Characterizing European cultural landscapes: Accounting for structure, management intensity and value of agricultural and forest landscapes

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ARTICLE INFO

ABSTRACT

Almost all rural areas in Europe have been shaped or altered by humans and can be considered cultural landscapes, many of which now are considered to entail valuable cultural heritage. Current dynamics in land management have put cultural landscapes under a huge pressure of agricultural intensification and land abandonment. To prevent the loss of cultural landscapes, knowledge on the location of different types of cultural landscapes is needed. In this paper, we present a characterization of European cultural landscapes based on the prevalence of three key dimensions of cultural landscapes: landscape structure, management intensity, and value and meaning. We mapped these dimensions across Europe at a 1-km resolution by combining proxies on management intensity and landscape structure with new indicators such as social media usage and registered traditional food products. We integrated the three dimensions into a continuous "cultural landscape index" that allows for a characterization of Europe's rural landscapes. The characterization identifies hotspots of cultural landscapes, where all three dimensions are present, such as in the Mediterranean. On the other hand, Eastern and Northern European cultural landscapes are mostly characterized by only one of the dimensions. Our paper can help to identify pressures to cultural landscapes and thus to target measures for the conservation of these landscapes, to link similar landscapes in different regions, and to inform policy design on the most important characteristics of cultural landscapes at a regional scale.

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1. Introduction

Almost all rural areas in Europe have been shaped or altered by humans and can be regarded a cultural landscape, many of which now are considered to entail valuable cultural heritage. Across Europe cultural landscapes have diverging characteristics. For instance, the narrow, low-lying fields of the Dutch and German *Marschhufen* differ significantly from the wide-open Iberian *dehesas*, but both are considered typical cultural landscapes (for a good overview see Zimmermann, 2006). What they do have in common is that they often provide valuable cultural ecosystem services (Schaich et al., 2010; Tengberg et al., 2012). These include aesthetic appreciation (Van Zanten et al., 2014), cultural identity and a 'sense of place' to local inhabitants (Waterton, 2005), and a combination of services that attracts tourism and recreation (Van Berkel and Verburg, 2011). Moreover, cultural landscapes can be important havens of farmland biodiversity (Agnoletti, 2014; Bignal and McCracken, 1996; Plieninger and Bieling, 2013).

The term cultural landscapes was introduced as an academic concept in the late nineteenth century by Friedrich Ratzel and later adopted in the English literature by Carl Sauer, to denote all landscapes modified by human activity (Jones, 2003). As one can argue that nowadays all European landscapes are modified in some way by human activity (e.g. global warming, nature conservation) the term 'cultural' has lost its classical meaning (Phillips, 1998; Wu, 2010). However, in the 1990s the term was revived with the

introduction of cultural landscapes into the UNESCO World Heritage Convention on the basis of their cultural heritage (Rössler, 2006). In addition to the classical definition, Jones (1991) identified two alternative interpretations of cultural landscapes: one that defines cultural landscapes as valued features threatened by change or disappearance and one where a cultural landscape is seen as subjective, focussing on the intangible values and meanings people attach to them.

Cultural landscapes are the result of the long-term, complex interactions between humans and nature and thus contain cultural heritage (Plieninger and Bieling, 2012). In this respect, the term cultural becomes a value-laden concept with the attention focused on those landscapes that are denoted as 'traditional landscapes' (Agnoletti, 2014; Antrop, 1997; Bignal and McCracken, 1996; Fischer et al., 2012; Plieninger et al., 2006). Antrop (1997) defines traditional landscapes as "those landscapes having a distinct and recognizable structure which reflects clear relations between the composing elements and having significance for natural, cultural, or aesthetical values." From a cultural geography perspective, scholars point at the origin of the landscape, somewhere between the Renaissance and the Industrial Revolution, and emphasize the low-intensity farming or livestock raising taking place in traditional landscapes (Plieninger et al., 2006). Consequently the terms 'traditional landscape' (Antrop, 1997) and 'low-intensity farmland' (Bignal and McCracken, 1996) are sometimes used interchangeably with the value-laden concept of cultural landscapes.

Cultural landscapes in Europe are threatened. Growing demand for food and progress in technology triggered a large-scale intensification of agriculture in highly productive areas. In contrast, less fertile land, or land less suitable for intensive agriculture, faces land abandonment (Estel et al., 2015; Kizos et al., 2009; Kuemmerle et al., 2008). This polarization of intensification on the one hand, and land abandonment on the other also induces a shift in the goods and services provided by cultural landscapes. Intensification increases agricultural commodity production, but often at the expense of a broad range of cultural services, including cultural heritage and identity (Plieninger and Bieling, 2012). Likewise, land abandonment can lead to a loss of the heritage embedded in the structure and composition of these landscapes (Van der Zanden, 2016b). These changes can be seen as decoupling of the links between humans and nature, or so-called social-ecological linkages (Fischer et al., 2012; Plieninger et al., 2015). To understand which cultural landscapes are at risk from these dynamics, to develop countermeasures to protect these landscapes and ensure a balance in the provisioning of different ecosystem services, and more generally, to retain social-ecological linkages in landscapes, knowledge on the location of different types of cultural landscapes is essential.

Existing spatially explicit typologies and characterizations of cultural landscapes rely mostly on biophysical factors such as topography, climate, soil, or land cover (Hazeu et al., 2010; Meeus, 1995). These biophysical factors, however, fail to characterize the social side of the coupled social-ecological systems, the 'cultural'. In this paper, we propose a new landscape characterization that explicitly incorporates this cultural aspect of the landscape by focussing on how people have altered the landscape, but also on how the landscape is perceived by people. We adopted a comprehensive understanding of the term cultural landscape by including all agricultural and forest landscapes, but at the same time also interpreting the adjective "cultural" as value laden, adopting the different approaches as outlined by Jones (1991). In this paper we chose to focus on rural landscapes, excluding urban landscapes, as they would require a different approach. With this definition we acknowledge that all landscapes have value to people, but these values tend to differ across Europe.

1.1. Characterizing cultural landscapes

Despite the diversity of cultural landscapes, three dimensions of cultural landscapes are frequently applied to describe them: (1) management intensity shows how people use the landscape (Bignal and McCracken, 1996; Plieninger et al., 2006), (2) landscape structure reveals how people use the landscape, but often also contains traces of how the landscape was cultivated in history (Van der Zanden et al., 2016a; Van der Zanden et al., 2013), and (3) 'value and meaning' is often used as an umbrella term for how landscape is perceived by people (Plieninger et al., 2015; Rössler, 2006).

In the literature, cultural landscapes are generally described as landscapes where agriculture is carried out with a low level of external inputs and by relatively small-sized (family) farms. One of the major threats to the cultural value of these landscapes is, therefore, directly related to intensification of land management. In terms of landscape structure, cultural landscapes are often characterized by smaller fields and the presence of landscape elements that reflect former management such as hedgerows or stonewalls (Van der Zanden et al., 2013). Finally, regarding the value and meaning of the landscape for people within a certain context (Plieninger et al., 2015), the cognitive aspect of the landscape "involves ways in which landscapes are perceived, understood and mentally structured by different groups in society" (Plieninger and Bieling, 2012).

These three dimensions form the backbone of the characterization developed in this paper. We mapped each dimension with two or more spatial variables across Europe. The characterization presented in this paper as well as the underlying data can be further explored through the HERCULES Knowledge Hub (http://labs.kh.hercules-landscapes.eu/landscape_typologies.html), a tool where users can alter the rules applied to map cultural landscapes to create their own characterization using our indicators.

2. Data and methods

2.1. Approach

For each of the three dimensions of cultural landscapes (management intensity, structure, and value and meaning), we derived a score between 0 and 1 for each landscape pixel of 1 km^2 in Europe (EU27 + Switzerland). High scores indicate a higher correspondence with landscapes that are commonly denoted as 'cultural landscapes'. With the score for each dimension we carried out two analyses. The first was the calculation of the average of the scores, yielding a continuous cultural landscape index score. This index shows which landscapes most likely resemble the traditional landscape as defined in the literature. A higher index score does not imply more cultural value as landscapes can have different value to different people (Jones, 1991). The emphasis in this paper in on the second analysis where a characterization based on the relative score of each dimension for each individual landscape was produced. Scores for each dimension are split into high and low classes. Three dichotomous scores for each landscape pixel resulted into eight different landscape types.

To assess the effect of the thresholds between high and low values chosen, we performed a sensitivity analysis. We divided the distribution of each dimension score with eight quantiles to be used as alternative thresholds. We generated a characterization for each possible combination of the different quantiles, resulting in $9^3 = 729$ possible different characterizations. For the final landscape characterization, we assigned the landscape type that occurred most frequently among the 729 characterizations. To quantify the sensitivity of the characterization to the threshold, we mapped how often the most frequently assigned landscape type occurred as a percentage of the total number of characterizations. The frequency