approach: The Case Study of Turin Metropolitan Area (Italy). Land, 12(1), Article 1. https://doi.org/10.3390/land12010217
Gottwald, S., Brenner, J., Albert, C., & Janssen, R. (2021). Integrating sense of place into participatory landscape planning: Merging mapping surveys and geodesign workshops. Landscape Research, 46(8), 1041–1056. https://doi.org/10.1080/01426397.2021.1939288
Haines-Young, R., & Potschin, M. (2013). Common International Classification of Ecosystem Services (CICES) V5.1 and Guidance on the Application of the Revised Structure. In Contract No EEA/IEA/09/003.
Hawthorne, T. L., Toohy, K. R., Yang, B., Graham, L., Lorenzo, E. M., Torres, H., McDonald, M., Rivera, F., Bouck, K., & Walters, L. J. (2022). Mapping Emotional Attachment as a Measure of Sense of Place to Identify Coastal Restoration Priority Areas. Applied Geography, 138, 102608. https://doi.org/10.1016/j.apgeog.2021.102608
Hidalgo, M. C., & Hernández, B. (2001). Place attachment: Conceptual and empirical questions. Journal of Environmental Psychology, 21(3), Article 3. https://doi.org/10.1006/jevp.2001.0221
Hu, M., & Chen, R. (2018). A Framework for Understanding Sense of Place in an Urban Design Context. Urban Science, 2(2), Article 2. https://doi.org/10.3390/urbansci2020034
Knaps, F., Gottwald, S., Albert, C., & Herrmann, S. (2022). Using meaningful places as an indicator for sense of place in the management of social-ecological systems. Ecology and Society, 27(4). https://doi.org/10.5751/ES-13340-270409
Koohsari, M. J., Yasunaga, A., Oka, K., Nakaya, T., Nagai, Y., & McCormack, G. R. (2023). Place attachment and walking behaviour: Mediation by perceived neighbourhood walkability. Landscape and Urban Planning, 235, 104767. https://doi.org/10.1016/j.landurbplan.2023.104767
Kopperoinen, L., Itkonen, P., & Niemelä, J. (2014). Using expert knowledge in combining green infrastructure and ecosystem services in land use planning: An insight into a new place-based methodology. Landscape Ecology, 29(8), 1361–1375. https://doi.org/10.1007/s10980-014-0014-2
Kristensen, L. S., & Primdahl, J. (2020). Landscape strategy making as a pathway to policy integration and involvement of stakeholders: Examples from a Danish action research programme. Journal of Environmental Planning and Management, 63(6), 1114–1131. https://doi.org/10.1080/09640568.2019.1636531
Layke, C., Mapendembe, A., Brown, C., Walpole, M., & Winn, J. (2012). Indicators from the global and sub-global Millennium Ecosystem Assessments: An analysis and next steps. Ecological Indicators, 17, 77–87.
Luiza Petroni, M., Siqueira-Gay, J., & Lucia Casteli Figueiredo Gallardo, A. (2022). Understanding land use change impacts on ecosystem services within urban protected areas. Landscape and Urban Planning, 223, 104404. https://doi.org/10.1016/j.landurbplan.2022.104404
Marušič, J., Ogrin, D., Jančič, M., Bartol, B., Jug, M., & Maligoj, T. (1998). Metodološke osnove: [Uvodni zvezek]. In Regionalna razdelitev krajinskih tipov v Sloveniji. Ministrstvo za okolje in prostor RS, Urad RS za prostorsko planiranje.
MEA. (2005). Millenium ecosystem assessment. Ecosystems and human well-being (Vol. 5). Island press Washington, DC.
Odlok o strateškem prostorskem načrtu Mestne občine Kranj, (2014) (testimony of MOK). https://www.uradni-list.si/glasilo-uradni-list-rs/vsebina/119153
Odlok o občinskem prostorskem načrtu Mestne občine Koper, (2022) (testimony of MOK). https://www.koper.si/wp-content/uploads/2022/02/11_odlok_cistopis.pdf
Odlok o občinskem prostorskem načrtu Mestne občine Ljubljana – strateški del, 3504-4/201 (2010) (testimony of (Mestna občina Ljubljana) MOL). http://www.uradni-list.si/1/content?id=100182
Mortoja, M. G., Yigitcanlar, T., & Mayere, S. (2020). What is the most suitable methodological approach to demarcate peri-urban areas? A systematic review of the literature. Land Use Policy, 95, 104601.
Mulvaney, K. K., Merrill, N. H., Mazzotta, M. J., Mulvaney, K. K., Merrill, N. H., & Mazzotta, M. J. (2020). Sense of Place and Water Quality: Applying Sense of Place Metrics to Better Understand Community Impacts of Changes in Water Quality. In Water Quality—Science, Assessments and Policy. IntechOpen. https://doi.org/10.5772/intechopen.91480

Neuvonen, M., Sievänen, T., Tönnes, S., & Koskela, T. (2007). Access to green areas and the frequency of visits—A case study in Helsinki. Urban Forestry & Urban Greening, 6(4), Article 4. https://doi.org/10.1016/j.ufug.2007.05.003
Nilsson, K., Pauleit, S., Bell, S., Aalbers, C., & Nielsen, T. S. (2013). Peri-urban futures: Scenarios and models for land use change in Europe. Springer Science & Business Media.
OpenStreetMap Contributors. (2023). Region extract retrieved from http://download.geofabrik.de/ [Data set]. https://www.openstreetmap.org
Palang, H., Spek, T., & Stenseke, M. (2011). Digging in the past: New conceptual models in landscape history and their relevance in peri-urban landscapes. Landscape and Urban Planning, 100(4), Article 4.
Pichler-Milanović, N. (2005). Urbs Pandens: Land use changes. http://www.pik-potsdam.de/urbs/projekt/lur_evidence2.pdf
Pintar, M., Perpar, A., Udovč, A., Zupan, M., Černič-Istenič, M., Miličić, V., Babič, T., Deranja, D., Bangiev, G., & Mlakar, A. (2013). Koper: Beyond the Rural and Urban Paradigm. In K. Nilsson, S. Pauleit, S. Bell, C. Aalbers, & T. A. Sick Nielsen (Eds.), Peri-urban futures: Scenarios and models for land use change in Europe (pp. 275–306). Springer. https://doi.org/10.1007/978-3-642-30529-0_11
Piorr, A., Ravetz, J., & Tosics, I. (2011). Peri-urbanisation in Europe: Towards a European Policy to sustain Urban-Rural Futures (pp. 144–144). University of Copenhagen / Academic Books Life Sciences.
Piorr, A., Ravetz, J., Tosics, I., & PLUREL. (2011). Peri-urbanisation in Europe: Towards European Policies to Sustain Urban-rural Futures : Synthesis Report. Forest & Landscape.
Plieninger, T., Dijks, S., Oteros-Rozas, E., & Bieling, C. (2013). Assessing, mapping, and quantifying cultural ecosystem services at community level. Land Use Policy, 33, 118–129.
QGIS project. (2023, June 14). QGIS Documentation: 16.1.2.3. Query Builder. QGIS Project. https://docs.qgis.org/3.28/en/docs/user_manual/working_with_vector/vector_properties.html#query-builder
Qviström, M., & Saltzman, K. (2008). Ambiguous edgelands: Landscape studies beyond rural-urban divides and disciplinary trench-lines. Urban Forestry & Urban Greening, 7(3), Article 3.
Relph, E. (1976). Place and placelessness (Vol. 67). Pion London.
RENATUR: Improving regional policies to better protect natural heritage of peri-urban open spaces. (2023). https://projects2014-2020.interregeurope.eu/renatur/
Ribeiro, D., & Hribar, M. Š. (2019). Assessment of land-use changes and their impacts on ecosystem services in two Slovenian rural landscapes. Acta Geographica Slovenica, 59(2), Article 2. https://doi.org/10.3986/AGS.6636
Ryan, R. L. (2011). The social landscape of planning: Integrating social and perceptual research with spatial planning information. Landscape and Urban Planning, 100(4), 361–363. https://doi.org/10.1016/j.landurbplan.2011.01.015
Ryfield, F., Cabana, D., Brannigan, J., & Crowe, T. (2019). Conceptualizing 'sense of place' in cultural ecosystem services: A framework for interdisciplinary research. Ecosystem Services, 36, 100907. https://doi.org/10.1016/j.ecoser.2019.100907
Shoard, M. (2000). Edgelands of promise. Landscapes, 1(2), Article 2.
Simon, D., McGregor, D., & Thompson, D. (2006). Contemporary perspectives on the peri-urban zones of cities in developing areas in. In D. F. M. McGregor, D. Simon, & D. A. Thompson (Eds.), The peri-urban interface: Approaches to sustainable natural and human resource use Earthscan, London (pp. 1–17).
Zakon o urejanju prostora (ZUreP-3), (199 C.E.).
Spyra, M., Kleemann, J., Calò, N. C., Schürmann, A., & Fürst, C. (2021). Protection of peri-urban open spaces at the level of regional policy-making: Examples from six European regions. Land Use Policy, 107, 105480.
Statistični urad RS. (2023). SiStat [Data set]. https://pxweb.stat.si/SiStatData/pxweb/sl/Data/-/2640010S.px
Stedman, R. C. (2003). Is it really just a social construction?: The contribution of the physical environment to sense of place. Society & Natural Resources, 16(8), Article 8. https://doi.org/10.1080/08941920309189
Stedman, R. C. (2016). Subjectivity and social-ecological systems: A rigidity trap (and sense of place as a way out). Sustainability Science, 11(6), 891–901. https://doi.org/10.1007/s11625-016-0388-y
Tuan, Y. (1977). Space and place: The perspective of experience (pp. vi, 235 p.). Edward Arnold.
Twigger-Ross, C. L., & Uzzell, D. L. (1996). Place and identity processes. Journal of Environmental Psychology, 16(3), Article 3. https://doi.org/10.1006/jevp.1996.0017
Tyrväinen, L., Mäkinen, K., & Schipperijn, J. (2007). Tools for mapping social values of urban woodlands and other green areas. Landscape and Urban Planning, 79(1), Article 1. https://doi.org/10.1016/j.landurbplan.2006.03.003
Ugolini, F., Massetti, L., Calaza-Martínez, P., Cariñanos, P., Dobbs, C., Ostoić, S. K., Marin, A. M., Pearlmutter, D., Saaroni, H., Šaulienė, I., Simoneti, M., Verlič, A., Vuletić, D., & Sanesi, G. (2020). Effects of the COVID-19 pandemic on the use and perceptions of urban green space: An international exploratory study. Urban Forestry & Urban Greening, 56, 126888. https://doi.org/10.1016/j.ufug.2020.126888
Wandl, A., Rooij, R., & Rocco, R. (2017). Towards sustainable territories-in-between: A multidimensional typology of open spaces in Europe. Planning Practice & Research, 32(1), Article 1.
Wandl, D. A., Nadin, V., Zonneveld, W., & Rooij, R. (2014). Beyond urban–rural classifications: Characterising and mapping territories-in-between across Europe. Landscape and Urban Planning, 130, 50–63.
Zhang, S., & Muñoz Ramírez, F. (2019). Assessing and mapping ecosystem services to support urban green infrastructure: The case of Barcelona, Spain. Cities, 92, 59–70. https://doi.org/10.1016/j.cities.2019.03.016
Žlender, V. (2021a). Characterisation of peri-urban landscape based on the views and attitudes of different actors. Land Use Policy, 101, 105181. https://doi.org/10.1016/j.landusepol.2020.105181
Žlender, V. (2021b). Developing a spatially explicit method for delineating peri-urban landscape. Urban Challenge, 98. https://doi.org/10.5379/urbani-izziv-en-2021-32-02-03
Žlender, V., & Gemin, S. (2020). Testing urban dwellers' sense of place towards leisure and recreational peri-urban green open spaces in two European cities. Cities, 98, 102579–102579. https://doi.org/10.1016/j.cities.2019.102579
Žlender, V., & Gemin, S. (2023). Different Environments and Physical Activity before and during the COVID-19 Lockdown: Data from Slovenia. Land, 12(2), Article 2. https://doi.org/10.3390/land12020282