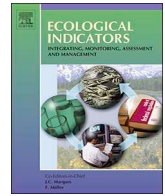




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Review

The potential role of cultural ecosystem services in heritage research through a set of indicators



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ABSTRACT

The Cultural Ecosystem Services (CES) field provides a methodological framework for identifying the “non-material” services that ecosystems can offer to people, such as aesthetic values, educational values or tourism and recreation possibilities. In areas of significant cultural value, the so-called Cultural Landscapes, these type of services influence landscapes’ role as development drivers. As Cultural Landscapes are recognised as heritage, CES assessment provides a methodological framework for bridging the gap between heritage and sustainable development, which has been a challenge for research and innovation. In this regard, the CES approach within the heritage sector is becoming increasingly relevant, but it has received limited attention to date in scientific literature. In order to fill this gap, this article conducts a literature review on the most-used supply-side quantitative CES-rooted indicators for the purpose of analysing their potential to inform heritage planning and management of Cultural Landscapes. A set of thirty-six indicators is obtained from the review. Our results show that the majority of them (86%) have potential application in the heritage sector, as these ones have already been applied in areas where there is interaction between human and natural factors -the essence of Cultural Landscapes- and their results have proven to be communicable to decision makers. 50% of the studied indicators have been applied at least once in a study whose case study is an area where this interaction is particularly relevant because of its representativeness and/or uniqueness. The study shows that policy-effectiveness and an integrative framework are the main benefits of a CES-rooted set of indicators in relation to their usability in the heritage field. However, the lack of a consolidated CES methodological framework represents the most significant obstacle for effective knowledge transfer to a heritage scenario. The variety of methods and approaches for addressing similar purposes leads to a lack of clear concepts, definitions and understandings of the processes to be measured.

1. Introduction

In recent decades, the assignment of services to a territory has received widespread attention in scientific literature. The majority of studies have been framed in two fields: ecosystem services (ES), which emerged as a point of contact between economy and ecology, and landscape ecology-rooted landscape services (LS), which highlight space and stronger foci on human habitats and actions (Bastian et al. 2014). In line with the theory of Termorshuizen & Opdam (2009) and Bastian et al. (2014), LS is a specification rather than an alternative to ES. Whilst they differ in their theoretical and conceptual approaches, the scientific debate does not promote two incompatible fields of work, but rather it aims at a synergy of techniques and approaches in assessment procedures (Babí Almenar et al. 2018; Duarte et al. 2018; Hodder et al. 2014; Syrbe & Walz 2012).

In fact, ES assessment’s call for interdisciplinary approaches is not new. The ES concept arose in the late 1990 s (Costanza et al., 1997; Daily, 1997) as a formula to assign economic values to ecosystems in an increasingly environmentally concerned panorama. By expressing ecosystem values economically, conservation scientists added a compelling new tool for “internalising” the worth of ecosystems and for conveying this to broader audiences, including land managers and policy makers (Chan et al. 2012). The field was officially consolidated with the Millennium Ecosystem Assessment program (MA 2003, 2005) and from then, scientific publications increased exponentially (Boerema et al. 2017; Fisher et al. 2009, Seppelt et al. 2011).

From the beginning, the most common categorisation schemes of ES (Haines-Young & Postchin 2018; MA 2005; TEEB 2010) have included “non-material” benefits that people obtain from ecosystems, such as aesthetic information, recreation, spiritual enrichment or cultural

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heritage (MA 2005). These are the so-called Cultural Ecosystem Services (CES). However, this category has traditionally been the one with less methodological development (Chan et al. 2012a; 2012b; Daniel et al. 2012; Hernández-Morcillo et al. 2013; Hirons et al. 2016; Plieninger et al. 2013; Schaich et al. 2010). The report of the Millennium Ecosystem Assessment already reflected this situation as only three of the ten CES categories could be assessed (MA 2005). Literature reviews also reflected this (Feld et al. 2009; Rey Benayas et al. 2009; Seppelt et al. 2011).

The reason for the weaker advancement of CES is clear taking into account the background of the field. This scientific gap, which has been broadly discussed (Chan et al. 2012a; 2012b; Fish et al., 2016; Hirons et al. 2016; James 2015; Kirchhoff 2019; Milcu et al. 2013), lies in the fact that the economic logic that has characterised ES theory (Gómez-Baggethun et al. 2010; Daily et al. 2009; TEEB 2010), as well as the biophysical dimension from which it was conceived (Kirchhoff 2019; Plieninger et al. 2013), closed the door to the less tangible social approaches that CES require for being properly assessed (Chan et al. 2012a). The ES framework placed the methodological gap with cultural services, as they demanded techniques that were not being produced in the ES field. In order to address this situation, many researchers have suggested promoting greater integration between ES assessments and social sciences, which could provide better understandings of the ways in which societies interact with ecosystems by using methods which go beyond exclusively material approaches (Chan et al. 2012a; 2012b; Milcu et al. 2013; Turner 2010), therein giving way to non-monetary techniques (Abson & Termansen 2011; Daniel et al. 2012; Kumar & Kumar 2008).

This new logic is clearly noted in a 2013 literature review whose approach was to understand the CES assessment's situation (Milcu et al. 2013). From the sixty-four analysed studies, thirty-five were framed by economic logic, normally assessing recreation and tourism services, but twenty-seven advocated against exclusively monetary evaluations for CES. This context created increasingly firmer connections between ES and social sciences. Methodological proposals with a perceptive approach and local community inclusions were addressed (e.g., Martín-López et al. 2012; Norton et al. 2012; Plieninger et al. 2013), and this trend progressively led to the division of assessment techniques into two groups: monetary and non-monetary techniques (Braat et al. 2015; Chen et al. 2019; Hirons et al. 2016).

The tendency towards moving beyond pure economic values and integrating social and humanistic approaches (Schaich et al. 2010) opens a new research framework where the heritage field might be involved. The heritage scenario has by now reached a solid commitment with largescale, territory-based planning and management practices. The idea of heritage as a single historical object has been overtaken by a broader spatial approach through concepts such as ambience, context or site, but it is mainly from the 21st century that, by the notion of landscape, it has fully reached a territorial perspective. Fostered by crucial documents as the European Landscape Convention (Council of Europe, 2000), the heritage sphere today considers landscapes as heritage realities, since they are expressions of relevant historic interactions between human and natural factors (Ortega Valcárcel, 1998). This field of work therefore currently develops formulas for the recognition of the cultural significance of places and the linkages between communities and the spaces that they inhabit, which can shed light on CES assessments by incorporating a traditionally less-developed historic perspective (Tenberg et al. 2012).

But it is not only the CES field that benefits from heritage scenes, as an interdisciplinary framework could support both directions. One of the main working lines in heritage research nowadays is aimed at exploring links between culture and development (Council of Europe 2005; UNESCO 1982; 1998; 2013; 2018). This approach to heritage interprets it not as an unchanging set of elements, but as a flexible phenomenon whose value extends beyond the historical-artistic relevance the conservation scenario has been traditionally focused on by reflecting on the role that heritage currently plays for citizenship

(Loulanski 2006; Mrak 2013). Particularly referring to Cultural Landscapes, CES offers a methodological framework from which to explore the role of this heritage reality as a social resource by detecting which features make it useful and beneficial for people from a cultural point of view. As the heritage sphere still lacks policy-effective, ascertainable, and easy-to-use methods for understanding the potential of Cultural Landscapes for sustainable development, CES field might be a potential contributor for filling in the gap.

One of the most successful examples of heritage management figures that fully addresses Cultural Landscapes' sustainable promotion are Cultural Parks (González & Vázquez 2014; Nuno Martins 2016). As González & Vázquez (2014: 34) point out, "the fields of spatial planning and heritage studies converge in Cultural Parks (...). Cultural parks seek to actively preserve extensive inhabited landscapes and their heritage resources, linking them to the tourist economies through the creation of a management structure". Cultural Parks' management could gain traction through using CES, as it provides a methodological framework for assessing the potential of an area in terms of economic benefit and human well-being (Antrop & Van Eetvelde 2017), which could shed light on tourism-related decision-making.

In considering current demands in heritage research, the relevance of exploring links between it and CES becomes therefore an interesting issue. Despite being denoted by various authors (Eliasson et al. 2019; Gearey et al. 2014; Hølleland et al. 2017; Tema Nord 2015; Tengberg et al. 2012), CES is still a relatively unknown concept by many professionals in heritage sphere (Eliasson et al. 2019). Hølleland et al. (2017: 221) assert that this could be motivated by the initial ES approach emphasising ecosystems' monetary values. Nowadays the situation has taken a turn, so exploring this topic deserves research attention, especially as it pertains to defining operative instruments that have potentials to bridge these fields. This paper addresses the potential know-how transfer from a CES framework to a heritage scenario by a set of indicators, to respond to challenges in the heritage field, as they produce specific, measurable and comparable results, which makes them potentially useful for management and planning practices. Indicators are oriented to support decision-making processes by illustrating and communicating complex phenomena in simple ways and they include tendencies and progresses over time (EEA 2005a).

We have conducted a literature review on the most used supply-side quantitative CES indicators, and then we have addressed specific issues with reference both to operability and benefits from using them for heritage planning and management of Cultural Landscapes. The two main addressed questions are:

Which kinds of supply-side quantitative indicators are currently used in the CES scenario?

How and to what extent can CES indicators inform heritage planning and management of Cultural Landscapes?

Concomitant questions include:

Which methods can contribute to an effective CES indicator review and listing process?

What are the main issues in current CES research regarding indicators' development?

This paper is structured as follows. In Section 2 we present the study's framework. Section 3 includes the methodological procedures applied in 1) the literature review; 2) the establishment of the indicators' index, and 3) the assessment of indicators' potential application in the heritage field. Section 4 presents 1) an overview of the selected studies in terms of the CES that they relate to; 2) the results obtained from the research in academic databases about the currently most used supply-side quantitative CES indicators, shaped in a final index of thirty-six value-based indicators, and 3) the assessment results of the potential usability of these indicators for heritage management and planning of Cultural Landscapes. In Section 5, the potential knowledge transfer from CES to inform the heritage sector is discussed in terms of the results from Section 4.3. Section 6 summarises the main conclusions of the work.

Table 1
CES indicators which have been identified in recent literature.

Indicator	Monetary/Non-monetary	SLR	CES classification (MA, 2005)					
			AES	INS	EDU	CHE	REL	RTO
Number of visitors	M/ NM	1, 2, 3	X		X		X	X
Spending on tourism	M	1, 2, 3						X
Willingness to pay for environment improvements	M	2, 3	X					
Willingness to pay for quality water improvements in local water bodies	M	1	X					
Comparative value of real estate near cleaner water bodies	M	1	X					
Comparative value of real estate near to nature (proxy)	M	1	X					
N° of fishing and hunting licences	M	1, 3						X
Nature and/or rural tourism employment	M	1						X
Number of rural enterprises offering tourism-related services	M	3						X
Tourist average length of stay	M/ NM	2						X
Accommodation suitability	M/ NM	2						X
Population density	NM	2						X
Number of tourist attractions	M/ NM	2						X
Green spaces in urban areas	NM	2						X
Bird-watching areas	NM	2, 3						X
Protected natural areas	NM	2, 3	X		X			X
Monitoring sites (by scientists)	NM	3			X			
Surface or number of wetlands located next to a bike path	NM	3						X
Outdoor recreation	NM	2, 3						X
Hunting and fishing areas	NM	2, 3						X
Walking and biking trails	NM	2, 3						X
Presence of iconic/endangered species (no.)	NM	2, 3	X			X		X
Farm tourism	NM	3			X			
Number of agricultural-livestock fairs	NM	3				X		
Natural heritage and cultural sites	NM	2, 3				X		
Number of certified products that require traditional landscape management	M/ NM	3				X		
Religious monuments, pilgrim paths	NM	3					X	
Contrasting landscapes (lakes close to mountains)	NM	3	X					
Landscape naturalness	NM	2	X					
Scenic beauty	NM	2	X					X
Proximity between urban areas and scenic rivers or lakes	NM	2, 3	X					
Proximity between urban areas and natural sites	NM	2	X					
Proximity between urban areas and recreational sites	NM	2						X
Proximity between tourist accommodation and recreational sites	NM	2						X
Accessibility	NM	2						X
Flower viewing	NM	2						X
Viewsheds	NM	2						X

Literature Review: 1) [Layke 2009](#); 2) [Egoh et al. 2012](#), 3) [Maes et al. 2016](#)

AES: Aesthetic value; INS: Inspiration; EDU: Education, Knowledge Systems; CHE: Cultural Diversity, Cultural Heritage, Sense of place; REL: Religious, Spiritual; RTO: Recreation/Tourism

2. Reference framework

2.1. Conceptual approach

Indicators are measurement methods, generally quantitative, whose usefulness for understanding non-immediately detectable realities makes them essential for many disciplines, especially in the socio-economic and environmental fields ([Pissourios 2013](#)). They are a common method for ES evaluations ([Boerema et al. 2017](#); [Czúcz and Arany, 2016](#); [Feld et al. 2009](#); [Seppelt et al. 2011; 2012](#)). In relation to CES, the extensive spectrum of this category has influenced the development of indicators with different conceptual and methodological approaches ([Hernández-Morcillo et al. 2013](#)).

This paper follows the conceptual approach of organisations such as the UK National Ecosystem Assessment (NEA) and the Common International Classification of Ecosystem Services (CICES), which consists on measuring services rather than benefits when it comes to assess CES. As [Tratalos et al. \(2016: 64\)](#) note:

“the distinction between services and benefits is helpful for the development of CES indicators, as it suggests that measurement of the availability and quality of the natural environment, and the measurement of what is undertaken in it, can form the basis for measuring CES. This is arguably easier to achieve than directly measuring benefits, which are often intangible and hard to quantify”.

This approach focuses on taking note of what generates cultural practices in a given ecosystem/landscape, which can be related to

unbiased measurement methods (e.g., the number of cultural and historical sites), instead of understanding the effects of these cultural practices for people, whose measure is generally very difficult to standardise (e.g., local identity). This service-oriented perspective points out the need of producing scientifically relevant indicators. They have to be cost-effective, communicative, comparable and clear in their measure, reading and interpretation, and to reach this aim, indicators have to measure the amount of something, the distance to something, or the degree of something ([Tratalos et al. 2016](#)). Based on this logic, this review studies indicators that are quantitative in nature, even when based on qualitative data.

Furthermore, indicators can be supply side if they measure the potential of an area for cultural practices (e.g., number of touristic accommodations) or demand side if they are focused on understanding the intentions and desires of people to conduct them (e.g., visitor rates). In this sense, supply/demand indicators represent two complementary but distinct metrics, as they require different types of data, they work with different measuring units, analytical methods, etc. There is no doubt that an integral landscape planning strategy has to consider both sides, but, as we are talking about two separable analyses, this review focuses exclusively on the supply side, as the main point is to understand the potential of the CES field for clarifying to what extent Cultural Landscapes can serve as social, cultural and economic resources by means of their own intrinsic features and values. The focus of the assessment in a heritage context will be mainly on the characteristics that shape the landscape because it is from them that heritage values

emerge. A demand-side indicator is not measuring the specific values of a place but the preferences of the population, which slightly escapes from the goals of this field. Supply-side CES indicators will be by contrast always focused on measuring landscape features as it is from them that CES are generated (de Groot et al. 2010: 23). Anyway, subsequent phases in a whole planning process should address demand-oriented studies in order to reach a comprehensive strategy.

2.2. Preceding the CES indicators index

A preceding CES indicators index is offered as a starting point. The aim of this first analysis is to obtain an earlier view of CES indicators to obtain a broader perspective to interpret research results, and to offer continuity to an established line of work. Indicator review in ES framework has been increasingly employed during the last years. There are some compiling-oriented studies that provide indicator indexes (Egoh et al. 2012; Layke 2009; Maes et al. 2016). Table 1 shows an initial CES indicator list elaborated by the analysis of these three studies.

The provided indicators correspond to those with higher valuations by the studies in relation to their effectiveness in decision-making processes. Through this index, we are able to obtain conclusions that verify some CES assessments' trends pointed out by different authors during the last years. They are arranged through three main points:

- There is a clear tendency for the analysis of aesthetic value and recreation/tourism potential in relation to the rest of CES.

Study examination: Just 24% of indicators are related to CES that are not of aesthetic value or recreation/tourism potential. Indicators dealing with recreation/tourism potential represent 51% of analysed indicators.

Publications sustaining this statement: Chen et al. 2019; Hernández-Morcillo et al. 2013; Milcu et al. 2013.

- There is a recent tendency for developing non-monetary indicators as opposed to the past common practice of applying monetary metrics.

Study examination: 100% of CES indicators compiled by the first study (Layke 2009) correspond to monetary techniques. However, the literature reviews of subsequent years (Egoh et al. 2012; Maes et al. 2016) show a paradigm shift toward non-monetary indicators. 65% of collected indicators are non-monetary.

Publications sustaining this statement: Abson & Termansen 2011; Chan et al. 2012a; 2012b; Chen et al. 2019; Daniel et al. 2012; Kumar & Kumar 2008; Milcu et al. 2013; Turner 2010.

- There is a low consolidation level for CES indicators.

Study examination: Just two indicators (number of visitors and spending on tourism), 6%, have been identified by the three analysed studies. They all also assign lower consolidation levels to CES indicators compared to the other categories. The first study (Layke 2009) does not assign to any CES indicator a consolidation level that guarantees full capacity to inform policymaking. The most recent study (Maes et al. 2016) just assigns its higher consolidation level to five CES indicators (presence of iconic/endangered species (no.), proximity to urban areas of scenic rivers or lakes, number of rural enterprises offering tourism-related services and protected natural areas, this latter both in educational and recreation services) while there are twenty-eight highly rated provisioning services indicators, and thirty-one regulation and maintenance indicators.

Publications sustaining this statement: Hernández-Morcillo et al. (2013). This study, which is one of the most recent ones conducting a general review of CES indicators, affirms in its final conclusion:

“since the existing studies on cultural ecosystem services have been pursued for different purposes and within different disciplines, the resulting attempts at assessing and valuing cultural services are highly heterogeneous in their definitions, frameworks and approaches”.

3. Materials and methods

This paper includes a literature search for supply-side quantitative CES indicators through peer-reviewed papers. Literature reviews have been commonly employed for the analysis of the methodological directions that the CES field has adopted (Chen et al. 2019; Hernández-Morcillo 2013; Milcu et al. 2013). One of the advantages of an indicator-oriented review lies in the fact that, besides reaching a consensus about commonly used parameters and criteria (Egoh et al. 2012; La Rosa et al. 2016; Layke 2009; Maes et al. 2016; Mocior & Kruse 2016; Sowinska-Swierkosz 2017), it may result in a specific product, i.e., the set of selected indicators, with potential operational usefulness (Sowinska-Swierkosz & Chmielewski 2016).

3.1. Research methodology and studies selection

The literature review uses the research engines Scopus (<https://www.scopus.com>) and ISI Web of Knowledge (<https://apps.webofknowledge.com>). The search was conducted on the following criteria: “cultural ecosystem services” OR “landscape services” OR “landscape functions” + “indicator” in the title, abstract or keywords. As pointed out before, LS are a parallel and complementary field of study for ES. As their methodologies present considerable common points (Bastian et al. 2014) and scientific panorama is moving forward to integrative assessments, both approaches are taken into account. In addition, the use of LS-rooted metrics is an advance for the indicator technique (Uuemaa et al. 2013). They have already been used during recent years for aesthetic value estimations framed in CES assessments (Frank et al. 2013; Schirpke et al. 2016), as well as for recreation/tourism analyses (Weyland & Laterra 2014).

Despite the fact that CES's integration in heritage management is this paper's main focus, terms such as “heritage” or “cultural” have been excluded from the search, as they tilt searches in favour of indicators directly associated with cultural heritage (Sowinska-Swierkosz 2017). This research does not seek to provide a methodological basis for a fragmentary study oriented exclusively to understanding the cultural heritage values of a territory (e.g., archaeological sites, listed buildings, etc.). The heritage field recognises Cultural Landscapes as meaningful examples of consecutive reorganisation of the land in order to better adapt their uses and spatial structures to changing societal demands (Antrop, 2005), so heritage value can be found in every landscape feature, including natural characteristics or physical structures. In this sense, heritage planning strategies of Cultural Landscapes will not focus on specific historic objects, but rather on the entire landscape as a whole. Besides, Cultural Landscape's management committed to promoting its role as a sustainable development driver requires a multi-dimensional integrative approach as it is not possible to implement sustainable, fair, and balanced socioeconomic practices by a sector-oriented partial view (Feria Toribio, 2012; Manero Miguel and García Cuesta, 2017).

After clarifying the criteria employed, the studies selection procedure appears. In March 2019, these criteria showed 190 documents in the Scopus database and 177 in the ISI Web of Knowledge database between 2000 and 2019, which resulted in a total number of 258 studies after removing duplicates. These 258 papers have undergone two selection-based evaluations. The first one consists of a title, abstract and keyword check and is based on one exclusion criterion:

- CES assessment framework: Papers without a service-oriented assessment approach or those not addressing cultural services have been discarded.

Most of the rejected papers from this first analysis relate to studies within the framework of LS, since in this case there is no terminology similar to “cultural ecosystem services” to guide the search. Many false positives include studies aimed at detecting changes in land use and land cover, as well as assessments framed in regulation, habitat or production LS. As a result of the first evaluation, 158 contributions were selected. These were subjected to a second analysis that involves reviews of entire texts and follows the exclusion criteria listed below. From this second analysis we have a set of forty-six papers that include indicator oriented CES assessments using entirely or partially supply-side quantitative indicators (see [Annex 1](#)).

- Legibility criteria

- Access: Studies without open access, or unavailable through the library subscription of the author’s university were not considered.
- Language: Studies written in languages other than English or Spanish were not considered.

- Applicability criteria

- Presence of supply-side quantitative indicators: Studies without explicitly mentioned supply-side quantitative indicators were discarded.
- Comparative studies: Papers focused upon a very specific area (e.g., water bodies) are rejected.

3.2. Establishment of the indicator index

As previously stated, the aim of the review is to obtain a refined list of the most-used supply-side qualitative CES indicators. In order to reach this goal, the following steps have been undertaken. First of all, the indicators of the forty-six papers have been categorised following the Millennium Assessment (MA) classification system. Just four papers (8,7%) are explicitly referring to the MA system, so we have performed a correlation exercise in order to obtain a common framework that allows us to understand which types of services the indicators refer to. The correlation exercise analyses the forty-six papers’ CES/LS categories in order to re-associate them to an MA category. The aspects considered are: 1) Category definition in the addressed paper; 2) MA official definition of its CES categories, and 3) the types of indicators associated with the analysed category in the paper.

In the supply-side quantitative sphere of CES indicators, the types of services addressed are stable, as most of the time they are readily linked to an MA category (see [Annex 2](#)). Some papers use different CES categories, but the indicators that they develop focus on attributes that the CES field has already dealt with.

After the reclassification exercise, the supply-side quantitative indicators of the forty-six papers were extracted, revealing a great variety of terminology and measurement methods associated with CES indicators. Indicators closely related to each other in meaning and purpose were, however, addressed differently (e.g., absence of noise and average noise level). To merge indicators with common objectives, a process of concept-related clustering was developed. This analysis transforms the 308 identified indicators in keyword pairings and sets them up in data organisation software in order to visualise and identify similar indicators and cluster them under all-encompassing concepts. It consists of assigning two keywords to each indicator. Keyword 1 refers to its measure unit (e.g., distance to, presence of, absence of, etc.), and Keyword 2 to the measured object (e.g., road, archaeological sites, noise, land cover, etc.). Each of the keywords also has an assigned code that links them with other related-meaning keywords ([Table 2](#)). The cluster analysis puts together indicators that have similar keyword 1-keyword 2 code combinations, finally creating groups of like-terms ([Table 3](#)). Transforming the indicators in keyword-pairings is an easy-to-use method to visualise, group, and thus obtain a representative catalogue of most-used CES indicators (see [Annex 3](#)).

Table 2

Examples of related-meaning keyword groups.

Related keywords_1 (Measure Unit)	
Code	Sub-code
1	1.1 Distance to; 1.2 Proximity to; 1.3 Travel time; 1.4 Accessibility; 1.5 Number of within a × m. buffer;
2	2.1 Presence of; 2.2 Number of; 2.3 Existence of; 2.4 Ratio of; 2.5 Position of; 2.6 Areas of; 2.7 Percentage of; 2.8 Density of; 2.9% of area; 2.10 Density index; 2.11 Actual use of a site for; 2.12 Concentration of
Related keywords_2 (Measurement object)	
Code	Sub-code
17	17.1 Viewpoints; 17.2 View axes; 17.3 Panoramas; 17.4 Points of observation; 17.5 Photo capture points; 17.6 Panoramic Points
18	18.1 Facilities; 18.2 Signage; 18.3 Touristic infrastructure; 18.4 Educational infrastructure

3.3. Potential application in the heritage field: Assessment method

Once a CES-rooted synthetic indicator catalogue is obtained, its usability for heritage management and planning is assessed. We follow the system applied by [La Rosa et al. \(2016\)](#). This study addresses the potential of CES indicators in urban planning, and its methodology is suitable for our research, as it highlights policymaking indicator effectiveness and applicability in specific contexts. The evaluation is based on an inclusive combination of two criteria: “communicability” and “relevance for Cultural Landscape context”. “Communicability” is the ability to transfer results from indicators to policymaking. It is assessed with the following sub-criteria: 1) use of a clear, theoretical framework for CES assessment; 2) the presence of spatially explicit results, and 3) reproducibility of the assessment methods. Indicators are communicable if all the above sub-criteria are present ([La Rosa et al. 2016](#)).

We checked the “relevance for Cultural Landscape context” to understand the potential of an indicator to be used in an area whose main characteristic is that it has been shaped by a relevant interaction process between human and nature. We evaluate this with a qualitative scale of three grades A–C, as done in [La Rosa et al. \(2016\)](#): A) null or low relevance –in this case, the area of study does not contain relevant interaction between human actions and territory, as it happens, for example, in natural reserves with limited human presence ([Smit et al. 2017](#); [Tenerelli et al. 2016](#)); B) medium relevance: the character of the area is the result of historic intervention of human communities in the territory, but the landscape is unexceptional, as in suburban areas of many cities ([Cortinovis et al. 2018](#)), and C) high relevance: the study area is a landscape shaped by a unique and/or representative interaction of human activity and nature ([Szűcs et al. 2015](#)). When there is no particular case study, grade B is assigned. The indicators used in the reviewed papers have been assessed under these two criteria and classified into three different levels as shown in [Table 4](#). The proportion of indicators of each level is what defines the possibility of each of the final indicators to be used in heritage management and planning of Cultural Landscapes, as shown in [Table 5](#) (see [Annex 4](#)).

4. Results

4.1. Overview of the studies’ service target

The papers are initially framed as ES or LS assessments, showing that only 33% of selected studies refers to LS analysis ([Fig. 1](#)). Therefore, although LS is progressively acquiring relevance in the scientific field, the consolidation level that the ES framework reaches continues to balance the research in favour of them. From the correlation exercise to the MA classification system we can observe greater attention to recreation and tourism assessments ([Fig. 2](#)). Aesthetic value is also tackled quite often; it is being remarkable in its high number of studies

Table 3
Example of the method in Group 29 (keyword pairing of codes 2–18), which produced indicator “Presence of facilities”.

Indicator	Keyword_1	Code_1	Keyword_2	Code_2
Number of facilities	Number of	2.2	Facilities	18.1
Position of facilities	Position of	2.5	Facilities	18.1
Information tables, market trails	Presence of	2.1	Signage	18.2
Existence of benches	Existence of	2.3	Facilities	18.1
Use-related facilities	Presence of	2.1	Facilities	18.1
Access-related facilities	Presence of	2.1	Facilities	18.1
Number of environmental education-related facilities/events	Number of	2.2	Facilities	18.1
Tourist infrastructure at a site	Presence of	2.1	Touristic infrastructure	18.3
Educational infrastructure (information boards, educational centres)	Presence of	2.1	Educational infrastructure	18.4
Presence of environmental signs or indicators (e.g., bioindicators) and the ability to recognize them	Presence of	2.1	Signage	18.2
Tourism infrastructure	Presence of	2.1	Touristic infrastructure	18.3

Table 4
Combination of “communicability” and “relevance for Cultural Landscape context” criteria.

Communicability	Relevance for Cultural Landscape context	Possibility for using in heritage management and planning of Cultural Landscapes
Y	A	Level 3
Y	B	Level 2
Y	C	Level 1
N	A	Level 3
N	B	Level 3
N	C	Level 2

that address it exclusively (26%). It should be noted that while there is a sufficient percentage of studies addressing cultural heritage category (37%), only one study analyses it exclusively (Stanik et al. 2018). In the majority of cases, this category, as with inspiration and religious/spiritual value, is addressed as part of a global CES assessment. An analysis was also carried out to see if there was a tendency in LS framework to address a specific type of cultural service. Results show that most are focused on aesthetic value, recreation and tourism, and cultural heritage, which coincides with general tendencies (Fig. 3).

4.2. Value-based set of CES-rooted indicators

Subsequently, concept-related clustering analysis was performed, and it has proven to be useful, as it has been possible to cluster the 308 identified indicators into a final catalogue of thirty-six indicators, which is presented below (Table 6). Even there is a great variety of indicators being developed in CES field nowadays, this study realizes that supply-side quantitative CES indicators can be summarised with a set of less than forty indicators.

Each of the final indicators is produced from a group that has been put together for related-meaning reasons. The number of indicators in each of the groups is presented in column 2 and gives us a reference to the level of attention each indicator is currently getting, which leads us to a list of most-used indicators (Table 7). Land cover complexity is the most widely studied supply-side CES indicator; as twenty-six of the forty-six analysed studies (56.5%) address it.

Our results verify an already noted situation in the CES field. The CES scientific panorama has of late asserted that a particular ecosystem/landscape feature could influence more than one cultural

Table 5
Percentages of Level 1,2 and 3 associated to indicator’s categorization according to their usability in Cultural Landscapes’ management and planning.

Level 1	Level 2	Level 3	Possibility for using in heritage management and planning of Cultural Landscapes
60–100%	0–40%	0%	It can be used (high consolidation level)
Rest of the cases			It can be used after minor checking (medium consolidation level)
0%	0–40%	60–100%	It can be used with mayor checking (low consolidation level)

67% · 31/46 CES

33% · 15/46 LS

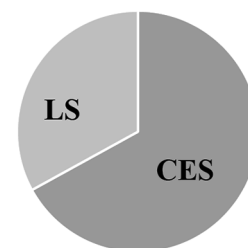


Fig. 1. Proportion of CES/LS studies.

service at the same time, as a single interaction with nature might involve aspects of all of them (Tratalos et al. 2016: 64), so the service-based classification scheme commonly used for CES could overlap considerably (Church et al. 2011; Schirpe et al. 2016; Szücs et al. 2015; Tratalos et al. 2016). This situation is notable in our analysis, as on many occasions indicators with the same keyword 1-keyword 2 combination are framed in different service categories depending on the study. For example, the presence of water bodies is an indicator related to aesthetic value in some papers, and for recreation/tourism potential in others. In fact, some authors assert that aesthetic service is directly related to recreation/tourism potential (Schirpe et al. 2016).

This situation is especially challenging for listing CES indicators, as placing the indicators in the traditional service-related categorisation scheme could lead to confusing results. How are we able to classify, for example, the indicator that focuses on the presence of historically relevant objects into a service category if we have found studies that affirm that this quality makes a strong contribution to aesthetic appreciation, while others link it exclusively to cultural heritage subservices, and other studies relate this indicator to recreation and touristic potential? To overcome this situation, this research follows the line of studies such as Szücs et al. (2015), who assign to the indicators a relevance level for each of the commonly established CES, considering then the possibility of indicators being influential for more than one service at a time. Our study addresses this indicator-service relation empirically by counting the number of times each indicator has been related to a specific service in each of the forty-six reviewed papers. The last column of Table 6 shows the influence level of each indicator for each of the cultural subservices.

We note that natural features are quite considered in the assessments of the aesthetic value and the recreation and touristic potential of an area. Recreation and tourism studies also address aspects such as

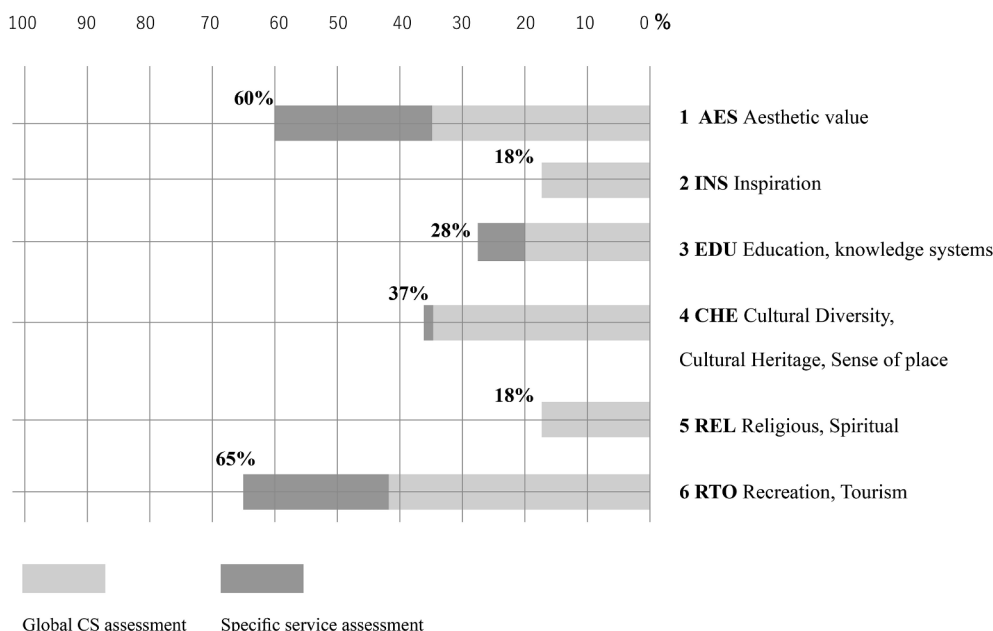


Fig. 2. Proportion of studies in each category. Relation between global and specific assessments per category.

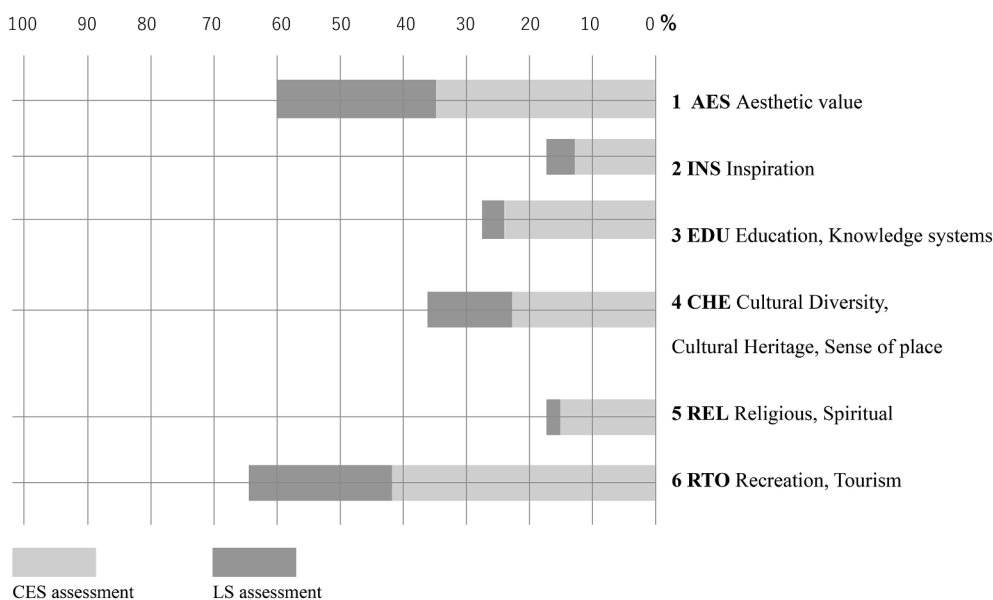


Fig. 3. Proportion of studies in each category. Relation between CES/LS assessments per category.

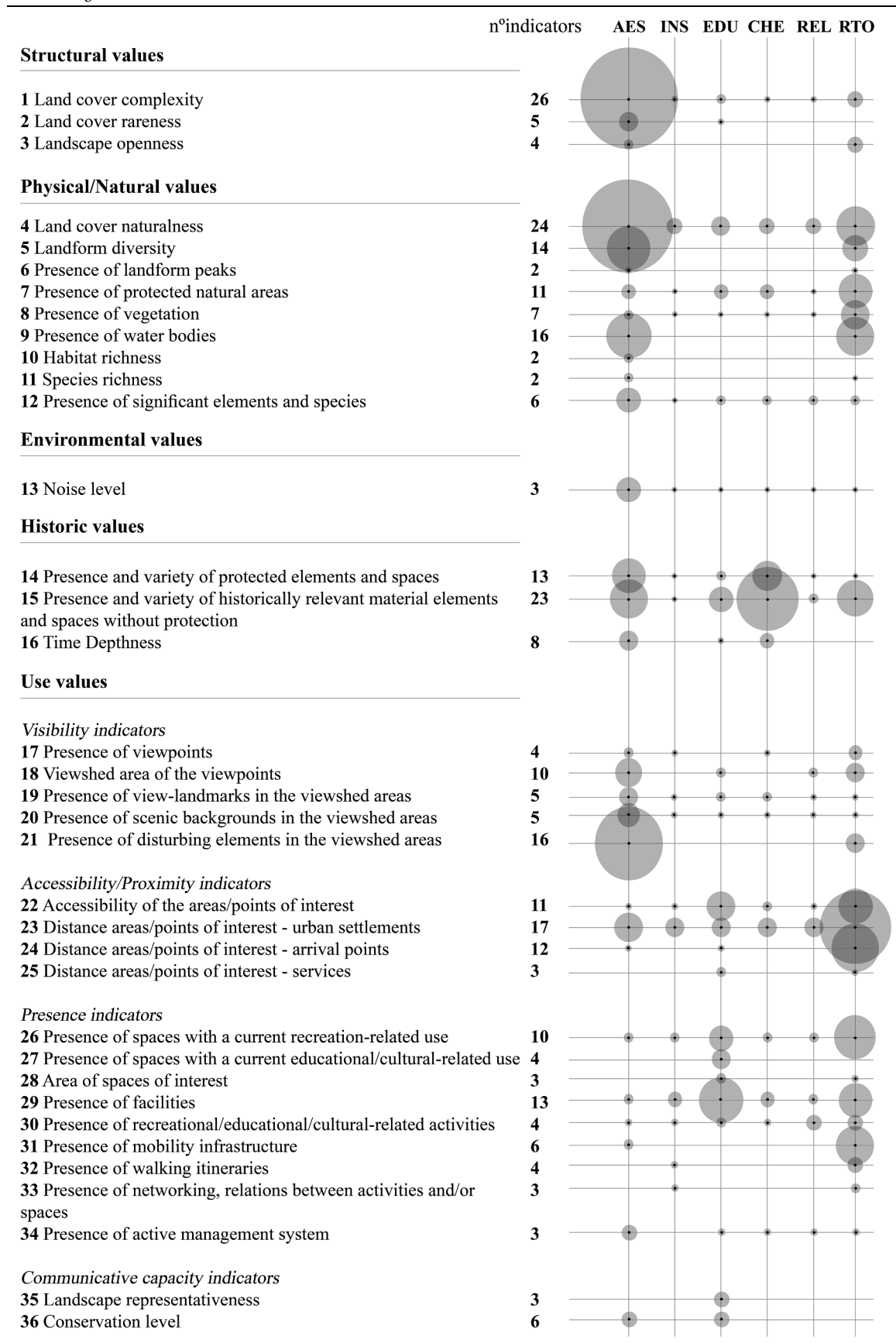
accessibility and presence of touristic infrastructures. They also sometimes manifest concern to visibility issues, being aesthetic-oriented studies the ones with more background on it. The landscape’s communicative capacity, measured by indicators such as its conservation level, is becoming salient in educational service-related studies, which also emphasise the convenience of an infrastructure for receiving visitors. It is remarkable that the presence of historical items such as heritage protected buildings is not considered favourable just for cultural heritage subservices, as there are recreational/touristic and aesthetic studies which also incorporate this aspect.

In this study, indicators are not classified as services, so we use a value-based scheme to categorise them. The results show that CES supply-side quantitative indicators work in three lines of assessment: understanding which spaces currently subsume cultural practices (e.g., number of *peri*-urban parks in an area, cycling paths, presence of viewpoints), their use capacities (e.g., proximity to urban areas,

presence of facilities, accessibility), and the intrinsic qualities of a given area (e.g., existence of monuments, presence of vegetation). These three lines can be structured by a value-based categorisation scheme that emphasises the features and values of places, instead of the different services that they can offer. This classification system for indicators is actually not new (Cassatella & Peano 2011; Sowinska-Swierkosz & Chmielewski 2016; Vallega 2008; Vizzari 2011).

The European Landscape Convention (Council of Europe 2000) explicitly includes a requirement to identify, analyse and assess landscapes to set quality objectives, which has led to landscape quality assessments from national planning instruments, such as the Landscape Catalogues in Spain, which provide value-based categorisation schemes with potential for CES indicator categorisation. These instruments constitute a catalogue of landscape values, each represented on a different map. These values represent the most representative landscape dimensions.

Table 6
Final catalogue of CES indicators.



The spheres show the influence level of each indicator for the subservice.
 AES: Aesthetic value; INS: Inspiration; EDU: Education, Knowledge systems;
 CHE: Cultural Diversity, Cultural Heritage, Sense of place;
 REL: Religious, Spiritual; RTO: Recreation, Tourism

Table 7
Most currently used CES indicators.

Most used CS indicators in current panorama
1° Land cover complexity
2° Land cover naturalness
3° Presence and variety of historically relevant materials elements and spaces without protection
4° Distance between areas/points of interest and urban settlements
5° Presence of water bodies
6° Presence of disturbing elements in the viewshed areas
7° Landform diversity
8° Presence and variety of protected elements and spaces
9° Presence of facilities
10° Distance between areas/points of interest and arrival points

For example, The Landscape Catalogue of Catalonia, the pioneer region developing these instruments, addresses natural, social, symbolic-spiritual, historical, aesthetic and productive values (Nogué et al., 2016). The cited academic works and planning instruments have been used as reference frameworks from which a final value-based classification scheme of the thirty-six CES set of indicators is defined. The scheme classifies indicators according to the main landscape dimensions that they represent. We have identified indicators strongly related to the land structure, indicators that measure physical (e.g., relief, water bodies) and natural (e.g., vegetation, habitats, species) landscape features, indicators related to environmental conditions such as noise level, indicators focused on detecting the features that most express the historical value of the area, and, finally, indicators that measure the current situation of a place for welcoming people.

4.3. Usability of the indicators for heritage management and planning

None of the indicators from the catalogue has reached enough of a consolidation level to be used directly in heritage management and planning of Cultural Landscapes. The majority (86%), or thirty-one of the thirty-six indicators, are potentially usable in heritage research though. There are good examples in the scientific literature of the application of CES indicators in Cultural Landscapes (Y-C), or in related contexts (Y-B), but there is a great variety of methods and approaches for addressing similar purposes, which leads to a still unclear panorama concerning concepts, definitions and understanding of the processes to be measured. Their application involves therein a checking process of the indicators in peer-reviewed literature in order to identify the methodology that better works as a reference according to the specific needs of the future research and a deeper analysis of the assessment procedure. 14% of indicators are usable just after thorough review, as even though in these cases they have been cited as convenient for CES assessments, as far as we are aware there are no studies in the current literature that have applied them and offered spatially explicit results yet. By adding up the number of times that each indicator has been applied in research that offers policy-effective results and whose case study is in a high (C) or medium (B) relevance context for heritage field, we can obtain an indicator ranking according for their potential application in heritage management and planning of Cultural Landscapes (Table 8). The Y-C combination has been scored with 2 points and Y-B with 1 point.

5. Discussion

The final CES indicator catalogue is designed to establish a comprehensive indicator base to discuss CES pertinence in heritage management and planning practices. It is not possible to address this issue without a clear image of what the CES field consists of, and a set of indicators has been shown to be an effective way to understand which are the most addressed issues in the CES field (de Groot et al. 2010; Müller and Burkhard 2012; Szücs et al. 2015). As it is also an operative

system, exploring the potential application of it in the heritage field already represents a specific line of action for bridging both fields.

This research highlights the fact that the CES indicators present aspects that are worth studying for the heritage management of Cultural Landscapes. From the catalogue of the thirty-six most-used supply-side CES indicators, thirty-one have already been applied in areas where there is a clear interaction between human and natural factors -the essence of Cultural Landscapes- and their results have been shown to be communicable to decision makers, which makes them potentially usable in the heritage field. Eighteen of the twenty-six indicators (50%) have been applied at least once in a study whose case study is an area where this interaction is particularly relevant because of its representativeness and/or uniqueness.

Cultural Landscapes are not isolated protected areas, but living and productive spaces where there is a need to find a balance between landscape conservation and development, so the conditions to tackle are not completely foreign to the CES field, in fact, compared to more natural ecosystems, Cultural Landscapes have much greater potential to supply cultural services. The catalogue shows a “road map” to understand Cultural Landscapes as sustainable development drivers, as they offer the key variables that make a landscape work as a socioeconomic resource by the use of its own features and values, and it also presents characteristics of special interest for the heritage field, as discussed below.

Nowadays, in Cultural Landscape’s management procedures designed to promote sustainable use strategies, the main challenge is to deal with the broad range of approaches that Cultural Landscape’s socioeconomic revalorisation covers, with a particular lack of cross-sectoral analyses. The traditional distinction between nature and culture in this field widens this gap (Lowenthal 2005). The dissolution of boundaries between natural and cultural factors should be taken as given in order to fulfil current demands in heritage research (Harrison 2013; 2015; Whatmore 2002). This separation leads us to think of objects, plants, people, and ideas as belonging to one or the other of these categories, which limits our ability to see and understand the many boundary-crossing relationships and processes that also take place (Eliasson et al. 2019), which are of importance for sustainable decision making. One of the main benefits of promoting links between the CES and heritage fields is the inherently integral approach of CES. As observed in section 4.2, the set of indicators responds to different landscape values (structural, physical/natural, environmental, historic and use-related). CES’s traditional call for interdisciplinary proposals has promoted a balanced vision of the different features and dimensions that generate cultural services. The CES-rooted set of indicators offers an assessment of both the natural and cultural landscape spheres, providing the heritage field with a practical tool which moves forward in the need of overcoming partial visions.

Other challenges in Cultural Landscape’s management, and in the heritage field in general, is a lack of communication between theoreticians and practitioners, which points out the need to develop policy-effective techniques that work as communicative instruments between heritage specialists and land managers. Indicators present potentials for contributing to the integration of the heritage view in regular planning practices (Tengberg et al. 2012), as they emerge as effective policy instruments. This is the original vocation from which they were conceived.

Since their first landscape-related use in environmental evaluations promoted by international organisations such as the UN, OECD or EEA (EEA 1999; OECD 1991; UNSD 1984), where landscape was considered one of the elements likely to suffer environmental impact within the cause-effect relation between development policies and environment, as well as in their use in agricultural policies framework (Delbaere 2003; EEA 2005b; 2006; LANDLIS et al. 2002; Wascher, 2000), indicators have been defined and implemented with the aim of working as a supportive tool in policy-making. The CES set of indicators offers a bridge between the characterisation and recognition of Cultural

Table 8

Raking of indicators according to its potential application in Cultural Landscapes' management and planning (Nogué et al., 2016).

	N° of Y-C combination (2 points)	N° of Y-B combination (1 point)	Total score of application potential for heritage field
Indicators that can be used with minor checking			
1° Land cover complexity	2	16	20
2° Land cover naturalness	0	19	19
3° Distance areas/points of interest - urban settlements	0	15	15
4° Presence and variety of historically relevant material elements and spaces without protection	5	3	13
5° Presence of disturbing elements in the viewshed areas	1	11	13
6° Distance areas/points of interest - arrival points	1	10	12
7° Presence of water bodies	0	10	10
8° Presence of mobility infrastructure	3	3	9
9° Presence of protected natural areas	2	5	9
10° Presence of facilities	2	5	9
11° Presence and variety of protected elements and spaces	0	9	9
12° Landform diversity	0	9	9
13° Presence of spaces with a current recreation-related use	2	4	8
14° Presence of vegetation	1	6	8
15° Accessibility of the areas/points of interest	1	6	8
16° Presence of viewpoints	3	0	6
17° Presence of significant elements and species	2	2	6
18° Presence of view-landmarks in the viewshed areas	2	2	6
19° Presence of recreational/educational/cultural-related activities	2	1	5
20° Landscape openness	1	3	5
21° Land cover rareness	0	4	4
22° Time Depthness	1	1	3
23° Presence of scenic backgrounds in the viewshed areas	1	1	3
24° Presence of walking itineraries	0	3	3
25° Noise level	0	3	3
26° Presence of active management system	1	0	2
27° Viewshed area of viewpoints	0	2	2
28° Species richness	0	2	2
29° Presence of networking, relations between activities and/or spaces	0	2	2
30° Habitat richness	0	1	1
31° Presence of landform peaks	0	1	1
Indicators that can be used with mayor checking			
32° Distance areas/points of interest - services	0	0	0
33° Area of spaces of interest	0	0	0
34° Presence of spaces with a current educational/cultural-related use	0	0	0
35° Landscape representativeness	0	0	0
36° Conservation level	0	0	0

Landscape's values and sustainable development-oriented decision making, since they offer tangible quantitative results with effective communicative ability, which allows to assess the efficiency and impact of a decision (Botequilha Leitão et al. 2006). Despite these benefits, a lack of conceptual clarity in the CES field is still one of its greatest challenges in integrating their conceptual base and techniques in other disciplines. When it comes to defining indicators in the CES field, there is no reference framework. Even though there is an important knowledge base in CES scientific literature that has proven to be already applied in Cultural Landscapes, the transfer of know-how from the CES panorama to the heritage field requires systematisation efforts to build a comprehensive methodological framework that can work efficiently as a reference for the discipline. It is crucial to address this problem, as even there are already CES-rooted indicators that have proven to be potentially useful for Cultural Landscape's management and planning, the lack of a consolidated methodological framework hampers the potentials of the technique to work as a multidisciplinary tool.

The categorization of CES in services is another inconvenience, which has already been pointed out in the ES field. It has been confirmed by this research, where it was not possible to use this classification system as the majority of the indicators have been found in several studies but associated to different services in each case. Just three out of thirty-six indicators (8%), "Habitat Richness", "Presence of spaces with a current educational/cultural-related use" and "Landscape Representativeness" are considered influential for just one service. Cultural service's indicators have to refer to particular landscape

features in order to be measurable, and these features are liable to be influential for more than one service at a time. This overlapping problem of the commonly used service-oriented categorisation scheme also contributes to the lack of clarity. Until a conceptual and methodological consensus is reached, a flow of knowledge between fields will remain challenging.

6. Conclusions

The CES field provides a conceptual and methodological background for addressing current heritage research demands in relation to Cultural Landscapes. The need to define management and planning strategies that address the potential of these areas as development drivers has been extensively remarked upon in the heritage scenario. Moving from theory to practice is challenging when dealing with such a highly complex concept as landscape, where the demands of integrative approaches faces a traditionally divided cultural-natural heritage sphere, and there is a general lack of policy-effective techniques. Using the CES approach could provide tools to address these issues.

The main finding of this research is the empirical demonstration of the potential application of a CES-rooted set of indicators in Cultural Landscapes. The results that make us reach this finding have been introduced by a theoretical discourse that exposes why it is convenient for the heritage sphere to address CES assessments at this time, forming a comprehensive reflection on the fact that we are faced with a very interesting combination that is worth studying.

Presently, as Hølleland et al. (2017) conclude, there is an emerging interest in ES from the cultural heritage management sector, in particular in Nordic countries (Tema Nord 2015), which might reflect the close governmental ties between environmental and cultural heritage management in these countries. However, greater scientific attention is still needed. This study emphasises the need to develop a comprehensive methodological framework in the CES field, which is its main gap. This lack of conceptual clarity makes it challenging to produce effective knowledge transfer to other fields. On the other hand, the heritage sector is encouraged to explore policy-effective tools in terms of quantifying, accounting, and valuating landscape features for understanding their role for human well-being, such as the ones being produced in the CES field. Heritage research currently faces new management scopes, and a full revision of related fields and their methods is crucial.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.ecolind.2020.106670>.

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