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Ecosystem and urban services for landscape liveability: A model for quantification of stakeholders' perceived importance

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A B S T R A C T

According to the anthropocentric perspective, ecosystem services (ES) can fulfil important societal needs in a similar way as urban systems, which deliver more traditional urban services (US). In this view, ES and US shape landscape liveability in a similar manner. Liveability assessments based on both ES and US importance quantification can allow for the more effective and coherent inclusion of both service typologies in landscape planning and policymaking. As liveability is strongly dependent on both environmental and human factors, stakeholder involvement is essential for its assessment. Widely applicable and reliable methodologies of liveability assessment based on the perceived importance of ES and US, according to stakeholders, still need to be developed. Using this framework, we design a hierarchical classification based on The Common International Classification of Ecosystem Services (CICES) for measuring both ES and US. This classification is used to structure a model based on Saaty's Analytical Hierarchical Process (AHP) for the quantification of stakeholder views of the importance of liveability services. The model, known as the LIAM (LIveability Assessment Model), is applied to a group of stakeholders selected among local experts and landscape planners in an Umbrian study area (Italy). The results show that the LIAM approach can support landscape planning and policy making through superior ES and US integration and through more effective assessments of their perceived relevance.

1. Introduction

1.1. Ecosystem services in landscape planning and policy making

Ecosystem services (ES) can be defined as structural and functional ecosystem contributions to human well-being that occasionally occur in combination with other anthropogenic inputs (Burkhard et al., 2012). ES are primarily public services (e.g., air purification, groundwater recharge or erosion prevention), but can also be private services (e.g., crop or biomass production). Though they are generally generated from natural resources, in several environmental systems, ecological processes and assets must often be managed to deliver valuable services to mankind (Wallace, 2007). Thus, the effects of human inputs on natural resources (e.g., fertilizing, seeding, power plant construction) form an inseparable part of the ecosystem service supply process (Kroll et al., 2012; Burkhard et al., 2014). In addition to ES, ecosystems can also deliver ecosystem disservices (ED), defined as "functions of environment that are perceived as negative for human well-being" (Lyytimäki and Sipilä, 2009). Disservices can result from natural phenomena and may include damages caused by floods, earthquakes, allergenic pollens and wildfires or man-made disservices resulting from, for example, toxic substance emissions or side effects of deliberate ecosystem manipulation. The differences between natural and anthropogenic driving forces of disservices are often ambiguous (Swinton et al., 2007).

The Millennium Ecosystem Assessment (MEA, 2005) contributed substantially in bringing forward the ES approach as a policy tool to achieve a more sustainable use of natural resources and to respond more effectively to competing social needs and demands (Seppelt et al., 2011). It is generally recognised that ES analysis and assessment can support the development of sustainable policies and instruments that can more effectively integrate ecological perspectives with social and economic issues (Carpenter et al., 2009; Burkhard et al., 2012; Koschke et al., 2012; Haines-Young and Potschin, 2013; McLain et al., 2013). However, systematic uses of ES approaches in landscape planning and policymaking are still largely absent (De Groot et al., 2010; Seppelt et al., 2011). At a local level, one of the most significant challenges in landscape planning involves optimizing the spatial pattern of land-use types and the management of benefit flows in view of social and economic objectives (De Groot et al., 2010). According to this view,

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reliable tools that integrate ES at early stages of decision-making processes (Burkhard et al., 2009; Bolliger and Kienast, 2010; Müller et al., 2010; Bastian et al., 2012; Lautenbach et al., 2012) while simultaneously supporting landscape planners and policy makers in meeting their strategic objectives would prove highly relevant (Daily and Matson, 2008; Daily et al., 2009; Rannow et al., 2010; Koschke et al., 2012).

ES may be integrated with landscape planning and policymaking more easily and effectively through their classification using a widely accepted and intuitive scheme (Wallace, 2007; Kroll et al., 2012) that can adapt to various contexts. This should allow for comparisons and the identification of trade-offs between relevant sets of potential benefits while preventing the inclusion of processes (means) necessary to produce deliverable and resulting services (ends) of the same classification category (Wallace, 2007; Fisher et al., 2009). In this way, the Millennium Ecosystem Assessment allows for a broader understanding and use of ecosystem services while serving as an excellent and widely used heuristic classification system that distinguishes between regulating, provisioning and cultural services. However, this classification does not appear to be suitable for environmental accounting or for landscape management and valuation. Alternative classifications have been proposed for these purposes (Bastian, 2000; De Groot et al., 2002; Boyd and Banzhaf, 2007; Wallace, 2007; Fisher et al., 2009).

One recent study, developed as part of an environmental accounting activity undertaken by the European Environment Agency (EEA), proposed a so-called Common International Classification of Ecosystem Services (CICES) (Haines-Young and Potschin, 2010), which was later refined and developed further (Haines-Young and Potschin, 2013). The CICES was implemented using ES typologies recommended in the MA classification as a starting point, though they were refined properly to reflect key emerging issues highlighted in the most recent research literature. As a result, the CICES is characterized by a more explicit hierarchical structure: at the highest level, there are the three familiar ES categories used in the MA (provisioning, regulating and maintenance, and cultural), though these major 'Sections' are conveniently organized into 'Divisions', 'Groups', and 'Classes' (Potschin and Haines-Young, 2012; Haines-Young and Potschin, 2013). This arrangement is meant to be consistent with accepted typologies of ecosystem goods and services that are currently used in the international literature and that are compatible with the current design of Integrated Environmental and Economic Accounting methods used by the EEA. For this reason, the CICES is becoming one of the most extensive and complete ES classifications available. Moreover, the CICES was developed by also considering international standard classifications of products and activities such that it should be able to identify the 'final outputs' of ecosystems while potentially helping to overcome 'double counting' problems in valuation studies (Haines-Young and Potschin, 2010), as also noted by Wallace (2007). In this vein, the CICES can be considered a suitable tool for integrating ES into analytical models that support landscape planning.

1.2. *Ecosystem and urban services in liveability assessments*

Urban systems are traditionally able to deliver services for the fulfilment of human needs (De Haan et al., 2014) via the provision of urban services (US), which are defined as public services and facilities that are historically and typically provided in cities (WAC 365-196-320). US are provided by society, generally without the direct use of ecosystems, and include basic provisions such as sanitary sewer systems, domestic water systems, fire and police protection services, public transit services, road construction services, lighting systems, recreational facilities, schools, and so on. Evidently, US are not the only services that address human needs. Rather, the full range of services (ES and US) directly shapes overall landscape liveability. This is strictly related to the notion of quality of life, as research has shown that typical indicators of quality of life include services originating from the environment, which are here referred to as physical, built, social, economic and cultural (Van Kamp et al., 2003; Abdel-Hadi, 2012; Abdel-Hadi et al., 2010; Van Berkel and Verburg, 2014). Both quality of life and liveability standards are becoming leading objectives in policy and strategic planning (De Haan et al., 2014). However, while quality of life primarily focuses on individuals, liveability is mainly related to the environment (object) based on a human perspective. In particular, liveability theory assumes that perceived quality of life is dependent on objective qualities of landscapes in which humans live (Van Kamp et al., 2003), as first suggested by Veenhoven (1996) who defined liveability as "the degree to which the environmental provisions and requirements fit with the needs and capacities of its citizens". This definition of liveability indicates that: (1) liveability depends on environmental characteristics, as previously noted, and that its assessment is thus strictly informative for both landscape planners and policy makers; that (2) liveability is dependent on the needs and capacities of inhabitants living in the environment who should consequently be involved in the assessment; and that (3) liveability is dependent on both services (provisions) and disservices (requirements) provided by the environment that should consequently be considered in the assessment.

Though not entirely exhaustive for liveability assessment, direct ES and US integration within the same liveability assessment classification model appears relevant and coherent, as they represent a significant component of landscape contributions to overall liveability. ES and US present several common characteristics and can be considered directly comparable, as both ES and US are actually "services" sensu stricto. In fact, they directly meet various societal needs and are produced by specific landscape components, which are typically managed through the application of various local policies (e.g., landscape, service, and socio-economic policies). Thus, ES and US integration in the same liveability assessment model may help to combine different sectorial approaches within a cross-sectorial view of landscape planning and policy making, helping to overcome well-known difficulties related to systematic ES integration in landscape planning and policy making (see e.g., De Groot et al., 2010; Vejre et al., 2010; Larondelle and Haase, 2013).

Various authors have highlighted that liveability characterization and quantification appears quite challenging (Wheeler, 2001; Balsas, 2004; Norouzian-Maleki et al., 2015), as human preferences and perceptions of values play a key role in its definition (see e.g., Lynch, 1998; Oberlink, 2006; Leby and Hashim, 2010; Niemelä et al., 2010; Viegas et al., 2013; Tian et al., 2014), and positive and negative effects of services and disservices on landscape liveability can hardly be compared directly (Power, 2010; Dobbs et al., 2011). Several studies on liveability assessments have already been developed. However, many of them focus on the definition and characterization of liveability concepts (see e.g., Van Kamp et al., 2003; De Haan et al., 2014; Ruth and Franklin, 2014) as they still appear to be new and dynamic. More applied studies typically focus on assessing and understanding facets of liveability in certain places (see, e.g., Pacione, 2003a,b; Shamsuddin et al., 2012), but these studies usually refer to urban liveability without considering the whole landscape. In a very recent study (Norouzian-Maleki et al., 2015), an interesting approach was applied to identify which candidate criteria are most appropriate to describe liveability for two countries (Iran and Estonia) together with their priority weighting. This approach was based on a survey that involved Iranian and Estonian urban planning and design experts. However, this method again focused on the development of liveability indicators as part of urban sustainability assessment rather than on a model that supports broader landscape planning. None of these studies present a