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The use of landscape value assessment in spatial planning and sustainable land management — a review

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ABSTRACT

The aim of this paper is to formulate a conceptual framework for integrating landscape value assessment with planning. Concepts of landscape value, methodological approaches and their possible use for spatial planning are discussed by critically reviewing interdisciplinary literature on the subject. The author analyses 47 papers presenting landscape value assessments. The reviewed research was undertaken in 24 countries in the years 1986–2016. Research papers are analysed in terms of a number of values, calculation methods and use of expert opinion/public participation or combined as well as theoretical frameworks. Methods of enhancing spatial planning and sustainable land management by means of landscape evaluation based on natural, cultural and aesthetic values are critically reviewed as well. Finally, a conceptual framework, that highlights the approach to planning based on landscape value assessment is presented. The framework forms the basis for further interdisciplinary research.

KEYWORDS

Landscape evaluation; landscape planning; landscape management; spatial planning; European Landscape Convention

Introduction

One of the responsibilities of the European Union Member States that signed the European Landscape Convention (ELC) is to 'integrate landscape into its regional and town planning policies (…) and other policies with a possible direct or indirect impact on landscape' (European Landscape Convention, 2000). Each member country needs to develop its own methods to achieve the objective. Landscape value assessment is a tool that enables comparison of different landscape units in terms of environmental, cultural and aesthetic/perceptual values. This kind of assessment provides information to planners on what values are strongly represented by a particular landscape. Many different perspectives may be adopted for landscape value assessment.

In the assessment process, it is important to understand the concept of value. This paper focuses on non-monetary value. From this perspective, landscape values provide information about human needs and desires (Zube, 1987) that can be different depending on the stakeholders and their interests. This information about landscape can be used to identify spots with special meanings, potential spatial conflicts among interest groups in planning and management, identify needs and opportunities for education about landscapes and scenarios of alternative planning recommendations (Zube, 1987). Landscape value assessment means an evaluation and comparison of values assigned to different sections of a study area (Smith & Theberge, 1986). The pioneering conceptual work in landscape value assessment was done by Rolston and Coufal (1991), who identified 10 basic landscape values: life support, economic, scientific, recreation, aesthetic, wildlife, biotic diversity, natural history, spiritual, and intrinsic. This concept was modified by Brown and

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Reed (2000), who expanded their range to 13 values by including subsistence, cultural, and therapeutic values. They enriched their research with tracking *special places* and *development/no-development places* to identify the character of a place in addition to landscape value assessment (Brown & Raymond, 2007). Gómez-Sal, Belmontes, and Nicolau (2003) identified five evaluative dimensions of landscape that include most of the elements contributing to landscape values and must be analysed by specific indicators: ecological, productive, economic, social and cultural.

Among the methods of assessing landscape value, the use of landscape metrics (LM) has become more popular during the last 10 years, although the evaluation of the change in land use or land cover remains the main field of exploitation of these metrics (Uuemaa, Mander, & Marja, 2013). This shift in use of LM may be associated with introducing the European Landscape Convention (2000), which obligates all member states to identify their landscapes and analyse their characteristics, forces and pressures transforming them (2.6.C). LM can be used on different levels and are easy to compare. First used in landscape ecology, they are now applied to assess cultural and aesthetic values (Ode, Tveit, & Fry, 2008; Tieskens et al., 2017). The biggest advantage of LM is providing a common language for stronger interactions between ecologists and planners (Leitao & Ahern, 2002). While ecologists focus on managing natural resources, planners seek to use them for the benefit of all people (Leitao & Ahern, 2002). On the other hand, numerous other methods that can enrich this approach have been developed during that time (Acar, Eroğlu, & Acar, 2013; Molina, Silva, & Herrera, 2016).

The aim of this paper is to integrate literature on the concept of landscape value assessment with spatial planning. This is achieved through addressing three objectives: (a) constructing a set of definitions; (b) undertaking a critical review of the literature on associations between landscape value assessment and spatial planning, (c) constructing a conceptual framework for the interface between those two disciplines. The following section presents materials and methods used in this study. Section three provides the information about specific values and calculation methods used to assess natural, cultural and aesthetic values of landscape. Section four focuses on possible use of landscape value assessment in spatial planning. Section five presents the discussion and conclusions.

Materials and methods

Electronic journal databases (Web of Science, Science Direct) were searched with the use of key words for landscape value assessment. Only peer review publications were selected for the subsequent selection of articles. A total of 47 relevant articles considering landscape as a complex system were identified. The articles were critically evaluated to answer the following research questions:

(1) Which landscape values are considered in landscape value assessment methods?
(2) What calculation methods are used in landscape value assessment?
(3) How can landscape value assessment support spatial planning and land use policy at the local level?

Landscape value assessment is used by researchers from different fields. To make the analysis clearer, landscape values are analysed in terms of landscape features identified by Swanwick (2002): natural, cultural/social, perceptual and aesthetic. From the group of 47 papers, only those with possible use in spatial planning were extracted and reviewed with a focus on:

(1) Calculation methods (LM or other);
(2) Use of expert opinion/public participation or combined;
(3) Theoretical frameworks for integrating landscape value assessment with land use policy/ spatial planning.

Results

The author analysed 47 papers in the field of landscape value assessment published in the years 1986–2016 (Table 1). The research was carried out in 24 countries around the world. The number of papers in the field of landscape value assessment increases after the year 2000. Only four out of 47 reviewed papers were published before the year 2000. Research papers focus on different landscape features. Only seven of them include all kinds of features: natural, cultural and perceptual/aesthetic. 29 papers focus on natural features and 14 on cultural and social. 29 papers consider perceptual and aesthetic features. The majority of calculations are based on LM (23 papers). Expert opinion has become less popular in landscape research (six papers) as opposed to public participation or a lay-people-opinion-oriented approach which is represented in 20 papers. It is assumed that the people-oriented approach can be a result of the landscape definition in the ELC ('Landscape means an area, as perceived by people…'). Most of the research is focused on a testing method on the case study area (40 papers), while some (nine papers) present a theoretical framework and literature review. The authors of 28 papers (60%) suggest possible use of a proposed landscape value assessment method in spatial planning.

Natural landscape values

There are 12 natural landscape values identified (Table 2). Seven of them were included only in one study: native wildlife and vegetation, marine (Brown & Brabyn, 2012), fragility, productivity (Smith & Theberge, 1986), natural history (Brown & Reed, 2000) and possible use for the renewal of groundwater resources (Bastian & Lütz, 2006). Life sustaining value, biological diversity, ecological value, wilderness and naturalness are more popular. Life sustaining value was first used by Brown and Reed to value the forest landscape. It is understood as a value of landscape (forest) that helps to produce, preserve, clean and renew air, soil and water (Brown & Reed, 2000). Biological diversity is understood as a value associated with a variety of species (Brown & Reed, 2000) and can be defined as a diversity of habitats, and is measured by Shannon's diversity index (Dramstad et al., 2002). Biodiversity can also be measured by the richness of species and the number of species of conservation concern (Milne & Bennett, 2007). To assess landscape quality, biodiversity is measured by the risk of species loss and the composition of forests in terms of different species (Sowinska-Swierkosz & Chmielewski, 2016), yet the authors do not explain their calculation method. Biodiversity is also discussed in the context of landscape preferences expressed by people. Research in the Swiss Alps shows that values of respondents range from biodiversity to cultural values, which in turn influences their landscape preferences (Soliva & Hunziker, 2009). Also, a study of perceived landscape values for Ogasawara Islands considers biodiversity as one of the values (Havas, Saito, Hanaki, & Tanaka, 2016). Biodiversity and life sustaining value are natural values which appear in another landscape evaluation by Brown and Reed (2000). Public preferences of rocky landscape include the criteria of ecological value and naturalness (Acar et al., 2013). One of the approaches is analysing the relationship between landscape perception and its ecological value. A Swedish study investigates whether preferences and biodiversity are compatible in urban green space and whether people recognize and appreciate ecologically rich environments (Qiu, Lindberg, & Nielsen, 2013). Research carried out in the island of Fuertavertura investigates landscape perception and the relationship between ecological characteristics, local society and visitor preferences (Díaz et al., 2010). Gómez-Sal et al. (2003) use the criteria of naturalness (measured by the slope, the steepest land the areas less impacted by human) and conservation value (measured by the size of protected natural areas) to assess ecological landscape value. Leitao and Ahern (2002) give a detailed core set of LM according to ecological processes: landscape composition and configuration metrics. They assume that LM can improve communication between ecologists and planners. Another assessment was based on ecological potential, stability, load and tension (Muradyan & Asmaryan, 2015). Social LM are used to value landscape units by people considering

Table 1. Landscape value assessment in scientific literature—considered types of values, methods and possible use in spatial planning.

Author	Year	Environmental value	Cultural/ social value	Perceptual/ aesthetic value	Possible use in spatial planning	Based on landscape metrics	Based on expert opinion	Based on public participation/survey	Case study	Review/thoretical framework	Country
Smith and Theberge	1986	x	x	x						x	-
Zube	1987	x	x	x	x			x	x		USA
Kent and Elliott	1995			x				x	x		United States
Lee et al.	1999	x			x	x			x		Great Britain
Brown and Reed	2000	x	x	x	x			x	x		USA
Weber et al.	2000	x	x		x	x				x	Germany
Krause	2001			x	x					x	Germany
Leitao and Ahern	2002	x			x				x	x	USA
Dramstad et al.	2002	x	x		x	x			x		Norway
Gómez-Sal et al.	2003	x	x		x	x			x	x	Spain
Dakin	2003			x	x			x	x	x	Canada
Weber	2004	x				x			x		United States
Jim	2004	x							x		China
Geneletti	2005	x			x		x		x		Italy
Bastian and Lütz	2006	x			x	x			x		Germany
Brown and Raymond	2007	x	x	x	x			x	x		Australia
Milne and Bennet	2007	x			x	x			x		Canada
Ode et al.	2008			x		x				x	-
Bulut and Yilmaz	2008			x	x				x		Turkey
Vouligny et al.	2009			x	x		x	x	x		Canada
Soliva and Hunziker	2009	x	x		x			x	x	x	Switzerland
Canas	2009			x				x			
Tveit	2009			x				x	x		Norway
Vouligny et al.	2009			x							
Beza	2010			x					x		Mt. Everest
Díaz et al.	2010			x				x	x		Spain
Pflüge et al.	2010			x				x	x		New Zealand
Renetzeder et al.	2010	x			x	x			x		Austria
Ramírez et al.	2011			x				x	x		Spain
La Rosa	2011			x		x	x		x		Italy
Brown and Brabyn	2012	x	x	x	x			x	x		New Zealand
Frank et el.	2012	x	x	x	x	x			x		Germany

(*Continued*)

Table 1. (Continued).

Author	Year	Environmental value	Cultural/ social value	Perceptual/ aesthetic value	Possible use in spatial planning	Based on land-scape metrics	Based on expert opinion	Based on public participation/survey	Case study	Review/thoreti-cal framework	Country
Willis et al.	2012	x			x	x			x		Algeria, Russia, Canada
Frank et al.	2013			x	x	x		x	x		Germany
Freudenberger et al.	2013	x			x	x			x		Germany
Chen and Lin	2013	x			x	x			x		Taiwan
Qiu et al.	2013	x		x			x	x	x		Sweden
Schirpke et al.	2013			x		x		x	x		Austria, Italy
Acar et al.	2013	x		x	x			x	x		Turkey
Kalivoda et al.	2014			x					x		Czech Republic
Muradyan and Asmaryan	2015	x				x			x		Armenia
Ozkan and Ozdemir	2015			x		x			x		Turkey
Sowińska-Świerkosz and Chmielewski	2016	x	x	x	x	x	x	x	x		Poland
Havas et al.	2016	x	x	x	x			x	x		Japan
Molina et al.	2016		x	x	x		x	x	x		Spain
Martín et al.	2016			x	x	x			x		Spain
Jones et al.	2016	x				x			x		Europe

Table 2. Natural values considered in landscape value assessments in scientific literature.

Author	Year	Life sustaining value	Biodiversity	Ecological/ environmental	Native wildlife	Native vegetation	Marine	Wilderness	Fragility	Natural history	Renewal of groundwater resources	Naturalness	Productivity
Smith and Theberge	1986			x				x	x				x
Lee et al.	1999			x									
Brown and Reed	2000	x	x					x		x			
Leitao and Ahern	2002			x									
Dramstad et al.	2002		x										
Gómez-Sal et al.	2003			x									
Weber et al.	2004			x									
Jim et al.	2004		x										
Geneletti	2005			x									
Bastian and Luetz	2006		x								x		
Brown and Raymond	2007	x	x					x					
Milne and Bennet	2007		x										
Jones et al.	2008			x									
Soliva and Hunziker	2009		x										
Voulingy et al.	2009			x									
Renetzeder et al.	2010											x	
Brown and Brabyn	2012			x	x	x	x	x					
Frank et el.	2012			x								x	
Willis et al.	2012		x	x									
Freudenberger et al.	2013			x									
Chen and Lin	2013			x									
Qiu et al.	2013		x										
Acar et al.	2013							x					
Muradyan and Asmaryan	2015			x									
Sowińska-Świerkosz and Chmielewski	2016		x	x									
Havas et al.	2016	x	x					x					

the criteria of ecological and wilderness value as well as the value of native flora and fauna (Brown & Brabyn, 2012).

Cultural and social landscape values

There are 15 cultural landscape values identified (Table 3). Most popular cultural values are: economic, recreational, historical and learning values. The economic value of landscape is understood as providing timber, fisheries, minerals, or tourism opportunities such as outfitting and guiding (Brown & Reed, 2000; Havas et al., 2016). Economic value can be established from the profitability of agricultural, stock-rearing and silvicultural exploitation (Gómez-Sal et al., 2003) in the context of rural landscape. In the context of urban landscape, economic efficiency is calculated as compactness of the city with the use of the Shape Index (SI) (Frank, Fürst, Koschke, & Makeschin, 2012). Recreational value of landscape is understood as providing space for outdoor recreation activities (Brown & Brabyn, 2012; Brown & Raymond, 2007; Brown & Reed, 2000). Recreation is one of the evaluation criteria for Ogasawara Islands landscape (Havas et al., 2016). Historical landscape value is understood as providing places or objects of natural and human history (Brown & Brabyn, 2012; Brown & Raymond, 2007; Brown & Reed, 2000). Cultural heritage is also calculated by LM with the use of national cultural heritage databases (Dramstad et al., 2002; Sowinska-Swierkosz & Chmielewski, 2016). The learning/educational value is included in several studies concerning theoretical frameworks (Brown & Raymond, 2007; Brown & Reed, 2000; Smith & Theberge, 1986) and evaluation performed by people (Havas et al., 2016; Vouligny, Domon, & Ruiz, 2009); however, it does not have any regular calculation methods. The productive value is used by Gómez-Sal et al. (2003) to assess value of agricultural, stock-rearing and silvicultural activities in rural landscape. Other values: social, scientific, therapeutic, future, attachment-to-the-place, accessibility, symbolism, subsistence and spiritual value are included in several studies based on people's perception of landscape (Brown & Raymond, 2007; Brown & Reed, 2000; Havas et al., 2016; Vouligny et al., 2009).

Perceptual and aesthetic landscape values

The author identified 15 perceptual and aesthetic landscape values (Table 4). The aesthetic value is understood as providing scenery, sights, sounds, smells, of different quality (Brown & Reed, 2000). A popular method for aesthetic value assessment is asking the participants of a survey to evaluate photographs (Beza, 2010; Bulut & Yilmaz, 2008; Canas, Ayuga, & Ayuga, 2009; Pflüger, Rackham, & Larned, 2010; Tveit, 2009). This method enables us to find out about people's preferences. As it is based on people's views and opinions only, it is hard to introduce this method to landscape planning. Some authors use more detailed criteria to assess scenic beauty of the landscape. Criteria of uniqueness, size, variety and representativeness are used to assess aesthetic value of natural areas (Smith & Theberge, 1986). Vouligny asks his respondents why they value a particular landscape. Perceptual and aesthetic values listed by people consider: harmony, atmosphere, ephemeral, uniqueness, maintenance (cleanliness, landscaping), sensory experiences, view, vastness, colour and admirability (Vouligny et al., 2009). Ramirez uses the criteria of form, colour and texture to assess aesthetic factors of landscape quality from rural roads in Spain (Ramirez, Ayuga-Tellez, Gallego, Fuentes, & Garcia, 2011). Formal criteria of tree composition, size and form were used to assess aesthetic value of urban environment (Ozkan & Ozdemir, 2015). Kalivoda, Vojar, Skřivanová, and Zahradník (2014) analyse landscape visual aesthetic quality, landscape type and variability among respondents to assess possible sources of judgment variance. Detailed study of landscape visual character using theory-based visual indicators was conducted by Ode et al. (2008). This study examines visual landscape character and LM using different data sources. As this study aims to integrate landscape value assessment with spatial planning, it is focused on metrics based on land cover data source. Aesthetic values of landscape can be measured by landscape complexity, land cover contrast and diversity (Frank et al., 2012; Frank, Fürst, Koschke, Witt, & Makeschin, 2013).

Table 3. Cultural values considered in landscape value assessments in scientific literature.

Author	Year	Economic	Productive	Recreational	Social	Hictorical/ Cultural heritage	Scientific	Therapeutic	Future	Learning/ educational	Attachment to the place/community/ family connections	Accessibility	Symbolism	Spiritual/ sacrum	Subsistence
Smith and Theberge	1986			x		x	x			x		x			
Brown and Reed	2000	x		x		x	x	x		x				x	x
Dramstad et al.	2002					x									
Gómez-Sal et al.	2003	x	x												
Brown and Raymond	2007	x		x		x		x	x	x	x			x	
Soliva and Hunziker	2009					x									
Vouligny et al.	2009					x				x		x	x		
Brown and Brabyn	2012	x		x	x	x									
Frank et al.	2012	x													
Sowińska-Świerkosz and Chmielewski	2016					x									
Havas et al.	2016	x		x		x			x	x					
Molina et al.	2016	x													

Table 4. Perceptual and aesthetic values considered in landscape value assessments in scientific literature.

Author	Year	Aesthetic/ scenic	Harmony	Atmosphere	Ephemeral	Uniqueness	Maintenance	Sensory experiences	View	Vastness	Colours	Admirable	Size	Variety	Representativeness/ typicalness	Texture
Smith and Theberge	1986					x							x	x	x	
Brown and Reed	2000	x														
Brown and Raymond	2007	x														
Ode et al.	2008	x			x											
Bulut and Yilmaz	2008	x														
Canas	2009	x														
Tveit	2009	x														
Vouligny et al.	2009		x	x	x	x	x	x	x	x	x	x				
Beza	2010	x														
Díaz et al.	2010	x						x								
Pflüge et al.	2010	x														
Ramírez et al.	2011	x									x					x
Brown and Brabyn	2012	x														
Frank et el.	2012	x														
Frank et al.	2013	x														
Qiu et al.	2013	x														
Schirpke et al.	2013	x														
Acar et al.	2013	x														
Kalivoda et al.	2014	x														
Ozkan and Ozdemir	2015	x														
Sowińska-Świerkosz and Chmielewski	2016	x														
Havas et al.	2016	x														
Molina et al.	2016	x														
Martín et al.	2016	x														

Integrating landscape value assessment with planning

To answer the following research question: 'what is the best way to integrate landscape value assessment with land use policy at local level?', there were 28 papers extracted from the group of 47 whose authors mention the possible use of landscape value assessment in planning. Then reviewed papers were divided into two groups: those which use LM to assess the value and those which do not.

15 papers that use LM to assess landscape value were reviewed. 13 of them consider the environmental value, five of them consider the cultural value, four of them consider the perceptual value of landscape. Two papers consider all three types of landscape values. Firstly, papers concerning natural value that use ecological indicators to assess value of particular area or type of area were analysed. Such studies were conducted for agricultural mosaics on the basis of the maintenance of faunal biodiversity (Milne & Bennett, 2007) or to assess naturalness and geometrisation of landscape on regional, national and European level (Renetzeder et al., 2010). Another study aimed to assess ecological value of landscape beyond protected areas (Willis et al., 2012). The LM is also used to assess potential impact on biodiversity, for instance spatial road disturbance index used to calculate the effect that roads have on the structure of natural habitats (Freudenberger et al., 2013). Combining LM with landscape functions and socio-economic parameters served to calculate the impact on environmental pressures of local farms (Bastian & Lütz, 2006). LM integrated with the landscape development intensity index (LDI) was used for environmental assessment of wetlands (Chen & Lin, 2013). Lee focuses on analysing the landscape structure with the use of criteria: land use, patch size and land use importance to assess the ecological value of landscape and design land use policy guidelines. The scores for different land uses were assigned by researcher (Lee, Elton, & Thompson, 1999). Weber (2004) uses the ecological parameters to characterize the hubs in the protected bay area.

Another type of papers are represented by a mixed natural and cultural approach (Weber, Strade, & Schön, 2000). Based on assessment of economic, ecological and production values of landscape, different development scenarios at the local level were designed (Gómez-Sal et al., 2003). LM was used as variables to assess landscape value as a part of a monitoring programme in Norway not only considering biodiversity and spatial structure of agricultural land but also cultural heritage and accessibility (Dramstad et al., 2002).

Five of the review papers were dedicated to aesthetic value of landscape. Ode et al. (2008) have identified a wide range of indicators covering different aspects of the visual landscape based on the landscape aesthetic theory and framed into visual landscape assessment to enable capturing visual character of a landscape. With the use of viewshed analysis, the proposition for index of visible landscape value was assessed (La Rosa, 2011). Another approach was verifying landscape aesthetic metrics by rating pictures of different landscape types by respondents (Frank et al., 2013). Schirpke, Tasser, and Tappeiner (2013) designed a GIS-based model that offers a valid instrument for scenic beauty assessments of mountainous regions as a basis for policy making and landscape planning. This method is based on viewpoints and spatial patterns of visible landscape analysed by means of the LM. Martin, Ortega, Otero, and Arce (2016) designed a methodology to evaluate both the character and the scenic quality of the landscape as viewed from motorways and to provide measures to assess whether the motorway conveys the character of the landscape part of which it forms. The main contribution of this research consists in assessing landscape character through a novel series of map-based indicators and combining the findings with a photo-based method of assessing visual landscape quality.

One of the analysed papers represents a holistic approach and was focused on spatially intersected landscape values (Scenic/aesthetic, Recreation, Economic, Ecological/life sustaining, Native wildlife, Native vegetation, Marine, Social, Historical/cultural, Wilderness) collected through a regional public participation GIS (PPGIS) process with landscape components and classes from the New Zealand Land Classification (NZLC) system (Brown & Brabyn, 2012). Sowinska-Swierkosz

and Chmielewski (2016) introduce Landscape Quality Objectives (LQOs) as a set of indicators and present a method of linking social and expert opinion in the process of the formulation of landscape indicators that consider natural, cultural and aesthetic landscape values. An integrated approach can be also achieved by linking ecosystem services with the LM. Assessing ecosystem services by the LM might provide information about landscape structure crucial for landscape management and highlight the spatial context and connections of natural areas (Frank et al., 2012).

There are 13 reviewed papers that do not use the LM to assess landscape value. One of the popular methods in this group is to rate a number of pictures that represent different types of landscape (Bulut & Yilmaz, 2008; Dakin, 2003; Kent & Elliott, 1995). Another approach is rating values (Krause, 2001) and checking correlation between declared landscape value important for the respondents and the use of landscape that they prefer (Brown & Reed, 2000) or landscape preferences (Acar et al., 2013; Molina et al., 2016; Soliva & Hunziker, 2009). Another research focuses on the relationship between the value and physical landscape features (Brown & Brabyn, 2012). Those methods are characterised by the use of GIS methods for richer place-based information, which is especially useful for land use policy makers (Brown & Raymond, 2007; Havas et al., 2016). The majority of the methods are based on participatory study. Two of them focus on expert opinion. One compares the expert-based approach and a lay people-based approach to capture the most valued components of ordinary landscapes (Vouligny et al., 2009). The other one aims to formalise expert opinion to support the nature conservation process (Geneletti, 2005). All methods aim to be implemented in the landscape planning process at the regional or local level.

In order to conclude the challenges of using a landscape value assessment model as a tool in the process of decision making in planning, we propose a three-stage theoretical framework (Figure 1). Concluding the reviewed papers, LM used to assess the structure of landscape combined with spatial data can be used on different levels to assess particular values for a specific place or area. The first level includes the use of spatial data, LM and expert opinion to assess landscape characteristics. This process gives us information about landscape that is considered to be an objective landscape evaluation and should supply the planner with information about landscape character, structure and quantitative assessment results concerning natural, aesthetic and cultural value. According to the European Landscape Convention (2000), which defines landscape primarily as an area perceived by people, we cannot exclude public participation in the planning process. On the second level, public participation is included, which gives us information how and why people value particular landscapes, which places are important for them for different reasons. Social value of landscape combined with information about landscape gives more complete landscape evaluation. On the third level, this structure can be incorporated in the landscape value assessment model that serves to support the process of making planning decisions and in forming the land use policy. Planning decisions based on this model help to balance the functioning of resources and their appropriate use for the benefit of people.

Discussion

There are 12 natural, 15 social/cultural and 28 perceptual/aesthetic landscape values identified. Landscape value assessment methods cross different research fields and disciplines. 43 of 47 analysed papers were published after the year 2000, which is connected to the introduction of the ELC. Among 47 analysed papers, 21 are based on the LM (Bastian & Lütz, 2006; Jones et al., 2016; Lee et al., 1999; Sowinska-Swierkosz & Chmielewski, 2016; Willis et al., 2012). Six papers are based on expert opinion (Geneletti, 2005; Qiu et al., 2013). A total of 20 are based on public participation or lay people opinion (Brown & Brabyn, 2012; Brown & Raymond, 2007; Brown & Reed, 2000; Díaz et al., 2010; Frank et al., 2013; Molina et al., 2016). Integrated frameworks that include more than one approach are represented among others by Vouligny et al. (2009), La Rosa (2011), Qiu et al. (2013), Sowinska-Swierkosz and Chmielewski (2016), Molina et al. (2016). The review includes case studies (41 of 47) as well as theoretical frameworks (10 of 47), for example, Leitao and

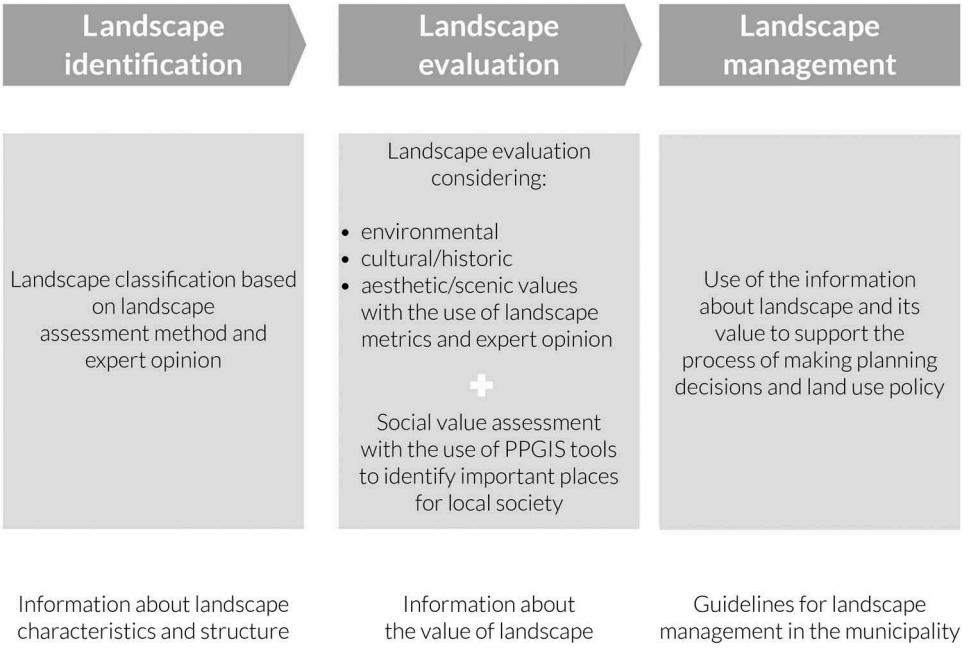

Figure 1. Theoretical framework for possible use of landscape value assessment model as a tool in the process of decision making in planning.

Ahern (2002), Ode et al. (2008), Soliva and Hunziker (2009). Different approaches are employed to assess different types of values.

Natural landscape values

Most popular in the landscape evaluation research are biodiversity, ecological value and wilderness. In the variety of tools to assess natural landscape value, we observe the landscape ecology approach with the use of ecological LM focused on the structure of landscape or/and biodiversity features. Ecological value of landscape is often mentioned by lay people (Brown & Reed, 2000; Havas et al., 2016; Qiu et al., 2013). An approach based on LM has the advantage of being mappable, and can easily be applied in urban and suburban planning (Leitao & Ahern, 2002).

Cultural and social landscape values

Assessment of cultural and social values is represented by theoretical and computational approach. Those values are assessed only with their accompanying environmental or/and perceptual values. The theoretical approach is focused on landscape perception supported by evaluation by lay people (Smith & Theberge, 1986). The computational approach is based on cultural heritage databases (Dramstad et al., 2002).

Perceptual and aesthetic landscape values

Perceptual and aesthetic values are most common, and there are two approaches to assess this type of value: supported by method of rating pictures in terms of preference or a survey concerning values attached to a particular place supported by the LM. The first approach may appear subjective and hard to define, yet it is very important to see individual landscapes through the experience of lay people to

accept landscape as a democratic entity (Butler & Åkerskog, 2014). According to this approach, the main focus is not on form, which usually implies missing the relationships and practices which underpin the landscape (Butler, 2016). Nowadays, we can also observe a trend of assessing social value, for example of ecosystem services by GIS application (Sherrouse, Clement, & Semmens, 2011) or using the societal awareness indicator to capture the social dimension of landscape without any reference to its cultural and structural characteristics (Jones et al., 2016). There are also papers based on very strong theoretical and computational approach concerning scenic values (Ode et al., 2008). Vouligny, by comparing the landscape perception of an expert and lay people, discovers that those two groups use different visual criteria. Expert perspective in landscape assessment is more closely linked to the experience of an individual that crosses the territory, because his evaluation is based on a field visit, and he does not experience the landscape continuously. This research concludes that to capture the value of ordinary landscapes (i.e. landscape that does not stand out in any particular way) in a planning perspective, a combination of expert and lay people approaches is necessary (Vouligny et al., 2009). LM should not replace the human perception of the landscape. Computational data and human experiences of the place should be complementary to give the full picture of the landscape that can be used in land use policy. This approach is presented in theoretical framework on the stage of gathering information about landscape character. Further implementation of public participation in the landscape assessment process should be included.

Conclusions

The landscape value assessment methods discussed in this paper have been analysed in the context of several related planning disciplines, that is, landscape planning, landscape ecology, spatial planning and landscape aesthetics. The proposed framework crosses all planning themes. The integration of several methods and tools (e.g. LM, expert opinion, public participation) developed originally to address specific planning activities into a common framework potentially applicable to landscape management process at the municipality level. The need for appropriate tools to effectively apply sustainable landscape management to spatial planning was recognised. In response to that need, a sustainable landscape management framework for the municipality based on three levels was proposed. The proposed framework includes: landscape characteristics assessment based on expert opinion and landscape value assessment with the use of LM on the first level; public participation to assess social value of landscape on the second level; using this integrated landscape evaluation method to support the process of making spatial decisions on the third level. The approach is based on the following assumptions:

(1) LM can improve the communication with planners (Leitao & Ahern, 2002) as well as illustrate the ecological value of landscape in the form of its cultural value (Sowinska-Swierkosz & Chmielewski, 2016) and aesthetics (Ode et al., 2008). Those metrics can be used according to specific needs and types of landscape assessment.
(2) According to the definition included in the European Landscape Convention (2000), landscape is an area perceived by people and the human perception of landscape cannot be skipped in the landscape value assessment. People's preferences and opinions should be included in the assessment as they experience and use the landscape.
(3) Landscape value assessment should be used in spatial planning. The theoretical framework presented here can be used by planners, local authorities and non-government organisations to gather information about landscape and implement it in planning.

The advantages of a landscape management framework include:

(1) A single framework with integrated character includes landscape character assessment with the use of expert opinion, LM and social value assessment of landscape with the use of lay people opinion and public participation.
(2) The framework is designed to answer the need for landscape planning tools at a local level, because spatial decisions made at a local level influence landscape the most.
(3) The theoretical framework presented here can be used by planners, local authorities and non-government organisations to gather the information about landscape and implement it in planning.

Recommendations for the use of a landscape management framework in landscape planning for the municipality:

(1) Landscape characteristics should be assessed based on the knowledge of a local expert.
(2) LM should be chosen according to needs in terms of natural, cultural and aesthetic values.
(3) Calculations should be based on data with a resolution suitable for local scale (municipality level).
(4) Assessing the social value of landscape should be done with the use of PPGIS, map-based questionnaires or Geodesign workshop.

Limitations of the method:

(1) The method is vulnerable to the choice of LM that influence the landscape evaluation process.
(2) There is a need for inter-institutional cooperation to achieve the goal of integrated planning.
(3) Civil society needs to participate more actively in the planning process. As we all perceive and use the landscape, we are also responsible for landscape management and land use policy process to raise landscape quality and awareness.

The proposed framework forms a basis for further interdisciplinary research to achieve sustainable land use management at the local level.

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