AESTIMUM 72, Giugno 2018: 5-26

Veronica Alampi Sottini, Iacopo Bernetti, Matteo Pecchi, Maria Cipollaro

Department of Agricultural, Food and Forestry System - GESAAF, Università degli Studi di Firenze, Firenze, Italy

E-mail: *veronica.alampi@unifi.it, iacopo.bernetti@unifi.it, matteo.pecchi@unifi.it, maria.cipollaro@unifi.it*

Parole chiave: *Agricoltura e ambiente, uso del suolo, tecniche statistiche non parametriche*
Keywords: *Agriculture and Environment, Land use, Nonparametric Methods*
JEL: *C14, Q15*

Visual perception of the rural landscape: a study case in Val di Chiana aretina, Tuscany (Italy)

The aim of the paper is to assess the perceived visual quality of the rural landscape in the Valdichiana aretina, Italy, through a survey conducted on a sample of ordinary people. The research comprises of three steps. First, the territory under study is divided into homogeneous landscape units through the implementation of GIS-based methodologies. Second, a photo-sampling of the area is carried out and a direct survey is conducted using the photographic material collected. Lastly, the information gathered is processed with the Multiple Factor Analysis technique.
The results reveal that the visual quality of the landscape units is perceived differently according to the sets of variables summarized by the extracted components: *composition and structure*, *stewardship* and *individual experience*.

1. Introduction

The public perception of a landscape has become of strategic importance in the European government policies on the territory since 2000, the year of the adoption of the European Landscape Convention by the Committee of Ministers of the Council of Europe (Conrad, Christie & Fazey, 2011; Stenseke, 2009). Article 1 of the Document gives a new definition of landscape (De Montis, 2014) which explicitly takes into account the population's perception: landscape is identified as "an area, as perceived by people, whose character is the result of the action and interaction of natural and/or human factors"(Council of Europe, 2000; article 1).

In the paper, the term "landscape" is uniquely referred to as its visual properties, excluding those characteristics that are linked with sensory experiences different from sight (Daniel, 2001). Moreover, the object under study is the agricultural landscape, which is defined as "the visible outcomes resulting from the interaction between agricultural commodity production, natural resources, and the environment." (OECD, 2001, p. 368).

According to the OECD (2001) definition, the agricultural landscapes are "Cultural landscapes", deriving from the interaction between the human activities and the environment. Besides just carrying out productive functions, agricultural landscapes perform different social functions and services, identified as Cultural Ecosystem Services (CES). These include recreational services, cultural heritage

DOI: 10.13128/Aestimum-23967

significance, aesthetic appreciation and artistic inspiration, as well as a feeling of belonging and identity for local communities.

The aim of the paper is to improve knowledge of the assessment of the visual quality of the landscape. The purpose of the research is to analyse how ordinary people perceive the different agricultural landscape typologies that characterize a delimited area of the Italian territory, the Val di Chiana aretina in Tuscany.

Scientific literature highlights the need to include public opinion on the processes that deal with the planning and the implementation of landscape policies (Eiter & Vik, 2015; Scott, 2011; Sevenant & Antrop, 2009; Stenseke, 2009). Effective strategies for the protection and enhancement of the landscape are needed. Through their formulation, it is also possible to overcome the socio-economic barriers that may arise to limit these objectives (Pouta et al., 2014; Sevenant & Antrop, 2009).

In Italy, many studies focused on rural and agricultural landscape assessments (Borin et al., 2010; Tempesta, 2010; Tempesta, 2014). As pointed out by Tempesta (2014), the long tradition of national legislation on this topic introduced several tools, based mainly on the principle of command-control and the definition of financial support mechanisms. This fact let top-down policies to spread. However, Tempesta (2014) highlights that the use of non-monetary approaches based on the opinions expressed by the population are the most suitable for meeting the objectives of the European Convention on Landscape.

Some authors (Rovai et al., 2016) point out that many landscapes are at risk of an expert-led landscape "elitism" (Rovai et al.,2016; p. 219). An example is Tuscany, an area whose landscape is internationally renowned (Regione Toscana, 2015; Rovai et al., 2016) and for which the imposition of judgments and values by experts (caused by the use of top-down land management policies) are not necessarily an expression of the stakeholders, neither of the population in general (Scott, 2011).

1.1 Theoretical framework

From a theoretical point of view, the analysis of the public perception of a landscape in terms of landscape quality assessment refers to non-monetary techniques (van Zanten et al., 2014) that use "subjective" approaches (Daniel, 2001; Lothian, 1999; Swanwick, 2009; Tveit et al., 2006). The scientific literature identifies two different methodologies for the non-monetary assessment of landscape: the "subjective" and the "objective" (Daniel, 2001; Lothian, 1999; Tveit et al., 2006). According to the second approach, landscape quality can be determined empirically by measuring objective parameters referring to its specific physical attributes (Scott, 2011; Tveit et al., 2006). This is a "specialist" type approach and involves the exclusive intervention of experts in the sector (Scott, 2006, 2011). In contrast, the "subjective" approach relies on ordinary people's opinions collected through psychological or perceptual descriptors within specific scales. Subjective approaches involve several techniques that belong to different scientific theories and disciplines. Many studies on the public preferences and perception of landscape have developed over time (Scott, 2006, 2011) embracing evolutionary, biological and cultural theories (Scott, 2011; Tveit, 2006). More recently, integrated approaches have asserted themselves (Dramstad et al., 2006; Tveit, 2009). According to these, both innate factors and "individual" factors influence the perception of landscape. The innate factors can be considered "universal" since they are primarily linked to the survival instinct of the species while the "individual" ones are influenced by the cultural background and the personal experiences of the individual for the formulation of his/her judgments (Jorgensen, 2011; Tveit, 2009; Tveit et al., 2006).

In the scientific literature, many studies analysed the perception and expressed preferences of ordinary people in relation to the rural and agricultural landscape (Arriaza et al., 2004; Cloquell-Ballester et al., 2012; Fyhri et al., 2009; Pouta et al., 2014; Rogge et al., 2007; Soini et al., 2012).

The paper refers to the methodological paradigm proposed in VisuLands framework by Tveit et al., (2006). This paradigm integrates different visual landscape quality assessment approaches (Tveit et al., 2006). In detail, Tveit et al. (2006) proposes a four-level hierarchical structure - concepts, - dimension, landscape attributes, indicators - which provides a link between the visual indicators of landscape and the theoretical concepts (Ode et al., 2008). Nine key concepts describe the visual landscape structure (Tveit et al., 2006, pp. 234-237): "naturalness", "stewardship", "disturbance", "historicity", "visual scales", "imageability", "ephemera", "coherence" and "complexity". These concepts define different aspects of the landscape that, together, offer a holistic experience of the visual quality of it (Pouta et al., 2014, p. 599). This paper operationalizes and implements four out of the nine concepts suggested by Tveit et al. (2006). It represents an exploratory study whose aim is to analyse the perception of the everyday agricultural landscape by ordinary people, following the example of other scientific papers, which have operationalized the key concepts suggested by Tveit et al. (2006), such as Pouta et al. (2014) and Sevenant & Antrop (2010).

2. Materials and methods

2.1 Case Study

The area under study is Val di Chiana in Tuscany (Central Italy). Val di Chiana is a valley of alluvial origin in Central Italy, and its territory lies within the provinces of Arezzo and Siena. Val di Chiana is naturally bordered to the south and southwest by the mountain chain Rapolano - Monte Cetona, to the east by the Alpe of Poti and to the west by the Mounts of Chianti (Regione Toscana, 2015).

The case study is Val di Chiana aretina, of the territory of Val di Chiana, which lies within the Province of Arezzo.

This area has a high agricultural vocation: overall, the Total Agricultural Area (TAA) within the boundaries of the eight selected municipalities amounts to approximately 72,400 ha (ISTAT, 2010). The Used Agricultural Area (UAA) is 64% of the TAA. The arable land covers 72% of the UAA (about 33,000 ha), followed

Figura 1. Area under study.

by tree crops (3,400 ha, 7% of tha total UAA) and vineyards (7,800 ha, 17% of the UAA). Kitchen gardens and permanent grassland jointly cover 4% of the total UAA (ISTAT, 2010). The data represent, respectively, 37% of the TAA and 48% of the UAA of agricultural units in the province of Arezzo and 7% of agricultural units of the entire region of Tuscany (ISTAT, 2010).

From an aesthetical-perceptual point of view the area is defined by terraced olive trees, alternated with extensive traditional agro-pastoral landscapes, which characterize the foothill agricultural landscapes of the area. The lowland areas around Arezzo are instead characterized by intensive cereal crops and by artificial processes due to the gradual expansion of residential and industrial areas of the city centre (Regione Toscana, 2015).

2.2 Methodology

The implemented methodology followed three steps:

- Step 1 – Mapping Landscape Pattern Types (LPT)
- Step 2 – Survey
- Step 3 – Statistical analysis

Initially, the investigated area was classified into homogeneous landscape units (Arriaza et al., 2004) through the use of GIS-based techniques. Subsequently, a ground photographic sampling of the area was performed. It involved creating a photographic record of representative images of the agricultural landscape, characterizing each identified landscape unit. A selection of these photographs was used during the survey interviews to determine the perception of the landscape by ordinary people. Finally, the data collected through the questionnaire was statistically analysed, using exploratory multi-way methodologies.

Step 1: Mapping Landscape Pattern Types (LPT)Methodology

The territory was classified into homogeneous units to evaluate the characteristics influencing the perception of the landscape. Numerous methods exist for the evaluation of landscape characteristics (Ode et al., 2008). This paper adopted the Landscape Pattern Types (LPT) method proposed by Wickham & Norton (1994). Wickham and Norton define LPT "as a kilometres-wide geographic area throughout which a limited number of land cover categories form a consistent pattern" (Wickham & Norton, 1994, p. 8). On the basis of the territory characteristics, the uses of the land cover were: Developed, Grazing, Permanent crop, Arable Land and Natural. The authors categorized the LPTs into three classes: matrix, matrix and patch, and mosaic. The land cover category that dominates the LPT by area is the matrix. Patch land cover components are those present, but not dominant. An additional pattern category, mosaic, was added to account for those areas where no land cover category was clearly dominant. LPTs, then, can be composed of different combinations of land cover categories in a matrix, matrix and patch, or mosaic pattern (e.g. Natural matrix, Natural matrix with permanent crop patch, or Arable land matrix with natural and developed patches).

The paper classifies a particular land cover as a matrix when the minimum percentage is 66%, as a patch when it is between 66 and 33%, and as a mosaic when the percentage is under 33%.

The classification of the territory into LPT was carried out on a raster land use map with 20 meter-pixels, through a circular floating window of 1 kilometre in diameter (Ridding et al., 2018, Riitters et al., 2009). Table 1 shows the results of the analysis.

The landscape mosaic map legend (Table 1) labelled the 31 LPTs using the letters 'D' (or 'd'), 'G' ('g'), 'P' ('p'), 'A' ('a') and 'N' (n) that referred to Developed, Grazing, Permanent crop, Arable land and Natural, respectively. An upper-case letter meant that 'at least 66% but less than 100%,' a lower-case letter meant 'at least 33% but less than 66%,' and the absence of a letter implied 'less than 33%'.

In order to simplify the photographic survey, the 31 categories were reduced to 8 categories (Table 1), by combining LPTs that were similar in terms of perception, that is, dominated by a highly territorial typicality (i.e. vines and olive trees are the permanent crops characterizing most of the Tuscan landscape) or hardly relevant in terms of size.

Since the analysis was conducted exclusively on agricultural landscapes, only 6 out of the 8 LPTs were subjected to photographic sampling: the analysis excluded those landscapes in which the artificial or natural matrix were prevailing.

The 6 selected LTPs were (Fig. 2):

1) "Developed patch with mosaic and other land use patches",
2) "Arable land patch with mosaic and other land use patches",
3) "Permanent crop patch with mosaic and other land use patches",
4) "Natural patch with mosaic and other land use patches",
5) "Arable land matrix",
6) "Permanent crop matrix"

Table 1. LPT's classification of the territory (Mosaic legend on the next page).

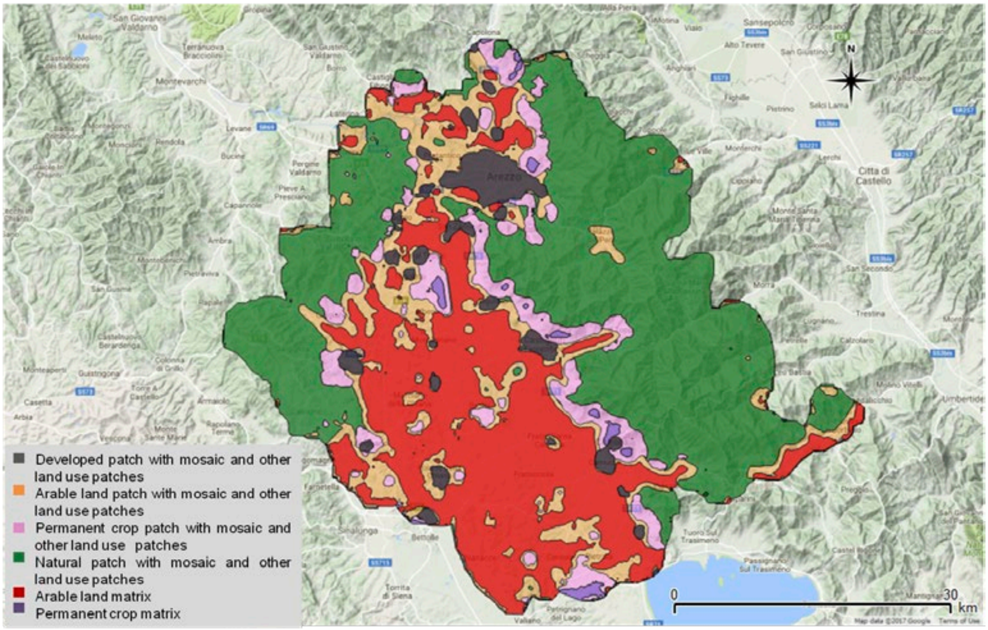
Cat	Developed	Gazing	Permanent crop	Arable land	Natural	Ha	Mosaic
1	<33%	< 33%	< 33%	< 33%	< 33%	395.8	
2	< 33%	< 33%	< 33%	< 33%	33-66%	6370.0	n
3	< 33%	< 33%	< 33%	< 33%	>66%	48175.2	N
4	< 33%	< 33%	< 33%	33-66%	< 33%	14849.8	a
5	< 33%	< 33%	< 33%	33-66%	33-66%	3575.9	an
6	< 33%	< 33%	< 33%	33-66%	>66%	25.2	Na
7	< 33%	< 33%	< 33%	>66%	< 33%	35991.0	A
8	< 33%	< 33%	< 33%	>66%	33-66%	27.4	An
9	< 33%	< 33%	33-66%	< 33%	< 33%	4671.9	p
10	< 33%	< 33%	33-66%	< 33%	33-66%	3317.3	pn
11	< 33%	< 33%	33-66%	< 33%	>66%	1.8	Np
12	< 33%	< 33%	33-66%	33-66%	< 33%	2805.6	pa
13	< 33%	< 33%	33-66%	33-66%	33-66%	0.04	pan
14	< 33%	< 33%	33-66%	>66%	< 33%	0.6	Ap
15	< 33%	< 33%	>66%	< 33%	< 33%	1019.3	P
16	< 33%	< 33%	>66%	< 33%	33-66%	2.2	Pn
17	< 33%	< 33%	>66%	33-66%	< 33%	4.8	Pa
18	33-66%	< 33%	< 33%	< 33%	< 33%	624.4	d
19	33-66%	< 33%	< 33%	< 33%	33-66%	24.0	dn
20	33-66%	< 33%	< 33%	< 33%	>66%	2.5	Nd
21	33-66%	< 33%	< 33%	33-66%	< 33%	3119.2	da
22	33-66%	< 33%	< 33%	33-66%	33-66%	0.7	dan
23	33-66%	< 33%	< 33%	>66%	< 33%	28.2	Ad
24	33-66%	< 33%	33-66%	< 33%	< 33%	376.3	dp
25	33-66%	< 33%	33-66%	< 33%	33-66%	0.0	dpn
26	33-66%	< 33%	33-66%	33-66%	< 33%	0.6	dpa
27	33-66%	< 33%	>66%	< 33%	< 33%	0.5	Pd
28	>66%	< 33%	< 33%	< 33%	< 33%	1152.9	D
29	>66%	< 33%	< 33%	< 33%	33-66%	0.7	Dn
30	>66%	< 33%	< 33%	33-66%	< 33%	12.2	Da
31	>66%	< 33%	33-66%	< 33%	< 33%	0.3	Dp

Source: our elaboration.

Table 1. Legend.

Natural matrix
Natural patch with mosaic and other land use patches
Arable land patch with mosaic and other land use patche
Arable land matrix
Permanent crop patch with mosaic and other land use patches
Permanent crop matrix
Developed patch with mosaic and other land use patches
Developed matrix

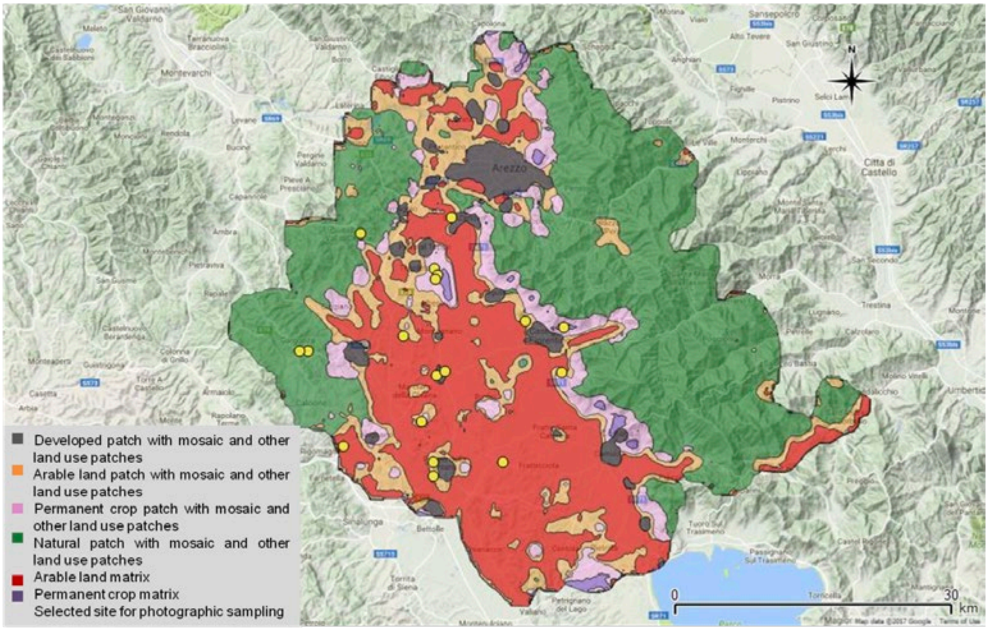
Figure 2. Map of a landscape mosaic.



Step 2. Photo-based survey

The landscape was represented by on the ground landscape photography. One of the researchers on the team took photos representing the different agricultural landscapes in Val di Chiana aretina. The maps obtained by using the methods described in Step 1 served as tools to select the location to shoot. The precise location from which each photograph was taken was recorded on maps in the fields (Fig. 3).

Figure 3. Map of the selected sites for the photographic sampling.



According to the guideline proposed in the scientific literature (Daniel, 2001; Nassauer, 1983), the photos were technically shot so as to represent the "real" landscape. The photographer used shooting, composition and framing techniques to make photos as close as possible to field experience (Nassauer, 1983): photographs were taken "from eye-level" by the use of a levelling tripod to ensure a vertical direction of view (Nassauer, 1983). The photographer created 180-degree panoramic pictures using a panorama-stitching software to stitch pictures. The photos were taken in colour (Nassauer, 1983).

In total, an archive of 100 photos was created. 18 photos were selected for the survey with each homogeneous landscape unit represented by three photos each (Fig. 4). Inside the categories the selection was random.

To survey different people's perception of landscape an exploratory study was conducted on a sample of 60 participants. The participants were selected based on a "convenience" sampling technique, which included residents within the territory of Val di Chiana and non- residents.Criteria used for the selection were: i) the interviewees had to be local people, i.e. citizens residing within the territory of Val di Chiana, or, alternatively, ii) non-local people, i.e. undergraduate students or new graduates in agricultural areas of study at the University of Florence, who were resident in another province or territory in Tuscany.

The data was collected via face-to-face interviews through a paper questionnaire. The questionnaire was structured into two sections. The first was to define the personal data of the interviewed through open questions on age, the town of

Figure 4. Photos selected for landscape visual quality assessment. Photos: M. Pecchi.

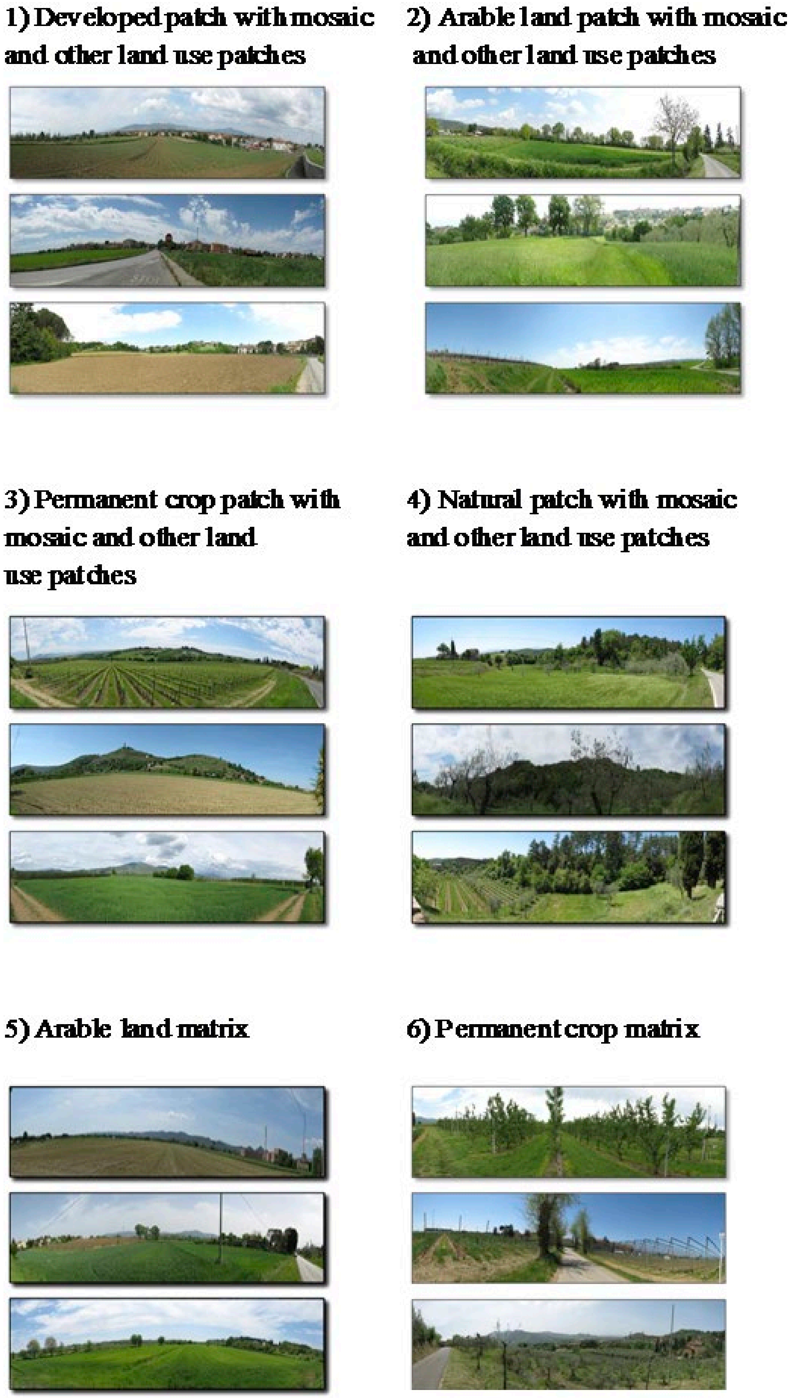


Table 2. Characteristics of the sample group.

Residents	Frequency	% Percentage	Typology
	14	47%	Bachelor degree
30	8	27%	High school diploma
	8	27%	Student
30	23	77%	Graduated with a bachelor degree
	7	23%	Bachelor's degree student

Source: our elaboration.

residence, education level and the area of study for their qualifications. Table 2 shows the sample characteristics and socio-demographic information on the survey respondents.

The second section of the questionnaire was designed to assess their perception of the agricultural landscape. Participants were shown the photographs of the agricultural landscapes selected in Step 2.

The participants were required to evaluate each landscape using a 17 seven-point semantic differential scale: 17 antithetical adjective pairs were chosen for the study, able to describe and operationalize the key concepts introduced by Tveit et al. (2006) and related to "naturalness", "stewardship", "complexity" and "imageability".

These concepts were selected because they were deemed relevant for the assessment of the visual quality of rural landscapes. For example, naturalness describes to what extent a landscape is perceived as close to its natural state (Tveit et al., 2006, p. 244). This concept is considered particularly relevant among the evolutionary theories (Ode et al., 2009). Stewardship has been included in the analysis as it is a concept closely linked with sustainability. Studies show that such indicators are drivers for landscape preferences. This criterion also justifies the differences in the perception of the landscape among groups of individuals (Sang & Tveit, 2013; Tveit, 2009).

The traditional agricultural and forest landscapes are the result of specific management systems, which are in some cases labour intensive (Fry et al., 2009). In Tuscany in particular, the traditional rural landscape is the result of a plurimillennial stratification of careful land management practices (Regione Toscana, 2015). The close relationship between the settlement system and the agricultural land, the high architectural and urban quality of the rural areas and the presence of a complex mosaic of the land uses are some of the distinct characteristics of the rural landscape in Tuscany (Regione Toscana, 2015).

Complexity is a criterion widely investigated among the studies on the expressed preferences on the landscape (Kuper, 2017); it describes the richness of the elements in the landscape (Tveit, 2006, p. 244) and is linked to the concept of coherence (Ode & Miller, 2011). Imageability (Blumentrath & Tveit, 2014; Tveit et al., 2006) mainly refers to the concepts of "identity", "sense of place" and "place attachment" (Brown & Raymond, 2007; Soini et al., 2012). These concepts describe the complex network of relationships between individuals and their surroundings (Soini et al., 2012). Imageability is linked to the existence of specific elements in the landscape able to capture the attention of observers and to convey to them sensations while evoking images that will remain etched in their minds for a long time (Blumentrath & Tveit, 2014).

The choice of the adjective pairs referred to the scientific literature (Hunziker & Kienast, 1999; Poutaet al., 2014; Tveit et al., 2006) and to the advice provided by the experts in the sector.

The antithetical adjective pairs used in the questionnaire were: boring – interesting (BO-IN), unpleasant – pleasant (UN-PL), uncared for – cared for (UN-CA), restless – quiet (RE-QU), unnerving – comfortable (UN-CO), not worth protecting – worth protecting (NW-WP), unfriendly –friendly (UN-FR), altered – natural (AL-NA), noxious – healthy (NO-HE), valueless – valuable (VL-VA), ordinary – special (OR-SP), strange – familiar (ST-FA), monotone – varied (MO-VA), confused – orderly (CO-OR), ugly – beautiful (UG-BE), boring – stimulating (BO-ST), work – recreation (WO-R).

2.3 Statistical analysis

The first step in the analysis involved the calculation of the averages of the opinions on the representative photos for each homogeneous landscape unit, since the opinions referred to three different photographs for each area.

The database was then organized in a three-way structure of the type I x J x K, arranged in 2-dimensions by the juxtaposition of the elementary matrices Xk of the group of variables, according to the common point of comparison of the units (Bolasco, 1999).

The data matrix is described through the following formula (Bolasco, 1999):

$X_{i,j,k} = \{ i = 1, \dots , 60; j = 1, \dots , 17; k = 1, \dots ,6 \}$

Where:
I = 60 interviewees
J = 17 variables detected with the semantic differential technique
K= 6 homogeneous landscape units

The most suitable technique to process the information collected through the questionnaire was identified in the MFA- Multiple Factor Analysis (Pagès, 2004). Statistical analysis was conducted using FactoMineR package vers. 1.28 (Lê et al., 2008) and factoextra vers. 1.0.4 (Kassambara & Mundt, 2017), belonging to the open source statistical software R. The Multiple Factor Analysis enabled the comparison of the structures of the single elementary matrices, represented by the six landscaped units and to investigate the relationships between the units and variables in average terms (Bolasco, 1999).

3. Results

3.1 Results of the statistical analysis

Table 3 and Fig. 5 show the percentage of variance explained by each dimension. Because of the number of variables (102) and of individuals (60), three dimensions were extracted. The first three variables sum up approximately 27.36% of the cumulative variance. The value is higher than that achieved through the implementation of a parallel analysis (13.69%).

The groups of observations projected in the space defined by the first two components (Fig. 6), identifies two groups of homogeneous landscape units: a first group, most correlated to the first extracted component, comprising the "Developed patch with mosaic and other land use patches", and the "Natural patch with mosaic and other land use patches", and a second group, mostly correlated with the second extracted dimension, comprising the "Arable land patch with mosaic and other land use patches", the "Permanent crop matrix" and the "Arable land matrix". As a result, it is clear that the homogeneous landscape unit "Arable land patch with mosaic and other land use patches" is correlated to both components, while the homogeneous landscape unit "Permanent crop patch with mosaic and other land use patches" shows low correlation with both dimensions.

The groups of observations, projected in the space defined by the first and third main components (Fig. 7), highlight, instead, how the third component is correlated with the landscape area "Permanent crop matrix", while the first dimension is mainly correlated with "Arable land patch with mosaic and other land use patches", "Developed patch with mosaic and other land use patches", "Natural patch with mosaic and other land use patches" and "Arable land matrix".

Figure 5. Eigenvalues: bar chart.

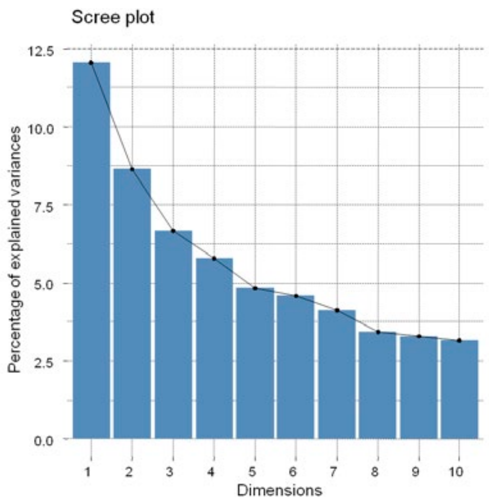


Table 3. Saturation matrix.

Component	Inertia %	Cumulative inertia %
Component 1	12.06	12.06
Component 2	8.63	20.70
Component 3	6.66	27.36
Component 4	5.77	33.14
Component 5	4.83	37.98
Component 6	4.57	42.55
Component 7	4.11	46.67

Source: our elaboration.

Figure 6. Groups' representation projected in the space defined by the first and second extracted dimension.

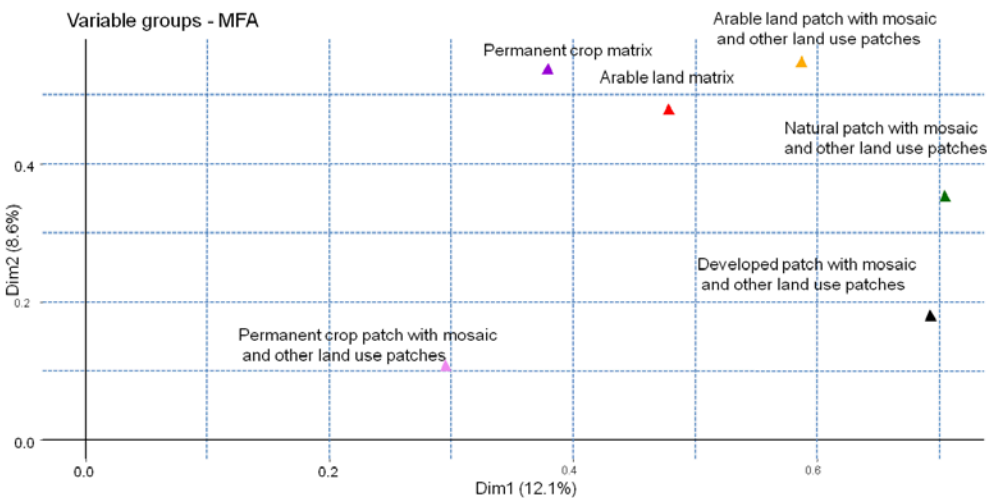
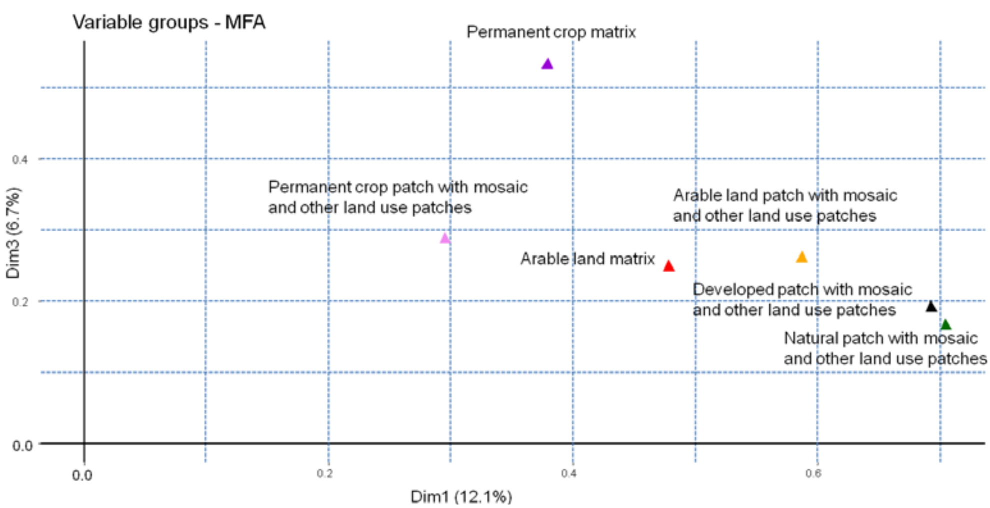


Figure 7. Groups' representation projected in the space defined by the first and third extracted dimension.

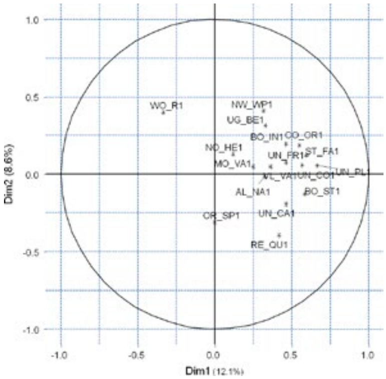


A better interpretation of the results can be achieved analysing the correlation circles (Fig. 8, Fig. 9 and Appendix A).

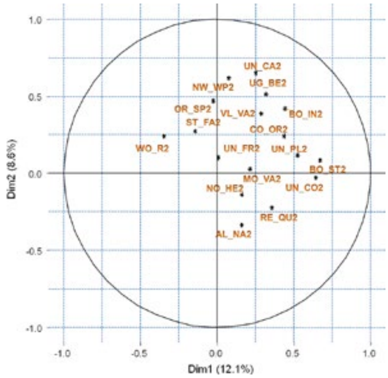
The variables mostly correlated with the first dimension appear to be "confused-orderly" in relation to landscape unit n. 4 "Natural patch with mosaic and other land use patches" and "boring- stimulating" in the landscaped unit n. 2 "Arable land

Figure 8. Correlation circle. Projection of the variables in the space of the first and second component, for each analysed LPT.

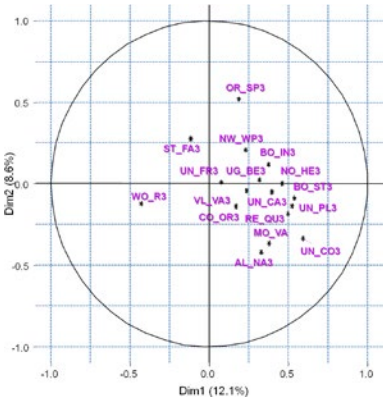
Developed patch with mosaic and Otherland use patches



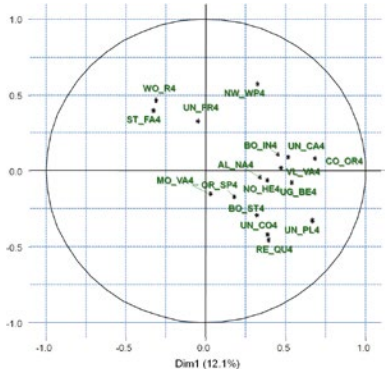
Arable land patch with mosaic and other land use patches



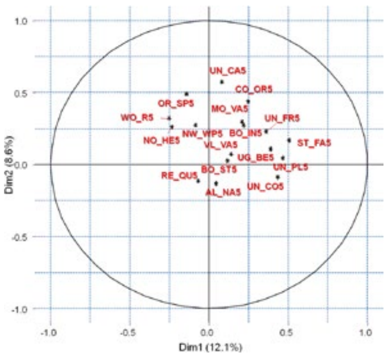
Permanent crop patch with mosaic and other land use patches



Natural patch with mosaic and other land use patches



Arable land matrix



Permanent crop matrix

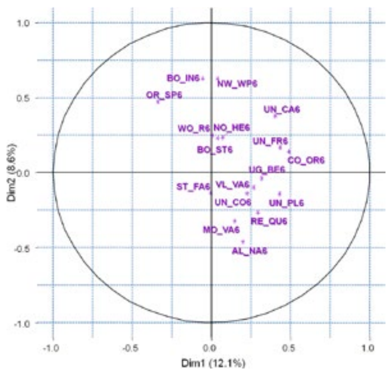
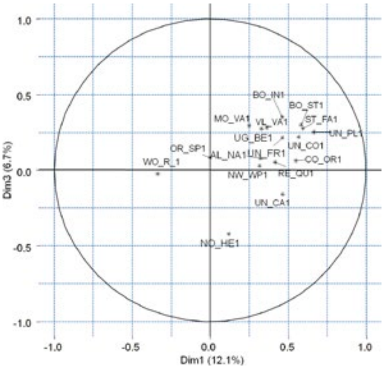
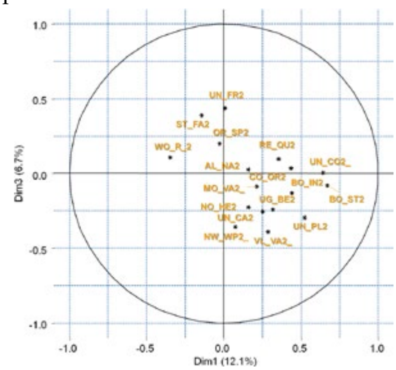


Figure 9. Correlation circle. Projection of the variables in the space of the first and third component, for each analysed LPT.

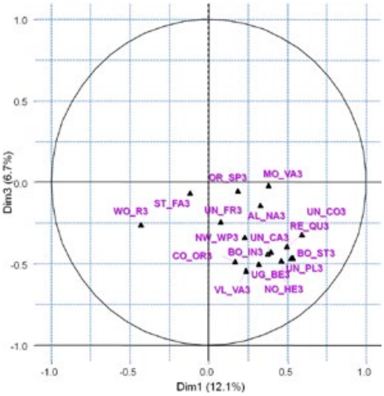
Developed patch with mosaic and Otherland use patches



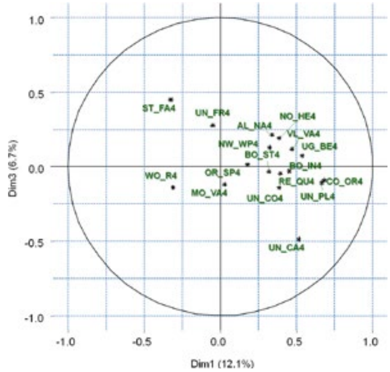
Arable land patch with mosaic and other land use patches



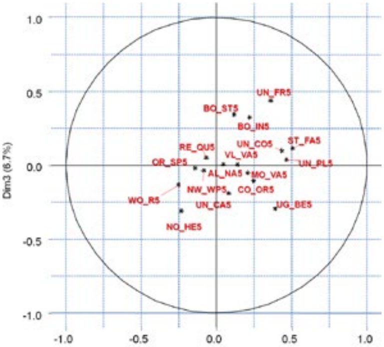
Permanent crop patch with mosaic and other land use patches



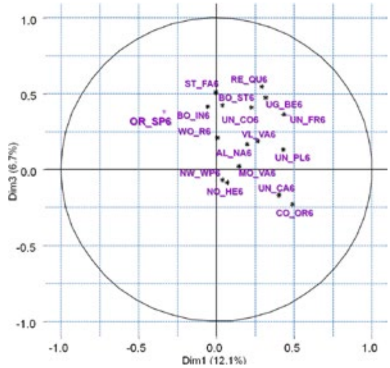
Natural patch with mosaic and other land use patches



Arable land matrix



Permanent crop matrix



patch with mosaic and other land use patches". High correlation coefficient values also characterize the dichotomy "unpleasant-pleasant" in landscape units n. 1 "Developed patch with mosaic and other land use patches" and n. 4 "Natural patch with mosaic and other land use patches". "Strange-familiar" in landscape unit n. 1 "Developed patch with mosaic and other land use patches" and "unnerving-comfortable" in the landscape unit "Permanent crop matrix". To these variables, the pair of adjectives "work-recreation" are in opposition in landscape units n. 3 "Permanent crop matrix" and n. 2 "Arable land patch with mosaic and other land use patches". These adjectives show a negative correlation with the first dimension.

The variables mostly correlated with the second extracted component are "uncared for - cared for" in landscape unit n. 2 "Arable land patch with mosaic and other land use patches", "boring-interesting" and "not worth protecting - worth protecting" in landscape unit n. 6 "Permanent crop matrix". It should be noted that the second dimension is characterized by rather high correlation values also for the variables "not worth protecting - worth protecting" in landscape unit n. 2 "Arable land patch with mosaic and other land use patches", "uncared for - cared for" in landscape unit n. 5 "Arable land matrix" and "not worth protecting - worth protecting" in landscape unit n. 4 "Natural patch with mosaic and other land use patches". The variables "altered - natural" and "restless - quiet", respectively of landscape units "Permanent crop matrix", "Natural patch with mosaic and other land use patches" and "Permanent crop matrix", show a negative correlation with this component.

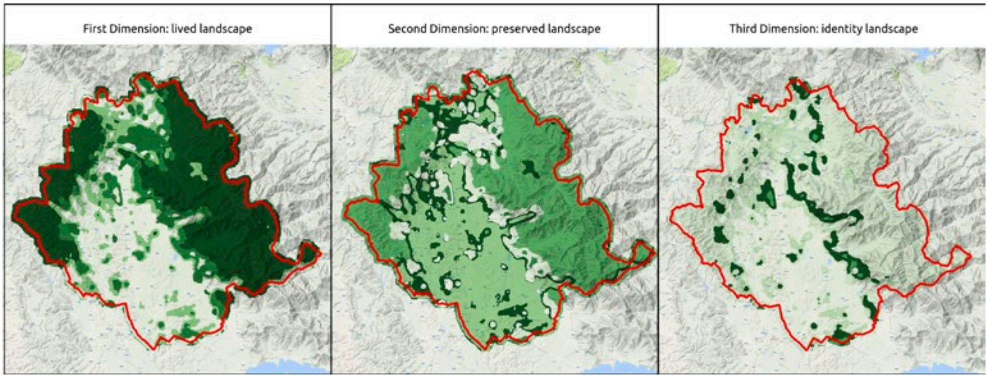
Finally, the variables mostly correlated with the third dimension are the following dichotomies: "restless - quiet", "strange - familiar" and "ugly - beautiful", all variables related to landscape unit n. 6 "Permanent crop matrix". High correlation values are associated with the variables "strange - familiar" in landscape unit n. 4 "Natural patch with mosaic and other land use patches" and with the dichotomy "unfriendly - friendly" in landscape units "Natural patch with mosaic and other land use patches" and "Arable land matrix". The third dimension is negatively associated with the variables "valueless - valuable", "ugly - beautiful" and "confused - orderly", in landscape unit n. 3 "Arable land patch with mosaic and other land use patches".

Giving an interpretation to the three extracted components, the first dimension can be named the "lived landscape"; the second component the "preserved landscape" while the third, more connected to the personal experience of the individuals, can be named an "identity landscape".

3.2 Creation of visual quality maps

The final phase of the analysis consisted of the creation of visual landscape quality thematic maps. The maps are used to display the results of MFA and represent the perceived quality of the examined landscape, according to the different concepts synthesized by the three extracted components: composition and structure, stewardship and individual personal experiences. It was achieved by giving

Figure 10. Maps of the perceived quality of Val di Chiana aretina rural landscape, detected through the semantic differential technique.



Source: our elaboration.

a value to the different landscape units, calculated as the weighted average of the scores given by the 60 interviewed people to each variable related to the square value of the corresponding loading factor for the three dimensions. The formula is the following:

$$\forall_c \sum_{p_i=1}^{17} V_p \cdot \frac{\sum_{i=1}^{60} L_1^c}{60}$$

where:
p: 1…6 landscape areas under study;
v: 1 …17 variables detected in the paper with the semantic differential techniques and concerning the landscape area p;
i: 1 ...60 respondents;
c: 1..3 extracted components;
V:square vale of the loading factor of variable vx on component c;
L: the sum of the scores given to variable Vx concerning the landscape area p.

Figure 10 shows the three different thematic maps

4. Discussion

The study aimed at the development of an analysis on the perception of the visual quality of the agricultural landscape that characterizes the Val di Chiana aretina, in Tuscany. The analysis revealed that the visual quality of the six landscape units identified in the area of Arezzo's Val di Chiana was perceived differently by the sample interviewed, depending on the set of 17 variables detected with the semantic differential technique.

The results of the Multiple Factor Analysis enabled extracting three dimensions, which provided a description of the phenomenon under study. It should be noted that the first dimension is mainly associated with variables that describe the complexity and richness of the elements found in the landscape (Fry et al.; 2009;Tveit et al., 2006), and which relate in particular to the abundance, uniformity and richness of the soil cover (Fry et al., 2009; Tveit et al., 2006). This dimension is associated with the landscape units "Natural patch with mosaic and other land use patches", "Developed patch with mosaic and other land use patches" and "Arable land patch with mosaic and other land use patches" (Fry et al., 2009;Tveit et al., 2006).

The second and the third components are both correlated to variables referring to the "stewardship" criterion, although the pairs of antithetical adjectives which most contribute to the definition of the two dimensions are different. The second and third components describe concepts related to the perception of a sense of order and care, due to the human presence (Fry et al., 2009;Tveit et al., 2006) and are linked to land use and the presence of specialized crops. However, the third dimension seems to be more closely tied to the individual experiences of the observers. In detail, the variables that saturate the second component are associated with the landscaped areas "Arable land matrix", and "Permanent crop matrix", while those that most saturate the third component are linked to the landscape unit "Permanent crop matrix".

5. Conclusion

The research included the use of exploratory techniques of statistical data analysis, which do not allow formulating deterministic conclusions. However, even though the area under study illustrates distinct characteristics which makes any generalization difficult, the results of the research may allow some conclusions. Firstly, the study highlights that the degree of fragmentation, the type of land use and the production system (extensive or intensive) influenced the way people perceived the agricultural landscape under study. Secondly, there are latent dimensions able to describe the way people also perceive the visual quality of the landscape. This seems to confirm that the visual quality of the landscape is a multidimensional construct (Pouta et al., 2014). Thirdly, the results highlight that the perception of the agricultural landscape under study was influenced not only by the visual characteristics of the landscape, but also by other elements that might depend on the specific economic interests linked to the landscape, the cultural background of the individuals, (Fry et al., 2009; Soini et al., 2012; Swanwick, 2009) as well as other socio-demographic characteristics. In conclusion, the research, even if carried out on a limited sample, represents a starting point for the development of future analyses, showing results in agreement with the scientific literature on the subject.

References

Arriaza, M., Canas-Ortega, J.F., Canas-Madueno, J.A., & Ruiz-Aviles, P. (2004). Assessing the visual quality of rural landscapes. *Landscape and urban planning* 69(1): 115-125.

Bolasco, S. (1999). Analisi multidimensionale dei dati: metodi, strategie e criteri d'interpretazione. Carocci.

Borin, M., Passoni, M., Thiene, M., & Tempesta, T. (2010). Multiple functions of buffer strips in farming areas. *European journal of agronomy* 32(1), 103-111.

Brown, G., & Raymond, C. (2007). The relationship between place attachment and landscape values: Toward mapping place attachment. *Applied geography* 27(2): 89-111.

Blumentrath, C., & Tveit, M.S. (2014). Visual characteristics of roads: A literature review of people's perception and Norwegian design practice. *Transportation research part A: policy and practice* 59: 58-71.

Cloquell-Ballester, V.A., del Carmen Torres-Sibille, A., Cloquell-Ballester, V.A., & Santamarina-Siurana, M.C. (2012). Human alteration of the rural landscape: Variations in visual perception. *Environmental Impact Assessment Review* 32(1): 50-60.

Conrad, E., Christie, M., & Fazey, I. (2011). Understanding public perceptions of landscape: a case study from Gozo, Malta. *Applied Geography* 31(1): 159-170.

Council of Europe, 2000. European Landscape Convention. http://www.coe.int/en/web/conventions/full-list/-/conventions/treaty/176

Daniel, T.C. (2001). Whither scenic beauty? Visual landscape quality assessment in the 21st century. *Landscape and Urban Planning* 54(1): 267-281.

De Montis, A. (2014). Impacts of the European Landscape Convention on national planning systems: A comparative investigation of six case studies. *Landscape and Urban Planning* 124: 53-65.

Dramstad, W.E., Fry, G., Fjellstad, W.J., Skar, B., Helliksen, W., Sollund, M.L. & Framstad, E. (2001). Integrating landscape-based values. Norwegian monitoring of agricultural landscapes. *Landscape and Urban Planning* 57(3): 257-268.

Eiter, S. & Vik, M.L. (2015). Public participation in landscape planning: Effective methods for implementing the European Landscape Convention in Norway. *Land Use Policy* 44: 44-53.

Fry, G., Tveit, M. S., Ode, Å., & Velarde, M.D. (2009). The ecology of visual landscapes: Exploring the conceptual common ground of visual and ecological landscape indicators. *Ecological Indicators* 9(5): 933-947.

Fyhri, A., Jacobsen, J.K.S., & Tømmervik, H. (2009). Tourists' landscape perceptions and preferences in a Scandinavian coastal region. *Landscape and Urban Planning* 91(4): 202-211.

Hunziker, M. & Kienast, F. (1999). Potential impacts of changing agricultural activities on scenic beauty–a prototypical technique for automated rapid assessment. *Landscape Ecology* 14(2): 161-176.

ISTAT, (2010). VI General Census of Agriculture, ISTAT, Rome, Italy.http://dati-censimentoagricoltura.istat.it/Index.aspx

Jorgensen, A. (2011). Beyond the view: future directions in landscape aesthetics research. *Landscape and Urban Planning* 100(4): 353-355.

Kassambara, A., & Mundt, F. (2017). Package 'factoextra': Extract and Visualize the Results of Multivariate Data Analyses. https://CRAN.R-project.org/package=factoextra

Kuper, R. (2017). Evaluations of landscape preference, complexity, and coherence for designed digital landscape models. *Landscape and Urban Planning* 157: 407-421.

Lê, S., Josse, J., & Husson, F. (2008). FactoMineR: An R Package for Multivariate Analysis. Journal of Statistical Software. 25(1). pp. 1-18. https://CRAN.R-project.org/package=FactoMineR

Lothian, A. (1999). Landscape and the philosophy of aesthetics: is landscape quality inherent in the landscape or in the eye of the beholder? *Landscape and Urban Planning* 44(4): 177-198.

Nassauer, J.I. (1983). Framing the landscape in photographic simulation. *Journal of Environmental Management* 17(1), 1-16.

Ode, Å.,Tveit, M.S., & Fry, G. (2008). Capturing landscape visual character using indicators: touching base with landscape aesthetic theory. *Landscape Research* 33(1): 89-117.

Ode, Å., Fry, G., Tveit, M.S., Messager, P., & Miller, D. (2009). Indicators of perceived naturalness as drivers of landscape preference. *Journal of Environmental Management* 90(1): 375-383.

Ode, Å. & Miller, D. (2011). Analysing the relationship between indicators of landscape complexity and preference. *Environment and Planning B: Planning and Design* 38(1): 24-40.

OECD (2001). Environmental Indicators for Agriculture: Methods and Results Volume 3, OECD Publishing, Paris.

Pagès, J. (2004). Multiple factor analysis: Main features and application to sensory data. *Revista Colombiana de Estadística* 27(1): 1-26.

Pinto-Correia, T., & Kristensen, L. (2013). Linking research to practice: The landscape as the basis for integrating social and ecological perspectives of the rural. *Landscape and Urban Planning* 120: 248-256.

Pouta, E., Grammatikopoulou, I., Hurme, T., Soini, K., & Uusitalo, M. (2014). Assessing the quality of agricultural landscape change with multiple dimensions. *Land* 3(3): 598-616.

Ridding, L.E., Redhead, J.W., Oliver, T.H., Schmucki, R., McGinlay, J., Graves, A.R., ... & Bullock, J.M. (2018). The importance of landscape characteristics for the delivery of cultural ecosystem services. *Journal of Environmental Management* 206, 1145-1154.

Riitters, K.H., Wickham, J.D., & Wade, T.G. (2009). An indicator of forest dynamics using a shifting landscape mosaic. *Ecological Indicators* 9(1): 107-117.

Regione Toscana (2015). PIT - Piano di indirizzo territoriale con valenza di piano paesaggistico. DeliberazioneConsiglioRegionale 27 marzo 2015, n.37 (Tuscany Region, Plan of Territorial Guidance with value as Landscape plan. Regional Council Deliberation N. 27, March 2015). http://www.regione.toscana.it/-/piano-di-indirizzo-territoriale-con-valenza-di-piano-paesaggistico

Rogge, E., Nevens, F., & Gulinck, H. (2007). Perception of rural landscapes in Flanders: Looking beyond aesthetics. *Landscape and Urban Planning* 82(4): 159-174.

Rovai, M., Andreoli, M., Gorelli, S., & Jussila, H. (2016). A DSS model for the governance of sustainable rural landscape: A first application to the cultural landscape of Orcia Valley (Tuscany, Italy). *Land Use Policy* 56: 217-237.

Sang, Å.O., & Tveit, M.S. (2013). Perceptions of stewardship in Norwegian agricultural landscapes. *Land Use Policy* 31: 557-564.

Scott, A.J. (2006). Assessing public perception of landscape: past, present and future perspectives. CAB Reviews: Perspectives in Agriculture, Veterinary Science, Nutrition and Natural Resources, 1, 41.

Scott, A. (2011). Beyond the conventional: Meeting the challenges of landscape governance within the European Landscape Convention? *Journal of Environmental Management* 92(10): 2754-2762.

Sevenant, M., & Antrop, M. (2009). Cognitive attributes and aesthetic preferences in assessment and differentiation of landscapes. *Journal of Environmental Management* 90(9): 2889-2899.

Sevenant, M., & Antrop, M. (2010). The use of latent classes to identify individual differences in the importance of landscape dimensions for aesthetic preference. *Land Use Policy* 27(3): 827-842.

Soini, K., Vaarala, H., & Pouta, E. (2012). Residents' sense of place and landscape perceptions at the rural–urban interface. *Landscape and Urban Planning* 104(1): 124-134.

Stenseke, M. (2009). Local participation in cultural landscape maintenance: lessons from Sweden. *Land Use Policy* 26(2): 214-223.

Swanwick, C. (2009). Society's attitudes to and preferences for land and landscape. *Land Use Policy* 26: S62-S75.

Tempesta, T. (2010). The perception of agrarian historical landscapes: A study of the Veneto plain in Italy. *Landscape and Urban Planning* 97(4): 258-272.

Tempesta, T. (2014). People's preferences and landscape evaluation in Italy: a review. *New Medit* 13(1): 50-59.

Tveit, M.S. (2009). Indicators of visual scale as predictors of landscape preference; a comparison between groups. *Journal of Environmental Management* 90(9): 2882-2888.

Tveit, M., Ode, Å., & Fry, G. (2006). Key concepts in a framework for analysing visual landscape character. *Landscape Research* 31(3): 229-255.

Van Zanten, B.T., Verburg, P.H., Koetse, M.J., & van Beukering, P.J. (2014). Preferences for European agrarian landscapes: a meta-analysis of case studies. *Landscape and Urban Planning* 132: 89-101.

Wickham, J.D., & Norton, D.J. (1994). Mapping and analyzing landscape patterns. *Landscape Ecology* 9(1): 7-23.

Appendix A. Correlation coefficient and significance threshold considered (0.05).

Variable	Correlationn	p.value	Variable	Correlation	p.value	Variable	Correlation	p.value
UN_CA4	0.68	0.00	UN_CA2	0.65	0.00	RE_QU6	0.55	0.00
BO_ST2	0.67	0.00	BO_IN6	0.63	0.00	ST_FA6	0.51	0.00
UN_PL4	0.67	0.00	NW_WP6	0.63	0.00	UG_BE6	0.48	0.00
UN_PL1	0.66	0.00	NW_WP2	0.62	0.00	ST_FA4	0.45	0.00
UN_CO2	0.64	0.00	UN_CA5	0.57	0.00	UN_FR5	0.44	0.00
ST_FA1	0.59	0.00	NW_WP4	0.57	0.00	UN_FR2	0.44	0.00
UN_CO3	0.59	0.00	OR_SP3	0.52	0.00	BO_ST6	0.42	0.00
BO_ST1	0.58	0.00	UG_BE2	0.51	0.00	BO_IN6	0.42	0.00
UN_CO1	0.57	0.00	OR_SP5	0.49	0.00	UN_CO6	0.41	0.00
CO_OR1	0.55	0.00	OR_SP6	0.47	0.00	ST_FA2	0.39	0.00
UG_BE4	0.54	0.00	OR_SP2	0.47	0.00	OR_SP6	0.38	0.00
BO_ST3	0.54	0.00	WO_R4	0.46	0.00	UN_FR6	0.36	0.00
UN_PL2	0.52	0.00	CO_OR5	0.44	0.00	BO_IN1	0.35	0.01
UN_PL3	0.52	0.00	BO_IN2	0.42	0.00	BO_ST5	0.34	0.01
UN_CA4	0.51	0.00	NW_WP1	0.41	0.00	BO_IN5	0.32	0.01
ST_FA5	0.51	0.00	W_RE1	0.40	0.00	BO_ST1	0.30	0.02
RE_QU3	0.50	0.00	ST_FA4	0.40	0.00	MO_VA1	0.29	0.02
CO_OR6	0.49	0.00	VL_VA2	0.39	0.00	VL_VA1	0.28	0.03
VL_VA4	0.47	0.00	UN_CA6	0.38	0.00	UN_FR4	0.28	0.03
UN_PL5	0.47	0.00	UN_FR4	0.33	0.01	ST_FA1	0.28	0.03
UN_CA1	0.46	0.00	WO_R5	0.32	0.01	UG_BE1	0.27	0.03
UN_FR1	0.46	0.00	UG_BE1	0.31	0.01	UN_CA2	-0.26	0.05
BO_IN1	0.46	0.00	MO_VA5	0.30	0.02	WO_R3	-0.26	0.04
NO_HE3	0.46	0.00	ST_FA3	0.28	0.03	UG_BE5	-0.29	0.02
BO_IN4	0.45	0.00	NW_WP5	0.27	0.03	UN_PL2	-0.30	0.02
BO_IN2	0.44	0.00	ST_FA2	0.27	0.04	NO_HE5	-0.31	0.02
CO_OR2	0.44	0.00	BO_IN5	0.27	0.04	UN_CO3	-0.33	0.01

Variable	Correlationn	p.value	Variable	Correlation	p.value	Variable	Correlation	p.value
UN_CO5	0.43	0.00	NO_HE5	0.26	0.04	NW_WP3	-0.34	0.01
UN_FR6	0.43	0.00	RE_QU6	-0.26	0.04	NW_WP2	-0.36	0.01
UN_PL6	0.43	0.00	BO_ST4	-0.29	0.02	VL_VA2	-0.39	0.00
RE_QU1	0.42	0.00	OR_SP1	-0.31	0.02	RE_QU3	-0.40	0.00
UN_CA6	0.40	0.00	MO_VA6	-0.32	0.01	NO_HE1	-0.42	0.00
UN_CA3	0.40	0.00	UN_PL4	-0.33	0.01	UN_CA3	-0.43	0.00
RE_QU4	0.39	0.00	AL_NA2	-0.33	0.01	BO_IN3	-0.44	0.00
UG_BE5	0.39	0.00	UN_CO3	-0.34	0.01	BO_ST3	-0.47	0.00
UN_CO4	0.39	0.00	MO_VA3	-0.37	0.00	UN_PL3	-0.47	0.00
NO_HE4	0.39	0.00	RE_QU1	-0.39	0.00	UN_CA4	-0.49	0.00
MO_VA3	0.38	0.00	UN_CO4	-0.42	0.00	NO_HE3	-0.49	0.00
BO_IN3	0.37	0.00	AL_NA3	-0.42	0.00	CO_OR3	-0.49	0.00
VL_VA1	0.36	0.00	RE_QU4	-0.46	0.00	UG_BE3	-0.51	0.00
UN_FR5	0.36	0.00	AL_NA6	-0.46	0.00	VL_VA3	-0.55	0.00
RE_QU2	0.35	0.01						
AL_NA4	0.34	0.01						
AL_NA3	0.33	0.01						
UG_BE1	0.33	0.01						
NW_WP4	0.32	0.01						
AL_NA1	0.32	0.01						
BO_ST4	0.32	0.01						
UG_BE2	0.32	0.01						
UG_BE3	0.32	0.01						
UG_BE6	0.32	0.01						
NW_WP1	0.31	0.01						
RE_QU6	0.29	0.02						
VL_VA2	0.29	0.03						
VL_VA6	0.27	0.04						
WO_R4	-0.31	0.02						
ST_FA4	-0.33	0.01						
ST_FA1	-0.34	0.01						
OR_SP6	-0.34	0.01						
WO_R2	-0.35	0.01						
WO_R3	-0.43	0.00						