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Winescape perception and big data analysis: An assessment through social media photographs in the Chianti Classico region

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Abstract

Quantifying and mapping the relevant landscape attributes of winescape is difficult due to both the complex identity characterization of the places and the multidimensionality of the pursued perceptive experience on the emotional level. Although the quality of the rural landscape is recognized as an essential element of winescape, in the literature there are no methodological and applicative studies on the identification of the most significant characteristics of a wine region that are fundamental attributes in the preferences of visitors. The aim of the work is to propose a methodology to link the environmental and cultural landscape characteristics of the territory with the concept of winescape to improve the image of wine tourism adopting a systematic approach for territorial branding starting from the analysis of the visitors' preferences. The analysis is conducted through the geographical information data shared on the social media Flickr. Different methods of analysis are applied in an integrated way to:

a) analyze the demand for winescape in its different dimensions;
b) identify the territorial variables that are part of the winescape supply;
c) build a spatial relationship model between winescape demand and supply to quantify the territorial suitability and provide useful information for rural development strategies.

Keywords: Winescape; Big data; Landscape quality; Image clustering; Maxent; Wine tourism: territorial marketing

1. Introduction

The landscape is a classic example of mixed good, as it guarantees both positive externalities and private benefits. In the case of the rural landscape, and in the light of a growing neo-archaism, this characteristic has become increasingly important as the people expectations have grown and the rural world was rediscovered for its positive elements, moving away from a prejudicial vision of absolute negativity lasted until the seventies (Menghini, 2009).

Today the rural landscape is linked to specific choices in terms of both local governance and economic development policies (Antrop, 2005). These policies focus on an increasingly integrated approach, based on "rural development". From a physical place, passively designated to host human activities, the territory is increasingly seen as a more complex resource made up of tangible and intangible assets, and able to orientate and ensure specific goods and local services (public and private ones) for residents and external users (Sidali et al., 2015).

This different vision of the territory has led to in-depth revisions of the principles of local governance and rural development policies. The former no longer considers the

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management of the rural areas to support urban growth in a residual way, while the latter explores new business development strategies according to the concept of multifunctional diversification (Morgan et al., 2010).

1.1. Literature review

The term "winescape" derives from the concept of servicescape introduced by (Bitner, 1992); p.65). Within this specific case, servicescape identifies those activities complementary to the product that facilitate the marketing of services. Within the different dimensions that can be identified when dealing with servicescape, Bitner highlights three composite dimensions as being particularly relevant: 1) ambient conditions; (2) spatial layout and functionality; and (3) signs, symbols and artefacts. According to the author, these attributes merge to influence the mood and attitude of customers and employees, leading to approach or avoidance behaviors.

Some recent empirical studies have extended this theory to space services. For example, for cruise travel marketing, Kwortnik (2008) identifies a broader range of space services: (1) natural environment (ocean); (2) environmental conditions (smell, music, cleanliness and lighting); (3) ship design; (4) social factors (human relationships, congestion, relationships with service personnel). Similarly, for Johnson and Bruwer (2007); p. 277), "*the "winescape" in turn encapsulates the interplay of: vineyards; wineries and other physical structures; wines; natural landscape and setting; people; and heritage, town(s) and buildings and their architecture and artefacts within, and more*." In the study of winescape, Thomas, Quintal and Phau (Thomas et al., 2010) define two approaches: the macro approach, which considers the winescape at the wine region or at a wine route scale (predominant in the literature on wine tourism, e.g. (Getz and Brown, 2006), and the micro approach, which focuses on the environment in a specific estate or winery. As for the macro approach, the authors point out that there are few empirical studies aimed at identifying and measuring specific attributes of the winescape according to their influence on the attitude of the wine tourist and his/her subsequent behavioral intentions. Among them, in his study on wine farms in the Niagara region, Carmichael (2005) highlights that "*Overall, the rural landscape is found to be highly important in visitor enjoyment of the wine tourism experience*". Getz and Brown (2006) identify four dimensions for wine tourism, but only "the cultural product" characterized by "*traditional wine villages, unique accommodation with regional character and fine dining and gourmet restaurants"* can be related to the concept of winescape (Getz and Brown, 2006); p. 153). In one research aimed at the conceptualization of the image of a wine region into the concept of winescape as it is perceived by tourists, Bruwer and Joy (2017) note that "*The most important winescape dimension is the destination's natural beauty/geographical setting of its landscape*". According to Bruwer et al. (2013); the landscape itself, with its characteristics of rurality and naturalness, is a fundamental part of the concept of winescape, especially with wine tourism. "*During the aesthetic experience of landscape, there are four levels of aesthetic cognition: the perceptual (senses are involved, viewing, hearing or smelling), expressive (feelings and emotions associated with), symptomatic (object signs are symptomatic of something else) and symbolic (ideas and imaginations created in the viewers mind) …. It should be noted that the winescape translates into the destination region's identity and eventually into its brand image, once operationalized accordingly.*" (p. 5).

More recently, Bruwer, Gross and Lee (Bruwer et al., 2016) point out that "*the scenic location … makes it a dramatic nature experience for visitors.*" and that "*The landscape itself, and ultimately the entire winescape, therefore "seduced" the visitor into engaging in a total experience and forming a cognitive and affective perception of a fairly hedonic nature.*" The authors conclude that "*The impact of the nature-related dimension (i.e., scenery and/or natural settings) outweighs all other dimensions of the wine region's winescape, whether from a distance from the destination region (in-state vs. out-of-state) perspective or wine tourism as the primary reason for visiting the region (wine tourists vs. non-wine tourists). Both in-state and out-of-state visitors, but more so out-of-state visitors, exhibit hedonic pleasure-seeking needs expression and actions in their actual wine tourism consumption behavior. This resonates with* Williams (2001) *work, which suggested a diminishing importance of the industrial features of wine tourist destination image with a trend toward more experiential aspects*".

Overall, in different ways all the authors underline the strong characterization of a wine-growing landscape both for the physical relevance of the vines, as a permanent cultivation, and for the ploughing and type of farming chosen. Within the wine sector, this is even more evident in the increasingly specialized local agri-food systems, as it is also set forth by the various territorial certifications. The physical presence of the vines is unequivocally linked to a specific production, wine, and represents an element of strong characterization for the identity of a place. In Italy, as in many other parts of the world, this evidence becomes the pivot around which processes of elevation of the attractiveness of the place, differentiation strategies and effective positioning of the wines are generated, according to a product-territory relationship among the most distinctive within the range of Italian agri-food quality products.

To fully understand the real recreational tourist opportunities of a winescape according to both the strong identity of the places and the local communities (their cultural values and traditions) is fundamental to consider how the preferences of the tourist demand evolved. In recent years, the tourist demand went towards an evident segmentation, differentiating into "charter" and "mass" tourism, on the one hand, and "elite" and "exploration" tourism, on the other (Cohen, 1979; Smith, 1977; Gubert and Pollini, 2002). In the first segments, composed of large groups, the mere visit of the place represents the primary aim, while the second segments, being inspired by post-modern behavioral patterns (Menghini, 2009), focus on a more engaging experience, willing to live the overall atmosphere of a place, such as in the case of

winescape. In the post-modern vision, the tourist, searching for fulfilment in a winescape, needs to perceive his recreational tourist experience as a guest and not as a customer, living the trip with a much deeper intensity than a simple stay.

Traditional surveys through questionnaires are largely used to analyze the preferences and perceptions of complex phenomena such as wine tourism (Boatto et al., 2013; Alebaki et al., 2015; Alampi Sottini et al., 2009; Hervé et al., 2018; Eustice et al., 2019). However, in recent years, additional techniques using the data shared through social media spread as a complementary tool to direct surveys. As Cinelli Colombini (Cinelli Colombini, 2013) highlighted in her article "*the web is the key for tourism […]10% of all the tourism business and 30% of the bookings happen online […] mobile phones or smartphones will be crucial for orienting visitors during their travel experience. Future travellers will not ask for information anymore and will look at the web for guidance on what to see, where to eat or sleep and what to do. In other words, all the useful information to turn a tour into something unique will be available online*" (p. 112). Numerous studies describe how social media can influence wine consumers and may represent an important opportunity for wineries. Reyneke, Pitt and Berthon (Reyneke et al., 2011) used data from the website howsociable.com to portray similar luxury wine brands in multi-dimensional space. Wilson and Quinton (2012); p. 282) conducted interesting research on Twitter's contribution to winery revenues. The authors found that "*The embracing of social media moves wine businesses beyond engaging with consumers through winery visits, email or direct mail marketing campaigns and offline tastings and into the social realm of connecting, sharing and extending audiences through social media*". Capitello, Agnoli, Begalli and Codurri (Capitello et al., 2014) explored the best practices adopted by Italian wineries in increasing wine brand visibility using social media as a low-cost tool in their marketing strategies. More recently, Sogari et al. (2017) studied the role of social media in the consumer purchasing behavior for wine between the millennial and non-millennial generations. Galati et al. (2017) analyzed the Facebook activities of a sample of Sicilian wineries and explored the relationships between these engagement activities and some primary features of the firms and their entrepreneurs. In the food tourism sector, Liu et al. (2013) studied the online image-sharing community Flickr to profile the users who are fond of online food photography as well as to explore the role of online food photography in their traveling planning process.

When focusing on the study of aesthetic appreciation of a specific rural area or landscape, the use of geo-tagged photographs seems to be a promising alternative to appraise landscape perception in respect to traditional investigation through questionnaires (Tempesta and Vecchiato, 2015); the evaluation of landscape through photographs has developed in the last decades as a method for the analysis of rural landscapes and natural areas. Levin et al. (2017) found "*strong and significant correlations between all crowdsourced data and visitation statistics, demonstrating the potential to use crowdsourced data to characterize the social and perceived importance of protected areas and as a proxy for visitation statistics*". The same authors also demonstrated the advantages of combining remote sensing data with geo-tagged photos of Flickr social media to identify the tourist frequency and monitor the impacts of overloading. Yoshimura and Hiura (2017) and Walden-Schreiner et al. (2018) analyzed the relationships between shooting locations of geo-referenced photos of Flickr with both the environmental characteristics of the territory and the presence of infrastructures; the aim of the authors was to deliver management strategies for the preservation of natural resources, while providing opportunities for tourism and recreation.

1.2. Aim of the work

Quantifying and mapping the relevant landscape attributes of winescape is difficult because of the complex identity characterization of the places (the type of cultivation, the production methods, the types of wines, the traditions of local consumption, etc..), and the multidimensionality of the pursued perceptive experience on the emotional level.

During the aesthetic experience of the landscape, there are four levels of aesthetic cognition: perceptive (the senses such as sight, hearing, smell are involved), expressive (feelings and emotions associated with the identity of the places), symptomatic (objective signs are symptomatic of something else) and symbolic (ideas and imaginations created in the minds of the viewers) (Nohl, 2001). The strong evidence of the relationships among vineyards, wine production and local traditions has the highest expression in the Chianti region, as the name of the territory indicates at the same time both a product and a specific geographic area. This strong relationship is the basis of the "winescape" concept. The most important practical consequence is that the interest in a territory is closely linked to the demand for wine.

Mitchell et al. (2012) emphasized this multidimensionality introducing the concept of "cultural geography" and stated that "*rural landscapes, regardless of their use, are perceived differently by different groups of people*" (p. 315). It means that the image of a destination is a function defined by those who visit the destination and by those who live in and around the wine region of destination. In conclusion, although the quality of the rural landscape is recognized as an essential element of winescape, in the literature there are no methodological and applicative studies on the identification and characterization of the significant attributes used to detect the identity elements of the image of a wine region as the visitor perceives them. The studies mentioned above, carried out through direct surveys, allowed to identify the relevant characteristics of winescape in terms of services to wine tourists, but they are very vague and generic in the determination of landscape and environmental attributes.

In the present study, the potential supply of winescape was considered instead of the real one. The former is defined as the (interconnected) set of intrinsic territorial characteristics that contribute determining the offer of Cultural Ecosystem Services (CESs). The contribution that CESs make to well-being can be understood considering three main elements: *the*

"identities" they help frame, the "experiences" they help enable and the "capabilities" they help equip. By making these distinctions the framework is designed to avoid describing benefits in purely intangible terms (Fish et al., 2016); p. 213). The potential supply of CESs can be mapped analyzing the relationship between the demand area and its environmental factors, as the demand map represents the visitors' aesthetic preferences.

With specific reference to the wine landscape, the paper highlights how this new vision of the territory requires different analytical approaches for the assessment of the resources, integrating analyses based on the quantification of the consistency of landscape resources with the preferences of individuals. However, the exploration of an individual's preferences must be carried out considering the nature of the landscape, which is not associated with a specific place and time of "exchange".

According to the above, the present research proposes an analysis of the quality of the landscape as visitors to a given territory perceive it. The analytical phase of the study, according to the concept of "winescape", investigates the preferences of visitors to the specific territory of Chianti, offering survey tools capable of monitoring the characteristics of the demand and the supply.

The main objective of the work is to propose a methodology to link the environmental, and cultural landscape characteristics of the territory with the concept of winescape to improve the image of wine tourism. Considering the limitations of the different approaches for the analysis of the potential supply of CESs highlighted in the literature, the present study integrates two theoretical approaches: one based on the indicators from the literature of the visual quality of the landscape and the other referring to the indicators from the existing literature on winescape. For this purpose, different methods of analysis presented in the literature were applied in an integrated way to pursue the following specific objectives:

(i) analyze the demand for winescape in its different dimensions;
(ii) identify the territorial characteristics, and their measurable variables, that define the supply of winescape;
(iii) create a spatial relationship model between demand and supply for winescape to quantify the territorial suitability and provide useful information for regional planning and rural development.

Within a local development plan framed in the most modern territorial marketing approaches, this methodological proposal represents a preliminary analysis of the demand through which to formulate development strategy able to combine the local attitudes (vocations) with the behavior of winescape users (see Fig. 1).

2. Study area

The Chianti Classico region (Fig. 2) stretches over 70,000 ha between Florence and Siena. It is covered by about 10,000 ha of vineyards, 7200 of which registered in the Chianti Classico PGDO appellation. In this territory, even though the vine covers only 15% of the total area, viticulture represents the key element of both the local landscape and the entire local socio-economic identity: the term Chianti indistinctly identifies both the geographical area and the most relevant product of the area, its wine. After a period of massive rural exodus, since the seventies, the territory has become the centre of a variety of interests, especially for the tourist-recreational potential of the area which now has one of the most extensive networks of farm tourism throughout Europe. The Chianti Classico region has a specific vocation to host forms of tourism characterized by predominantly individual behavior, aimed at the search for recreational opportunities far from mass tourism and willing to visit places with a level of discretion able to capture the most hidden and intangible elements.

3. Methods

3.1. Introduction

In summary, the proposed methodology is divided into the following phases:

Step 1: Analysis of the winescape demand (dependent model variable). It is carried out by:

a) Downloading both the photos taken in the study area and their geographical coordinates;
b) Filtering the photos to identify images related to the concept of winescape;
c) Classifying the photos automatically and identifying the winescape user's clusters.

Step 2: Analysis of the supply of ecosystem services (independent variables of the model). It is carried out by:

a) Calculating the naturalistic and historical indices;
b) Identifying and calculating the winescape service indicators.

Step 3: Analysis of supply-demand balance: spatial modelling of photograph distributions. It is carried out by:

a) Computing maps of high-value location for the winescape user;
b) Evaluating the marginal importance of the indicators.

Fig. 2 shows the flow chart of the proposed methodology.

3.2. Demand for winescape services

We are currently experiencing a rapid increase in available data sources regarding voluntary geographical information. The term "Volunteered Geographic Information" (VGI) means the range of content, provided through the Web by its users,

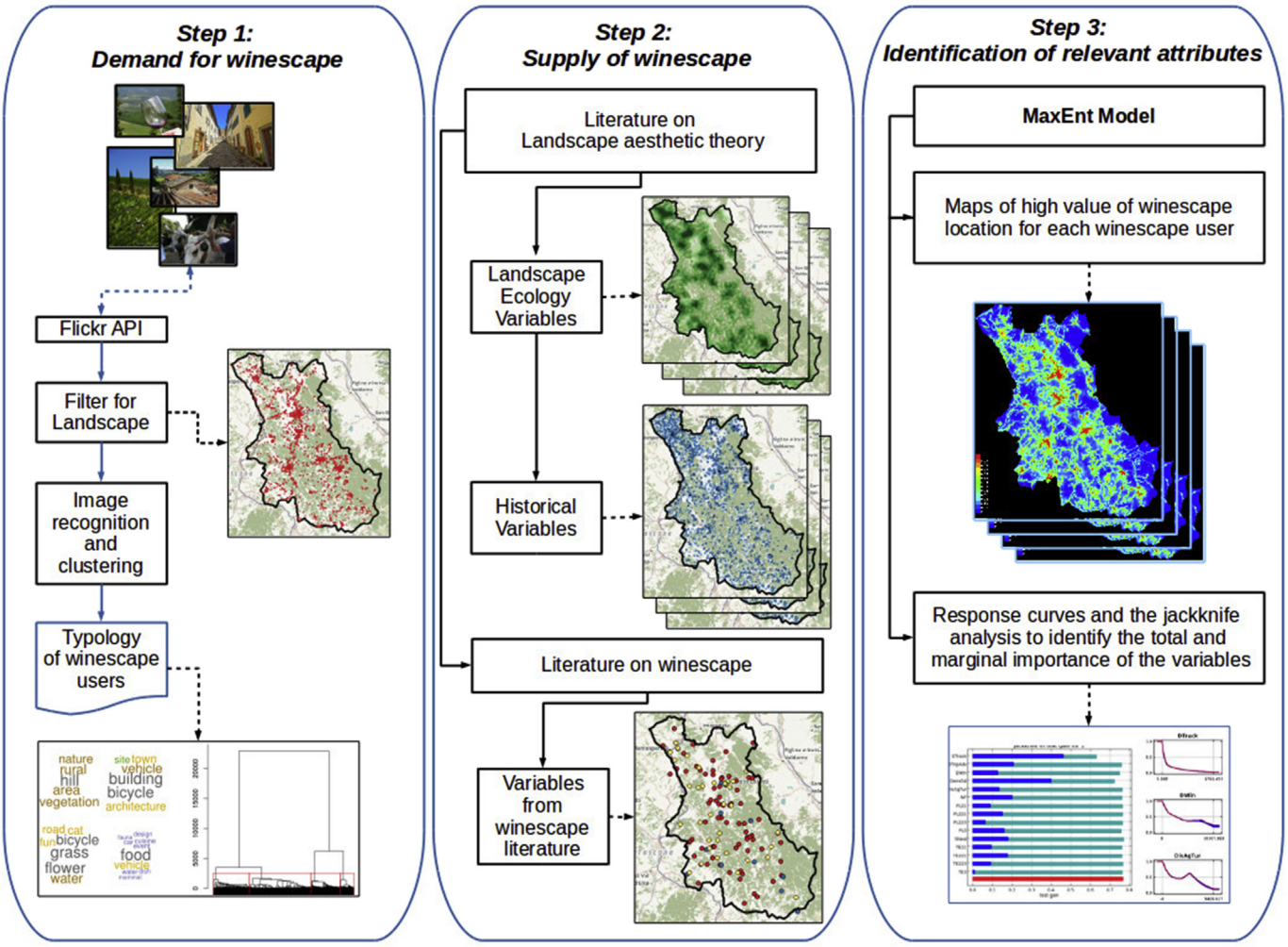

Fig. 1. Flow chart of the work.

which allow the generation of geographical information (Goodchild, 2007). Social media applications, such as Twitter, Flickr or Facebook, provide a source of geographical information that can be queried via public Programming Interfaces (APIs). At the same time, people are showing a growing willingness to actively share their experiences of living the urban, rural and natural spaces, in a context of use that falls under the broad term of "People as sensors". In addition, geotagging (i.e. to associate geo-localization information to a piece of information) becomes increasingly popular for photos.

According to Nov et al. (2010); the photographic data uploaded on the Flickr platform implies an individual process that can be divided into two main phases:

a) the technical-creative phase of taking the photo;
b) the social phase of sharing this photo by associating commentary information to it.

Lynch suggests that "[…] *the generalized mental picture of the exterior physical world that is held by an individual […] is the product both of immediate sensation and of the memory of past experience, and it is used to interpret information and to guide action*" (Lynch, 1960): p. 4). Speaking generally (Collier, 1967; Sontag, 1977; Dakin, 2003; Scott and Canter, 1997), the action of taking a picture is not only linked to the characteristics of the surrounding environment, but involves all of the aspects of the interpretative cognition that the individual applies to that space (personal preferences, memories, opinions, etc.). So, both the act of taking a picture in a specific place and the consequent action of choosing which photos to share on the social network platform reflect the quality of the perception that the individual has of that place.

For the present research, different sources of information were initially considered: Instagram, Facebook, Twitter, Panoramio and Flickr. We decided to choose Flickr for the following reasons: a) it is broadly used as a data source in GIScience, landscape, geography and tourism literature (Dunkel, 2015; Gliozzo et al., 2016; Oteros-Rozas et al., 2017); b) it offers an accessible API that has been widely experimented (Alivand and Hochmair, 2017); c) it provides a source of free, updated, and with good spatial as well as temporal resolution information (Levin et al., 2017).

Fig. 2. The study area.

The density of pictures taken in each location can be considered an indicator of the interest in the territorial services of the winescape. However, interpreting the information in the photographs can be a challenge for the investigation on the cultural uses of the environment, since the choice of what to photograph is naturally subjective. The subject of the photo can provide very useful information to characterize the geographical and cultural identity variables of a location. Manual classification of the content of the photographs is not an easily applicable solution since the investment in terms of time required to compare a large number of sites would be substantial. To allow a rapid evaluation of territorial cultural services over large areas, automated analysis of the contents of the photographs from social media is necessary. To solve this problem, Richards and Tunçer (2017) applied an online machine learning algorithm - Google Cloud Vision - and used hierarchical clustering to group the photos. This method turned out to give good correspondence compared with manual classification.

Based on this approach, in the present study, each downloaded image was analyzed by the learning algorithm (Google Cloud Vision, 2017), obtaining a specific description of the context, encoded in specific keywords. This analysis was carried out by automatic access to the Google Cloud Vision

API via the R package {RoogleVision}. A maximum of five keywords per image was returned.

After this analysis, a hierarchical clustering algorithm was applied to group photographs according to their keywords (Oteros-Rozas et al., 2017). Then, a distance matrix was generated by building a document-term matrix with photos as documents and keywords assigned to photos as terms. Afterwards, hierarchical clustering was applied to the matrix using the Ward distance, implemented in the "hclust" function for the statistical programming language R (R Core Team, 2018). We choose the elbow method to determine the optimal number of clusters. It optimizes the sums of squares within the clusters (Kassambara, 2017).

Clusters identified by hierarchical grouping were then used to categorize photographs. Lastly, to give meaning to each of the resulting clusters, we considered the fifteen words most commonly attributed to the photographs in each group. This number of words was considered adequate to let us define the type of photographs included in each cluster.

3.3. Supply of winescape: the choice of explanatory variables

Differently from the real supply, the potential supply of CESs includes locations with intrinsic characteristics that can potentially satisfy the demand but has limitations that do not allow the matching of supply and demand. The potential supply analysis aims to go beyond the current situation, suggesting strategies for the future.

As for the assessment of landscape quality, the exhaustive classification of indicators proposed by Ode, Tveit and Fry (Ode et al., 2008) was used as a reference. The conceptual framework developed by these authors links each indicator to concepts described by different aesthetic theories of landscape:

(a) complexity indicators are referred to the Biophilia evolutionary theory (Ulrich et al., 1993);
(b) naturalness indicators are related to the degree of naturality (or naturalness) of the examined environment, and they are explained by the restorative and therapeutic role of nature (Kaplan, 1995);
(c) coherence indicators are explained by the legibility aspects of the theories of Information Processing (Kaplan and Kaplan, 1989).

According to the above, in the present study, three main conceptual categories were identified and linked with five different visual quality indicators:

1) Complexity indicators
   - Number of different land covers per view in a radius of 1000 m;
   - Shannon index in a radius of 1000 m.
2) Naturalness indicators
   - percentage area, edge density, and number of patches of natural and semi-natural vegetation.
3) Coherence indicators
   - percentage area, edge density, and number of patches of vineyards in a radius of 1000 m;
   - percentage area, edge density, and number of patches of olive groves in a radius of 1000 m.

As for the indices deriving from the specific literature on winescape, the experimental studies of Echtner and Ritchie (1991); Winkler and Nicholas (2016); and, in particular, Getz and Brown (2006); were considered. According to Getz and Brown, the expectations of enotourist are at the same time related to the product (wine), the essential destination features and the cultural values. According to the authors, the ''core wine product'' considers both the product and the wineries (the hospitality of places, the frequency of events, the expertise of the staff, the size of the winery, etc.); the ''core destination appeal'' includes attractive scenery with well marked wine trails; the ''cultural product'' encompasses unique accommodation with regional character, fine dining and gourmet restaurants, and traditional wine villages.

In the present paper, the following indicators have been identified, which fall within the dimensions 'core destination appeal' and 'cultural product':

- core destination appeal
  - distance from historic villages in a radius of 1000 m;
  - territorial density of traditional and historical buildings (reference year: 1954), calculated using a Gaussian filter, with a radius of 1000 m;
  - proximity to historic travel paths.
- cultural product
  - proximity to the best restaurants based on the ratings shared on the TripAdvisor social network;
  - proximity to cellars included in the first best 100 places in Italy according to the magazine Wine Spectator.

The indicators were calculated at landscape level using the Frastag and QGIS software.

3.4. Supply-demand balance: spatial modelling of photograph distributions

The final step of the research was the analysis of the correlations between the shooting locations of Flickr georeferenced photos with the environmental characteristics of the territory. This analysis was carried out by the MaxEnt model (Yoshimura and Hiura, 2017; Walden-Schreiner et al., 2018). The method is based on an automatic learning procedure to estimate the probability of the presence of a winescape user in a specific location according to territorial characteristics. This model integrates continuous and categorical predictive variables, minimizes over-treatment, and evaluates the influence of each covariate.

In present study, the model runs on 15 replicas. The maximum number of background points was set to 10,000,

with a convergence threshold of 0.00001 (Merow et al., 2013; Phillips et al., 2006; Poor et al., 2012). The Area Under the Curve (AUC) of the Receiver Operating Characteristic (ROC) graph was used as the first parameter to validate the MaxEnt model (Phillips and Dudík, 2008).

The ROC can measure the efficiency of a binary classifier, such as the MaxEnt model, and the AUC represents the probability of sensitivity. An AUC value of 0.5 indicates a random pattern, while a value of 1 indicates a model that perfectly classifies the presence of data. An AUC value between 0.50 and 0.70 suggests a reasonably accurate model; a value between 0.70 and 0.90 suggests an accurate model, and a value higher than 0.90 indicates an extremely accurate model (Swets, 1988).

The response curves are another useful evidence given by the MaxEnt model. The curves show how the probability of predicted presence varies according to each environmental variable, keeping all the other environmental variables at the average value of the sample. Then, the Jackknife analysis was used to indicate the most informative variables. The Jackknife test obtained from MaxEnt allowed the contribution of each environmental variable to be analyzed; this approach excludes one variable at a time when running the model. Thus, it provides information on the performance of each variable in the model in terms of how important each variable is in explaining the distribution of species and how much unique information each variable provides. The Jackknife test determined the contribution of all variables to the distribution of the Flickr points.

The MaxEnt methodology was applied separately for each cluster identified in par. 2. A probability map for each cluster was obtained. Lastly, the different maps were aggregated into a single map of prevailing probability. To each geographical location, the cluster with the highest probability was assigned.

4. Results

4.1. Image recognition and clustering

Using the algorithm based on Flickr's *Application Programming Interface* (par. 2), the coordinates of 28,815 shooting points of shared photos were downloaded from 2005 to 2017. Afterwards, the pictures with the tags containing the words, and related terms, “wine”, “vineyard”, “Chianti”, were selected. Lastly, specific filters were applied to avoid distortions due to photos repeated many times in a single location by a single photographer. The final dataset contained 9304 photographic points. The records were downloaded and analyzed in R and converted into shapefiles for geospatial analysis using QGIS.

Then, on the 9304 records, the *Google Cloud Vision API* assigned at least one descriptive label to 9228 photos; the remaining 76 not labelled photos were excluded from further analysis. Fig. 3 shows the dendrogram and the results of the elbow method used for determining the optimal number of clusters. The elbow method suggests 4 clusters. Through hierarchical clustering, the following groups of photo points were identified for each cluster: cluster 1 counting 2657 points, cluster 2 1100 points, cluster 3 4693 points and cluster 4778 points.

The contents of the images were classified considering the 15 most frequent labels for each cluster (Table 1). Cluster 1, named “Landscape”, was characterized by open panorama photographs mainly belonging to winegrowing areas, with a combination of rural, natural and artificial historical elements typical of the Chianti landscape. Cluster 2, named “Miscellaneous” collected a mix of photos, with a relative prevalence of images taken during the international cycling event "*L'eroica*". Cluster 3, named “Villages”, comprised photos of urban spaces of historical villages and photos of architectural details (gates, fountains, arches, etc..) belonging to them. Cluster 4, named “Events”, was mainly made up of photos of food, places (wine cellars and restaurants), and events (weddings, conferences, etc.).

4.2. Spatial modelling of photograph distributions

The probability of occurrence for photographs of the “Landscape”, “Miscellaneous”, “Villages” and “Events” was modelled separately for each cluster. The AUC was high for all models: in “Landscape” the AUC, calculated through the training set, was 0.82 and the standard deviation was 0.023; in “Miscellaneous”, the average test AUC for the replicate runs was 0.811 and the standard deviation 0.024; in “Villages”, the

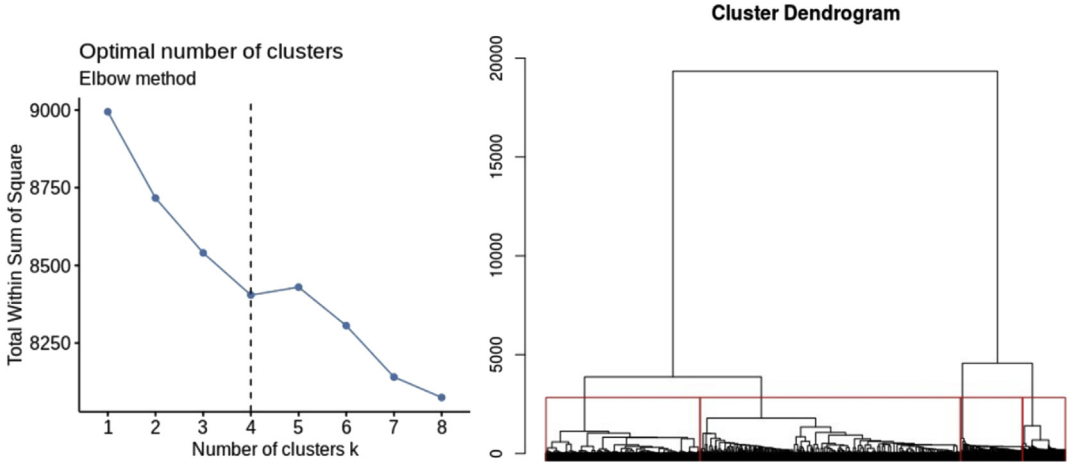

Fig. 3. Results for the elbow method and the cluster dendrogram.

Table 1
Most common descriptive labels of the photographic content in the identified clusters.

	Cluster 1			Cluster 2			Cluster 3			Cluster 4		
	words	freq	%	words	freq	%	words	freq	%	words	freq	%
1	hill	653	24.59%	bicycle	81	7.36%	building	704	15.00%	food	144	18.51%
2	agriculture	624	23.49%	flower	74	6.73%	vehicle	583	12.42%	event	54	6.94%
3	rural	560	21.08%	water	70	6.36%	town	521	11.10%	cuisine	51	6.56%
4	vegetation	531	19.99%	design	68	6.18%	architecture	503	10.72%	water	49	6.30%
5	nature	500	18.83%	building	68	6.18%	history	442	9.42%	design	48	6.17%
6	vineyard	391	14.72%	cat	60	5.45%	site	421	8.97%	dish	46	5.91%
7	town	382	14.38%	road	58	5.27%	road	391	8.33%	mammal	44	5.66%
8	leaf	347	13.06%	fun	58	5.27%	property	365	7.78%	flower	41	5.27%
9	landforms	277	10.43%	vehicle	56	5.09%	historic	361	7.69%	product	40	5.14%
10	grassland	269	10.13%	vegetation	54	4.91%	house	360	7.67%	motor	32	4.11%
11	house	266	10.02%	leaf	53	4.82%	medieval	358	7.63%	wood	32	4.11%
12	property	253	9.53%	girl	51	4.64%	village	314	6.69%	family	31	3.98%
13	village	241	9.07%	interior	51	4.64%	rural	308	6.56%	flora	31	3.98%
14	alley	213	8.02%	wood	50	4.55%	nature	296	6.31%	like	31	3.98%
15	neighbourhood	198	7.45%	mammal	48	4.36%	agriculture	289	6.16%	recreation	31	3.98%
	N. of images	2656			1100			4693			778	

AUC was 0.885 and the standard deviation 0.042; in “Events”, the AUC was 0.857 and the standard deviation 0.047.

To examine the territorial localizations where it is more likely to have geotagged photos classified in the different clusters, the prevalent probability map was calculated. Fig. 4 shows the map of the prevailing probability of photos classified in the four different clusters. Near the historical villages, we identify the maximum probability of having users classified in the “Villages” and “Events” clusters. However, the overlap between the two clusters is limited. The “Events” cluster is concentrated in the larger villages while the users belonging to the cluster “Villages” also visit scattered villages and historic houses. Visitors belonging to the clusters “Landscape” and “Miscellaneous” visit Chianti in a more widespread way. The places where the probability of having users of the cluster “Landscape” is higher are located near the historic Chiantigiana road. On the other hand, the “Miscellaneous” cluster is characterized by users that explore the territory also using unpaved roads.

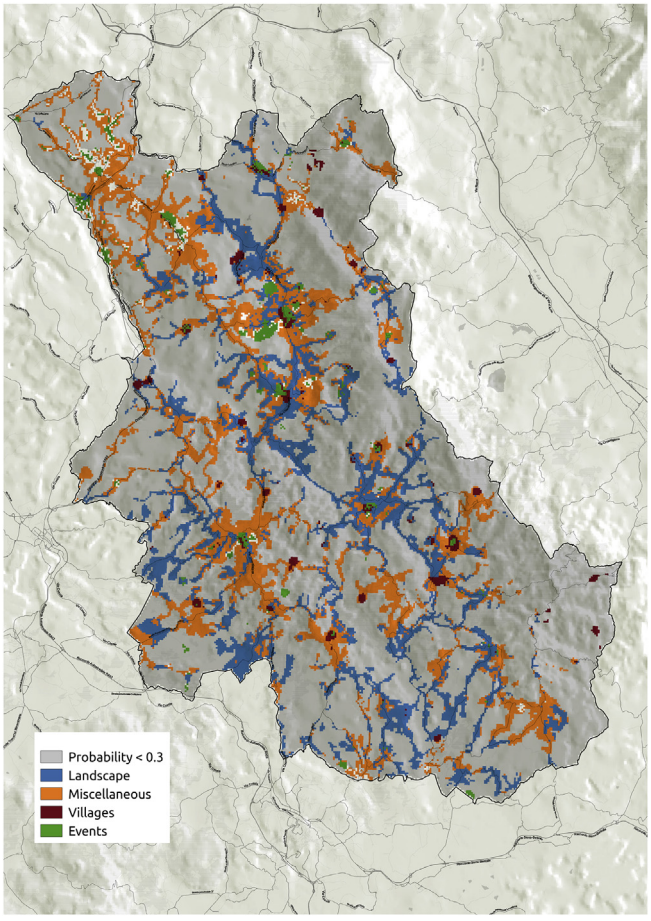

Fig. 4. Map of the prevailing probability of photos classified in the different clusters.

The importance of the variables evaluated by the Jackknife test is showed in Fig. 5. In detail, the most significant variables for the cluster “Events” are, in descending order, the density of traditional and historical buildings, the distance from travel path and the number of different land covers per view. For the cluster “Villages”, the most important variables are the density of historical and traditional buildings, the distance from travel path and the distance from farm holidays. For the cluster “Miscellaneous” the most essential variable is the distance from travel path, followed by the density of traditional and historical buildings and the Shannon index. Lastly, for the Cluster “Landscape” the most significant variables are, again, the distance from travel path and the density of traditional and historical buildings, and the ecology and landscape indicators referring to crops (edge density of vineyards, percentage of vineyards and percentage of natural areas). To be noted that many variables have a jackknife test value higher than 0.65, demonstrating an excellent predictive capacity.

Lastly, the response curves give interesting information. As an example, Fig. 6 shows the curves relative to some variables of the model. On the one hand, distance from travel paths indicates a high logistic probability of infrastructure being present within five hundred meters. On the other hand, the

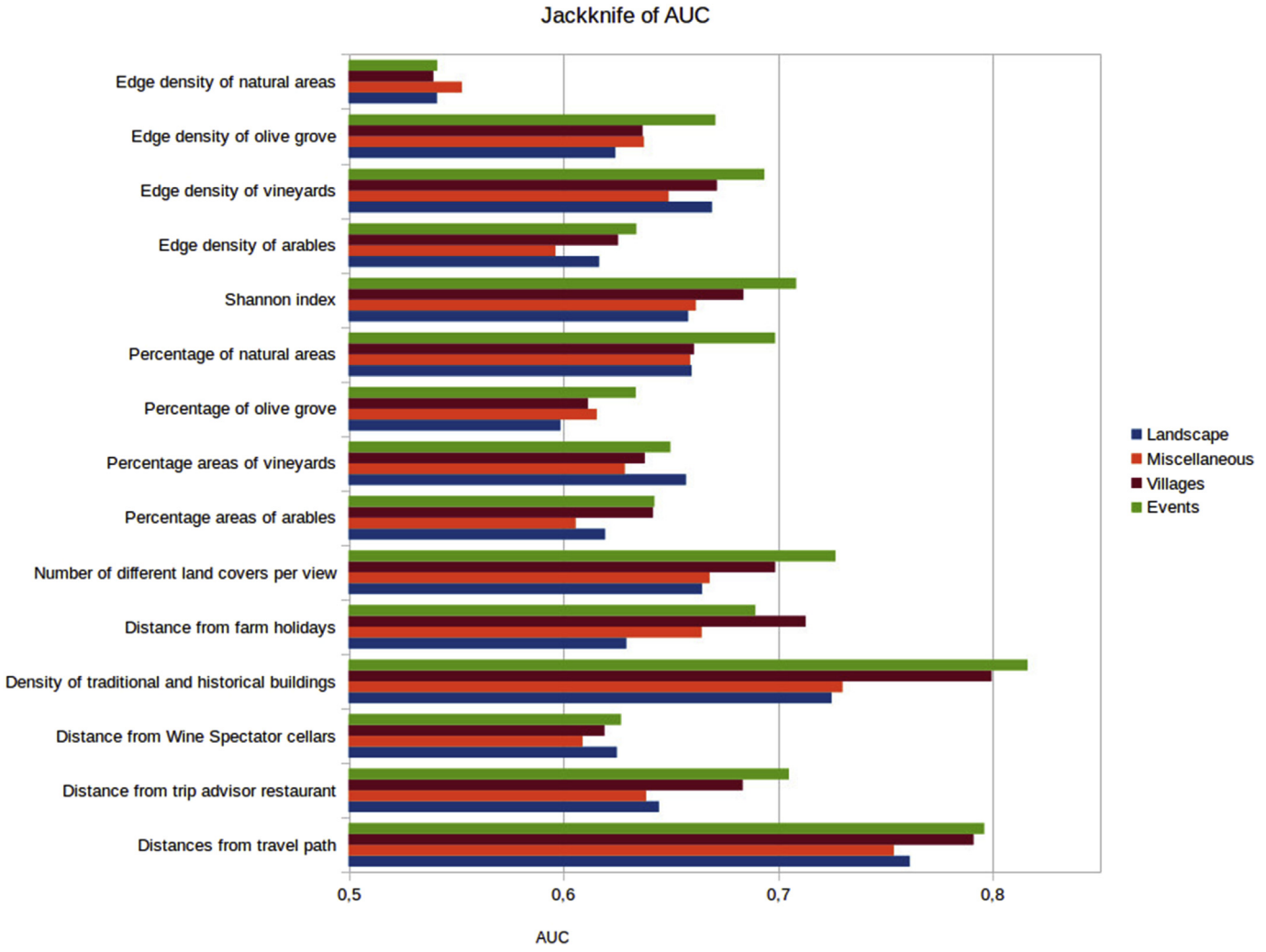

Fig. 5. Jackknife test.

logistic probability is directly proportional to the percentage of vineyard for all image clusters up to at least 30 per cent; beyond this value the probability is stable for the "Landscape" cluster, slightly decreases for the "Miscellaneous" and "Events" clusters and sharply decreases for the "Villages" cluster. The MaxEnt procedure output reports are available as supplementary materials. They also contain all the calculated response curves.

The response curves allowed the definition of specific agricultural land planning interventions. As an example, Fig. 5 shows the response curves for the following variables: percentage of vineyard, percentage of olive grove, edge density of olive groves, and edge density of vineyards. These curves allowed the outlining of a model of identity landscape consisting of a mosaic made up of about 50–60% of vineyards and 25–30% of olive groves, with 30,000 m of vineyard margins in a radius of 1000 m (95 m/ha) and about 40,000 m of vineyard margin (127 m/ha). These parameters can be implemented as prescriptions or guidelines for the provision of payments, encouraging farmers to enhance the environment and landscape services on their farmland within the framework of rural development programs (Bernetti and Marinelli, 2010).

5. Discussion

Winescape is a fundamental emotional attribute able to influence consumer behavior by elevating the perceived quality of the product. Tempesta et al. (2010) p. 833) proved that «*"Evocative" landscape obtained the highest partial preference level, and was without doubt the factor capable of most greatly influencing the liking of a wine. Clearly linking wine production to cultural heritage and, therefore, implicitly to the most noble regional viticulture traditions … had a significant effect on preferences*». Moreover, Sillani et al. (2017) proved that the combination of viticulture and wine-making, on the one side, and landscape, history and culture, on the other, can be a powerful tool to convert externalities into relevant attributes within a marketing strategy. Therefore, the territorial elements highlighted by the analysis of winescape perception can be considered as tangible elements of landscape that become intangible

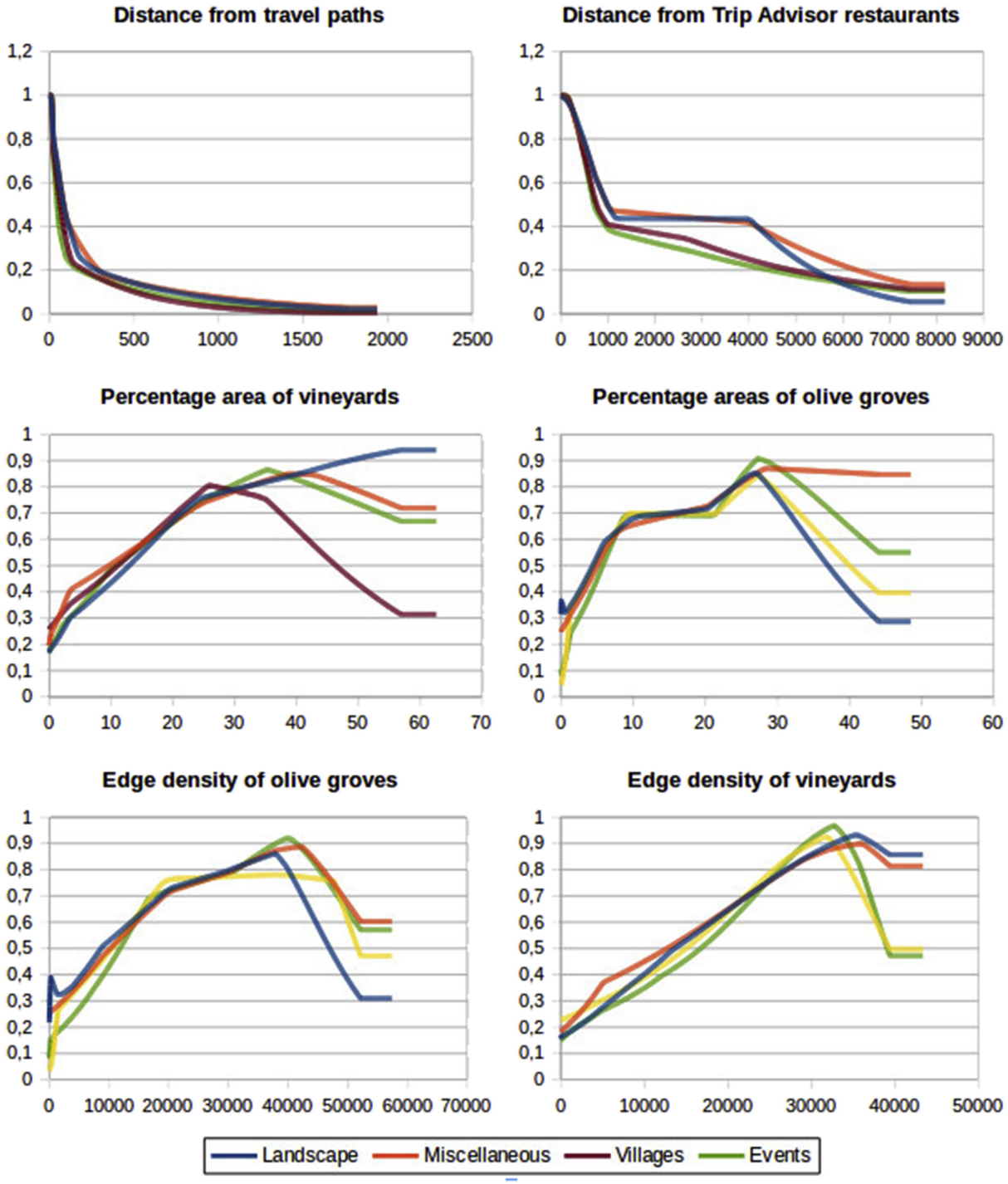

Fig. 6. Response curves for some variables.

components of the wine product, thus useful for its differentiation.

In addition, according to Fish (Fish et al., 2016) the four different clusters can be interpreted considering three different aspects: i) the identity of the places, ii) the lived experiences; iii) the individual capabilities.

Even if these three aspects can be identified in each cluster, it is possible to point out how:

i) The identity of the places are mostly related to Cluster 1, "Landscape", being the wine landscape full of suggestions that immediately evoke the relationship between the product and the places;
ii) The lived experiences mainly characterize Cluster 4 "Events" and Cluster 2 "Miscellaneous"; in this case, the relationship between winescape and the product is given by events. Mason and Paggiaro (2012) highlighted the

importance of festivalscapes in determining emotions, satisfaction and future behavior of participants at food and wine events;

iii) The individual capabilities characterize Cluster 3 “Villages” and Cluster 4 “Events”; winescape is used in knowledge acquisition processes at the level of intellectual advancement through both tasting and wine-food pairing or the connection of wine with architecture.

The elaboration of a spatial model for each cluster offers the planner the possibility of identifying the areas in which to intervene with priority, implementing safeguard projects starting from the most important and critical situations, e.g. the containment of the anthropic pressure where needed. Furthermore, in recent years, an increasing share of budgetary resources has been used for measures aimed at protecting the visual quality of agricultural landscapes (Howley et al., 2012). The understanding of the individual perception of the landscape becomes an essential cognitive element for the effective planning of rural development policies, in line with the promotion of bottom-up approaches of territorial governance (De Vreese et al., 2016).

The analyses carried out in the present study allow us to create a theoretical-methodological framework useful for the definition, planning, and development of winescape on a geographical scale. The overall approach adopted in the present study in Chianti Classico demonstrates that big data derived from Flickr platform are a valid source of information to identify the elements that characterize the territory, according to both the "macro" scale of Thomas, Quintal and Phau (Thomas et al., 2010) and the vision of winescape as a "cultural product" (Getz and Brown, 2006). In particular, the results highlight how winescape determines a specific territorial brand thanks to the contribution of the different tangible and intangible territorial elements, which act as both goods and services.

The present study can be a useful analytical tool for both farms and public decision makers that are involved in the definition of rural development strategies based on sustainable territorial marketing approaches. Through the correct management of the rural landscape, the approach proposed is a valid support for implementing the conditionality measures, regarding the provisions of the Italian National Strategic Plan and the regional rural development plans. After the introduction of decoupling and conditionality (EC Reg. 1782/2003), farms were asked to adopt agri-environmental measures preserving and improving the quality of the landscape. This attention on the landscape has been confirmed and even increased with the CAP strategies for 2014–2020, which aim at strengthening rural development objectives.

However, the paper is not without limitations. It has been demonstrated that the number of Flickr users has been positively correlated with the number of visitors (Wood et al., 2013), but, probably, the representativeness of the sample in sharing the appreciation of the landscape is influenced by some technological aspects (the rate of Internet use, the diffusion of cameras and smartphones with GPS, …). Moreover, the sample could be distorted depending on the age, the level of education and the tendency of using the social platform. However, methods based on questionnaires or interviews show the problem of representativeness as well (Tenerelli et al., 2016). A further drawback in the use of the Flickr platform is the difficulty in distinguishing the photos taken by residents from those taken by tourists since most Flickr user profiles do not have detailed home address information. Zheng et al. (2015) proposed a method for predicting places of residence and vacation locations, merging the visual content of the photos and the spatial and temporal characteristics of people's mobility patterns. In this direction, the future development of this research will be the updating of this methodology with additional information about the origin of Flickr users and their itineraries. The occurrence and density of photographs of the wine landscape can provide an indicator of public interest for a specific please, but there is a mismatch between such an indicator and the measurement of the value of the winescape service. The motivations for people to photograph the landscape and historic villages vary. In some cases, people take photographs to record positive attributes of the environment they find attractive, while in other cases, visitors take photographs to record negative environmental attributes (Dorwart et al., 2009). Furthermore, photographs can be taken to represent a place as a physical object or, otherwise, to be interpreted through the lens of a person's memories and the experiences surrounding a place (Scott and Canter, 1997). Therefore, it is complex to attribute a winescape value to the indicator showed in the paper. People can take photographs in a place while they use it for recreational purposes (i.e. while they are creating art or while they are documenting what they see as an important cultural heritage). The analysis of the content of social media photographs to evaluate the services of the wine landscape should be aware of the uncertainty belonging to the content of the photograph. In our approach, we considered the occurrence of landscape photographs as general indicators of public interest for that specific place. To understand more clearly why people take photographs in a particular place, and what cultural ecosystem services are provided, more information on the context may be needed. It may be possible to get a context on the use of rural spaces through metadata, as the latter is sometimes provided together with the social media photos (i.e. the title, notes, comments and tags) (Bernetti et al., 2019). Alternatively, interviews or surveys with people in a specific place may provide an additional context on the most popular cultural ecosystem services (Pleasant et al., 2014).

Therefore, the analysis of social media photographs should not be the only approach used when trying to quantify the services of the cultural ecosystem. It can represent a useful tool for providing quantitative data on large spatial scales, which can integrate more in-depth qualitative analyses (Richards and Friess, 2015; Thiagarajah et al., 2015).

6. Conclusion

The rural dimension is revealed in the territorial values of both the tangible (detectable with the senses in the physical evidence of a landscape, and perceivable on a visual, olfactory and acoustic level) and the intangible elements (culture, tradition, health, state of mind, etc …).

The methodology described in the paper aims to be original, to classical GIS analysis (i.e. ROS models), qualifying the landscape not through the measurement of objective territorial characteristics but through the visitors' preferences revealed by Flickr. The proposed model measures what visitors notice and what strikes them most both when they decide to take a picture (an aspect that is increasingly relevant in the digital age) and when they select what to upload and share in the web, adding precise "tags" that specify the object on which they have placed their attention. This sequence can be assimilated to a process of "selective attention" through which an individual discriminates between what she/he sees and what strikes her/him in a particular way. In this sense, the image taken and published in the web points out the relevant attributes in the preferences of the person who is experiencing the landscape at that moment, highlighting those characteristics of the territory that are most evident at his/her sight. Once the possible macroscopic dissonances between the territorial characteristics (not included in the analyses carried out in this research) and the predominant attributes pointed out by the visual preferences have been assessed, the model provides public decision-makers with precise indications on the main attractions of the winescape and indicates how to promote certain specific characteristics, if poorly perceived by the final user, by informing and educating him/her according to a communicative mix that constitutes a priority lever of any territorial marketing strategy.

Furthermore, the big data information shows the precise moment in which the photo was taken, and it allows the researcher to get some essential indications about the situation. For instance, it is possible to associate whether and to what extent the attention on specific landscape features is due to specific events or routes. This wide range of information is the starting point for the development of sound territorial marketing strategies, which are based on a thorough knowledge of the preferences of the visitors and not on a simple collection of places and events from calendars and documentation.

Conflicts of interest

There is no conflict of interest.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.wep.2019.07.001.

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