



## Research Paper

## Aesthetic appreciation of the cultural landscape through social media: An analysis of revealed preference in the Dutch river landscape

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## ABSTRACT

Aesthetic enjoyment and perception are increasingly recognized as important values of cultural landscapes. The study of these values transcends mere physical attributes of the landscape and requires assessment of its social meaning. In recent years the usage of social media has gained momentum to study the aesthetic preferences and perception of the environment. However, until now the different approaches have not yet been sufficiently combined to provide more in depth understanding of what attracts people in the landscape. We propose a robust methodology using social media photos from Flickr and Panoramio to estimate the correlation between landscape attributes and landscape preferences. We combine formal modeling of spatial photo distribution based on the occurrence of landscape elements with content analysis of the photos to pinpoint what it is in a landscape that attracts people. We use the Kromme Rijn Area –a peri-urban area in the center of the Netherlands and a popular recreation area- as case study area. The analysis shows that this area is appreciated by its visitors and residents for the presence of monumental buildings, small water bodies and opportunities for hikes along grasslands. The method successfully linked the structural elements of the landscape with the revealed preferences, providing a way of quantifying the appreciation of the landscape. Qualitative surveys remain essential to study motivations for outdoor recreation, but social media data can be incorporated as evidence of what elements of the landscape are valued, where people are interacting with the landscape, and how these interactions characterize a landscape.

## 1. Introduction

Cultural landscapes are, besides their role in food production, increasingly recognized and valued as objects of aesthetic beauty (Buijs, Pedroli, & Luginbühl, 2006). Their importance for economic welfare and well-being, through for instance recreation, or sense of place, inspired ample scholarly work on the link between these non-material benefits and the physical landscape attributes (Van Zanten, Verburg, Koetse, & van Beukering, 2014). However, the study of these values transcends mere physical attributes of the landscape and requires assessment of its social meaning within a given context (Lothian, 1999; Plieninger et al., 2015). Traditional stated preference approaches often rely on choice experiments representing different landscape attributes with context specific (manipulated) photographs to gain insight into landscape preferences (e.g. Barroso, Pinto-Correia, Ramos, Surová, & Menezes, 2012; van Berkel and Verburg, 2014; van Zanten, Verburg, Scholte, and Tieskens, 2016b). The on-site employment of photographs in choice modeling is generally regarded as an adequate method to unravel landscape preferences as it allows for keeping external factors

such as light and weather conditions equal while manipulating landscape elements present in photos (Steen Jacobsen, 2007). However, photographs are unable to capture the experience people have in a landscape as the photo is imposed by the researcher (Scott & Canter, 1997). Consequently, choice experiments cannot avert suffering from a hypothetical bias (Hanley, Mourato, & Wright, 2001).

The rise of social media has opened up new paths in landscape preference studies. Platforms such as Flickr, Panoramio, and Instagram allow their users to upload photos of the environment and place them on a digital map (Casalegno, Inger, Desilvey, & Gaston, 2013; Wood, Guerry, Silver, & Lacayo, 2013). Together, they provide a publicly available database of volunteered geographic information (VGI) with millions of geo-tagged photos spread all over the world (Goodchild, 2007). One of the main advantages of VGI is that it gives an insight into spatial choices and preferences of people without bias of experiments or surveys (Schlieder & Matyas, 2009). Within the last decade applications of VGI have been numerous and include semantic spatial analysis to study collective understandings of spatial concepts (Hollenstein & Purves, 2010) or using sentiment analysis of Twitter data to analyze

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Fig. 1. Location of case study Kromme Rijn area.

presidential election (Gordon, 2013). Recent studies show how VGI allows employing photos generated by users, as proxies for their landscape preferences, rather than hypothetically stated preferences for different landscapes (Gliozzo, Pettorelli, & Haklay, 2016; Hausmann et al., 2017; Oteros-Rozas, Martín-López, Fagerholm, Bieling, & Plieninger, 2017; van Zanten et al., 2016a).

Wood et al. (2013) were among the first to utilize social media content for landscape value research. They found evidence that actual visitation rates can successfully be predicted using the density of geo-tagged Flickr photos. Where Wood et al. (2013) used the trail of geo-tagged photos to explain spatial behavior of people, Casalegno et al. (2013) applied a similar method but instead mapped preferences. They used Panoramio densities as a proxy for the aesthetic value of landscapes in Cornwall, UK. When analyzed in combination with spatial data, the spatial patterns of photo density can reveal the preference for different landscape attributes (van Zanten et al., 2016a) or the consequences of land-use change (Sonter, Watson, Wood, & Ricketts, 2016). Currently social media data are also incorporated in the frequently used InVEST ecosystem service models to represent recreation services (Sharp et al., 2016). Yet another step further, Richards and Friess (2015), Tenerelli, Demšar, and Luque (2016), and Oteros-Rozas et al. (2017) not only use the spatial locations of photos but also incorporated the actual content of the photos to make sure only relevant photos are taken into account and to analyze what is actually on the photos to gain more information on landscape preferences. All these studies make stepwise advances in the interpretation of social media for landscape preferences. However, until now the different approaches have not yet been sufficiently combined to provide more in depth understanding of what attracts people in the landscape.

The objective of this paper is to synthesize different approaches to interpret social media photos to pinpoint what it is in a landscape that attracts people. We hypothesize that more insight can be obtained by incorporating both qualitative content of photos as well as the spatial relation to the environment where the photo is taken, to be achieved by

combining spatial regression of photo density with systematic content analysis. We used the Kromme Rijn area, a peri-urban agricultural area in the center of the Netherlands as an example case study area.

## 2. Methodology

The fundamental assumption in this paper is a direct correlation between the density of photos and the aesthetic appreciation of cultural landscapes. A cultural landscape can be described by the combination of its physical components, its management intensity and its cultural value and meaning (Tieskens et al., 2016). These three dimensions determine how a cultural landscape is perceived and valued (Plieninger et al., 2015). We are interested in the causal relation between the physical components of the landscape and its appreciation by people. In prior studies plenty of evidence was found to support the claim that higher densities of Flickr and Panoramio photos suggest higher visitation rates and appreciation of the landscape (Hausmann et al., 2017; Kisilevich, Krstajic, Keim, Andrienko, & Andrienko, 2010; Sun, Fan, Helbich, & Zipf, 2013; Wood et al., 2013). Moreover, multiple studies showed that differences in photo density can partly be attributed to the presence or absence of landscape elements (Gliozzo et al., 2016; van Zanten et al., 2016a). Following van Zanten et al. (2016a) we hypothesize a positive relation between the presence of landscape elements such as water bodies, tree lines and forest, and the aesthetic appreciation of people, measured by photo density.

To test our hypotheses, we downloaded all geo-tagged photos on Flickr and Panoramio in the case study area and performed a negative binomial linear regression to explain photo density with a set of spatial variables consisting of physical landscape attributes, demographics, infrastructure and place specific highlights. Subsequently, photos in areas with large residuals were analyzed using systematic content analysis to derive meaningful inferences about the relation between the landscape and aesthetic appreciation by people.

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