Preferences for European agrarian landscapes: A meta-analysis of case studies[1]

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Abstract

Stated preference studies are increasingly employed to estimate the value of attributes of European agrarian landscapes and changes therein. Despite the vast amount of case studies, preferences for landscape attributes are context specific, which inhibits cross-case comparison and up-scaling. In this study, we address this problem by applying a meta-analysis of stated preference studies that focus on attributes of European agrarian landscapes (n = 345). The main objective of this study is to identify generic preferences for particular types of landscape attributes across case studies. In addition, landscape context variables that explain preference heterogeneity between different cases that address similar landscape attributes are identified. We find that landscape attributes that describe mosaic land cover, historic buildings or the presence of livestock generally receive the highest stated preferences across cases. Furthermore, we find relations between preferences for particular attributes and context variables – such as population density and GDP per capita – using a meta-regression analysis. The results of the present study provide the first cross-disciplinary and cross-case evidence on relations between preferences for landscape attributes and socio-economic and landscape context conditions. The study is a first step toward up-scaling of landscape preferences and the development social landscape indicators that reflect the perceived value of landscapes at regional and pan-regional scales, which is increasingly important as landscape policies are progressively implemented at European level.

1 Introduction

Agricultural landscapes provide multiple ecosystem services beside the production of food, feed and fibers (Van Zanten et al., 2014). Amongst the most common services are recreation and tourism as well as cultural heritage and aesthetic functions, often summarized as cultural services (Chan et al., 2012 and Daniel et al., 2012). A common way to obtain insight into these cultural services is to study stated landscape preferences. In Europe, various scientific disciplines have made contributions to the landscape preference literature. Many of these research efforts were driven by changes in landscapes due to processes such as intensification, scale enlargement and agricultural abandonment (Howley et al., 2012, Hunziker and Kienast, 1999 and Van Berkel and Verburg, 2014). These processes have drastically changed landscape structure and composition and, therefore, the visual appearance and quality of many post-war European agrarian landscapes (Klijn, 2004 and Van der Zanden et al., in review).

Landscape preferences have been addressed by numerous empirical studies. These studies have applied different methodologies originating from different disciplines, among others environmental psychology, landscape ecology, environmental economics and geography. Despite addressing a similar problem, methodological heterogeneity constrains the comparison of landscape preferences across empirical studies and, therefore, inhibits the advancement of cross-case evidence. An important conceptual distinction can be made between monetary and non-monetary valuation of landscape preferences, where monetary valuation studies present beneficiaries with landscape alternatives that also include a financial tradeoff, while non-monetary studies use ranking methods to measure the landscape preferences of relevant beneficiaries. Another important conceptual distinction between empirical preference studies arises from differences between expert-based and stakeholder-based assessments of landscape quality. The former type of studies regard landscape quality to be an intrinsic attribute of the landscape, whereas the latter type regards landscape quality as a subjective value that is derived through the eyes of the beholder (Lothian, 1999 and Tveit, 2009).

In stakeholder-based landscape assessments, researchers have applied both cognitive (e.g. Sevenant & Antrop, 2009) and physical landscape attribute approaches (e.g. Arnberger and Eder, 2011 and Dachary-Bernard and Rambonilaza, 2012) to measure visual preferences for landscapes. Cognitive attributes, such as landscape coherence, disturbance, and naturalness, often measure aspects of landscape preference based on evolutionary theories that emerged in environmental psychology (Appleton, 1975 and Kaplan and Kaplan, 1989). This category of attributes does not address preferences for a specific physical component of a landscape, but provides a holistic assessment of landscape character (Tveit, Ode, & Fry, 2006). Physical attributes address preferences for tangible and quantifiable landscape components, such as the presence of hedges or a land cover type. Studies that address physical attributes often estimate a change in preferences as a result of (potential) landscape change. Hunziker and Kienast (1999), for example, examined stakeholder preferences for different stages of afforestation in Switzerland. Campbell (2007) estimated the economic value of landscape attributes, such as hedgerows and stone walls in Ireland, using stated preferences.

In addition to their conceptual and methodological heterogeneity, studies that address preferences for landscape attributes tend to be context specific and thus lack external validity (Bateman, Day, Georgiou, & Lake, 2006). Local case studies are valuable to gain understanding on local causal mechanisms (i.e. how does one's occupation as a farmer affect one's landscape preferences?), but the strength and magnitude of causal effects could differ from place to place (Gerring, 2007 and Rudel, 2008). As a result, it has been proven difficult to upscale locally measured landscape preferences and to use these preference estimates for developing social landscape indicators of the perceived value of landscapes to support landscape planning on regional or pan-regional scales (Paracchini & Capitani, 2011).

To address this problem, this paper aims to review the findings of existing empirical stated landscape preference studies and to examine if there are generic preferences across Europe for particular types of landscape attributes. Stated preference studies assess the general public's preferences by asking respondents to rank, rate or state a willingness to pay for an environmental good or service; contrasting to revealed preference studies that derive environmental quality preferences from observed behavior. We aim to analyze and interpret preference heterogeneity between different contexts by incorporating spatially explicit socio-economic and land use/land cover related proxy variables in a meta-regression analysis. To enable a comparison of preference estimates across cases, we have collected a large set of case studies that measure stakeholder's landscape preferences for physical landscape attributes. We use this subset of the stated landscape preference literature to conduct our meta-analysis. Hence, holistic landscape character assessments and expert evaluations of landscape preferences are not included in the analysis as they inhibit quantitative meta-analyses of case study results.

Section 2 of this paper describes the methods that were applied; section 3 describes the results of a descriptive cross-case comparative analysis and a meta-regression analysis; section 4 discusses the results and draws conclusions.

2 Methods

2.1 Overview of methodology

This paper uses meta-analysis to synthesize findings of empirical landscape preference studies in Europe. Meta-analyses of case studies are applied to provide a higher level of generalization of specific case study knowledge and address the scale sensitivity of causal mechanisms and effects (Young, Lambin, & Alcock, 2006). To construct a database with comparative cases, this study follows the methodological recommendations for meta-analyses proposed by Rudel (2008). First, empirical studies were selected based on a predefined set of criteria. Second, a typology of agricultural landscape attributes was designed to enable cross-case comparison and frequency analysis of similar attributes. Third, preference scores for specific landscape attributes in the individual studies were normalized to enable cross-case comparison of preferences. Fourth, a number of potential explanatory variables were coded for each case. The database was analyzed using frequency analysis, cross-case comparison of mean preferences for specific landscape attributes, and meta-regression analysis.

2.2. Search protocol and selection criteria

This study analyzed empirical studies (n = 51; see S1 in the Supplementary material) that focus on stated landscape preferences for a set of landscape attributes. Every preference estimate for a landscape attribute stated by a defined group of beneficiaries in a defined case study area was treated as a unique case in the database, resulting in 345 cases. The case study areas in the database range from local to national scale and all studies were published between 1993 and 2013. The studies were retrieved by keyword search using the search engines ISI web of Science, Scopus and Google Scholar. Search strings were: (rural OR agricultural) AND landscape AND (preferences OR valuation). In addition, snowball search was applied to selected studies.

The selection criteria for empirical studies were the following: (1) studies measured landscape preferences for particular visual attributes of landscapes; (2) beneficiaries who stated the preferences were defined; (3) case studies addressed landscape preferences in agrarian landscapes; (4) studies were conducted in Europe. The search protocol and selection procedure of this meta-analysis were performed in accordance to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses protocol (PRISMA; checklist see S2 of the SI).

2.3. Landscape attribute typology

To enable cross-case comparison of preferences for landscape attributes, a classification of the attributes used in the different case studies into generic categories is required. As there is a great diversity in European agricultural landscapes, there is also a wide variety of different attributes that potentially contribute to the quality and value of these landscapes (Gobster, Nassauer, Daniel, & Fry, 2007). The types of landscape attributes that are addressed in the empirical studies depend on the objectives of the study, the perspective of the researcher and the research design. In many studies, expert knowledge or focus groups are used to identify the most important landscape attributes that contribute to the quality or the value of the landscape (Howley et al., 2012 and Moran et al., 2007). Other studies relate cognitive attributes to physical landscape attributes (e.g. land cover diversity or complexity) or use metrics of landscape structure and composition (Ode et al., 2009 and Ode et al., 2008).

In this analysis, we distinguish four groups of landscape attributes (Fig. 1). First we distinguish a group of attributes that describe direct anthropogenic influences in agrarian landscapes, mainly encompassing visual agricultural management practices such as irrigation, farm stewardship, presence of livestock and sustainable field margins. The second and third group consist of attributes that describe landscape structure and composition, which are often regarded as a result of both anthropogenic and (biotic and abiotic) biophysical processes (Mücher, Klijn, Wascher, & Schaminée, 2010). Landscape attributes referring to land cover patterns and crop types are categorized as land cover composition; landscape attributes referring to specific elements that affect the spatial structure of agrarian landscapes such as hedgerows, tree lines, ditches or historic buildings, are categorized as landscape elements. The fourth group consists of attributes that describe visual aspects of biophysical features of landscapes, i.e. presence of water in a landscape, hills or mountains. This first level of landscape attribute grouping enables a comparison of the observed landscape attributes in the primary studies on a nominal level.

The second level of landscape attribute typology breaks down the first level attribute groups into more refined categories (for a detailed description of the landscape attribute typology see S3 of the SI). This level enables the comparison of landscape preferences between attributes at ordinal or interval level. The second level typology is designed by an iterative coding routine, adapting and adjusting the classification and research design to interpretations and preliminary results from a small subset (n = 40) of the database as proposed by Rudel (2008).

Some studies include a number of attributes that cannot be categorized in either the first or the second level attribute typology (e.g. Kaltenborn and Bjerke, 2002, Moran et al., 2007 and

Westerberg et al., 2010). Such classification problems arise either from the fact that not all attributes in the study refer to landscape characteristics directly (e.g. public preferences for the promotion of locally grown food, Moran et al., 2007), or they occur when the preference that is measured cannot be assigned to one attribute type specifically (for example 'summer farm, log buildings, mountains in the background', Kaltenborn & Bjerke, 2002). In the former case, the particular landscape attributes are left out of the database; in the latter case landscape attributes are included in the database, but marked as uncategorized.

2.4. Normalization of the dependent variable

Landscape preferences are measured using a wide variety of methods. As a result, the dependent variable is expressed in different units throughout the case studies. Economic valuation studies provide an estimate of willingness to pay (WTP) in monetary units for landscape attributes. In landscape research, preferences for landscape attributes are generally expressed using a preference rating (for example on a 5 point Likert-scale), a preference ranking or by interpreting positive or negative correlations between stated preferences and the presence of a landscape attribute. In addition, some studies express preferences as the percentage of respondents that chose the landscape attribute as the most preferred attribute (from here on referred to as % respondent choice) (e.g. Barroso et al., 2012 and Gomez-limon, 1999)

To enable the comparison of landscape preferences across case studies and test the robustness of the results, preference scores are normalized in three different ways.

2.4.1. Preference direction (positive-neutral-negative)

This normalization method assesses the preference direction of beneficiaries for a particular landscape attribute. All cases, except those applying a latent class choice model, are normalized on this qualitative scale. For studies that elicited preferences using the % respondent choice method, preference rating or economic valuation, preference scores for attributes were ranked. For instance, when a study yields a score of 5 for hedges, 2 for presence of livestock and 1 for mixed forests, the ranking will be (1) hedges, (2) presence of livestock and (3) mixed forests. In this case, hedges are considered positive, presence of livestock neutral and mixed forest negative. For these studies, the preference direction reflects relative preferences for the attributes in the study.

The normalization method described above is only applied to case studies that yield preferences for at least three attributes. With respect to case studies that address less than three attributes and case studies that provide qualitative preference scores, the preference direction of landscape attributes is derived from the interpretations of the authors of the particular case study.

2.4.2. Normalized-rank transformation

This normalization method provides a normalized preference score based on the rank of the attribute. All cases with preference scores expressed at ordinal, interval or ratio levels were converted to rankings. Cases were ranked by their relative preference within the case study. In an ideal situation, all case studies would consist of the same amount of attributes and the ranks of attributes would be directly comparable across case studies. However, some studies include eight attributes, whereas other studies include only one. Therefore, the cases are transformed to a normalized rank (0–1), using:

$$r_{norm} = 1 - \frac{(r-1)}{(R-1)} \quad ,$$

where *r* represents the rank of the attribute within the case studies, *R* the lowest rank (and therefore the number of attributes in the case study) and rnorm the normalized rank. For instance, when a study yields a score of 5 for hedges, 2 for presence of livestock and 1 for mixed forests, the ranking will be (1) hedges, (2) presence of livestock and (3) mixed forests. In this case, hedges receive a score of 0, presence of livestock a score of 0.5 and mixed forest a score of 1. This normalization method is only applicable to case studies that provide preference estimates for at least three attributes.

2.4.3. Min–max normalization

This normalization method provides a normalized preference score based on the continuous preference score of the attribute (for other applications of min–max normalization see: Stürck et al., 2014 and Tian et al., 2013). All cases that express landscape preferences by a WTP estimate or by preference rating are subjected to a min–max normalization to assess the relative preference of the particular landscape attribute within the case study. In the case of min–max normalization, all preference scores are assumed to be at continuous scale. In contrast to the normalized rank transformation, min–max normalization also accounts for the relative differences between the preference scores within the case study. The expression for the normalization procedure is given by:

$$s_{norm} = \frac{(s - s_{\min})}{(s_{max} - s_{min})} \, ,$$

where *s* represents the initial preference score and s_{norm} the normalized preference score. For instance, a study yields a score of 5 for hedges, 2 for presence of livestock and 1 for mixed forests. In this case, the normalized preference score for hedges is 1, presence of livestock is 0.25 and mixed forest is 0. Similar to the procedure in the normalized rank transformation, only case studies with a minimum of three attributes are included in the min–max normalization sample.

2.5. Explanatory variables in the empirical studies

The most common type of explanatory variables addressed refers to characteristics of beneficiaries. Especially studies that focus on the implications of landscape preferences for planning and policy pay attention to the heterogeneity of preferences between beneficiary groups (Rogge, Nevens, & Gulinck, 2007). Below we discuss the most important findings from the literature that underlie the formulation of hypothesis on which the selection of variables for our analysis is based.

2.5.1. Socio-economic and demographic characteristics

General socio-economic and demographic explanatory variables, such as income, gender, level of education and age, are addressed in most of the empirical studies. Sevenant and Antrop (2010) find a statistically significant relationship between age and preferences for Flemish agrarian landscapes. In their latent class analysis, older people (70–80 years) have relatively strong preferences for stewardship and restricted urbanization. Van den Berg and Koole (2006) find similar results, indicating a relatively strong preference for managed landscapes of respondents older than 50. Various studies include gender in their analyses, but often no statistically significant results are found (Howley et al., 2012, Junge et al., 2011 and Van den Berg and Koole, 2006). The effects of income have been tested especially in economic valuation studies; the theoretical expectation that income and WTP estimates correlate positively is often confirmed (e.g. Campbell, 2007). Highly educated beneficiaries generally express a stronger preference than lower educated beneficiaries for multifunctionality, ecological restoration and wilderness of agrarian landscapes (Howley et al., 2012, Lindemann-Matthies et al., 2010 and Van den Berg and Koole, 2006).

2.5.2. Environmental attitude

The beneficiaries' environmental attitudes often strongly affect preferences for landscape attributes. A number of studies address the influence of membership of an environmental non-governmental organization (Junge et al., 2011, Liekens et al., 2013 and Sevenant and Antrop, 2010). Junge et al. (2011) find that organization members, especially when combined with a high level of education, have a relatively strong preference for more ecological compensation areas (e.g. sustainable field margins) in Swiss agrarian landscapes. Other studies have captured environmental attitudes using indicators such as the ecological paradigm score (Sevenant & Antrop, 2010) or by distinguishing between anthropocentric and ecocentric beneficiaries (Kaltenborn & Bjerke, 2002). Kaltenborn and Bjerke (2002) find a strong relation between ecocentric beneficiaries and preferences for wild lands, whereas anthropocentrists express a relatively strong preference for farm landscapes.

2.5.3. Familiarity with the landscape

Characteristics that describe familiarity with the landscape and sense of place of the beneficiary are examined by a number of empirical studies. Soini, Vaarala, and Pouta (2012) analyze beneficiaries' sense of place in relation to their stated landscape preferences using a factor analysis in a Finnish case study. Local beneficiaries with ties to the agricultural sector stated a relatively low preference for naturalness and high adaptability toward landscape change, while beneficiaries less familiar with the landscape regarded the landscape more as a static entity and were more reluctant toward landscape changes (Soini et al., 2012). Some studies find significant relations of preferences with the familiarity of a landscape by including the frequency of visits and recreational activities as a dummy variable in a regression model (Dachary-Bernard and Rambonilaza, 2012 and Sayadi et al., 2009). In a choice experiment study, Hasund et al. (2011) find a significant positive relation between familiarity with a landscape element (stonewalls, headlands, and ponds) and preferences for this particular landscape element.

2.5.4. Residential location

Residential location (e.g. visitors versus local residents, rural versus urban residents, distance to area) is the most dominant variable addressed in the case studies (e.g. Barroso et al., 2012 and Soliva et al., 2010). Residential location is often related to the way people use landscapes: in many cases recreants do not reside in the landscape of interest, whereas local residents often do not use the landscape for recreation. Typologies of the beneficiaries are often based on residential location (Hunziker et al., 2008 and Rambonilaza and Dachary-Bernard, 2007). Rambonilaza and Dachary-Bernard (2007), for example, find in a Breton case study that residents have a stronger preference for hedgerow restoration, while tourists prefer the integration of farm buildings in the landscape.

2.5.5. Other characteristics

A number of other beneficiary characteristics are addressed by some of the case studies. Several studies compare preferences of landscape professionals to preferences of a representative local or regional sample, in order to test the impact of expert knowledge (Rogge et al., 2007 and Tveit, 2009). Other case studies test the effects of the relation of beneficiaries to farming (e.g. farming relatives, employed in the agricultural sector) (Sayadi et al., 2009), language group (Soliva et al., 2010), household size (Kallas et al., 2007 and Sayadi et al., 2009), and social class (Howley, 2011 and Moran et al., 2007).

2.6. Meta-regression analysis: Preferences for land cover composition attributes

Two groups of explanatory variables are used in the meta-regression analyses: the first group is derived from the case study descriptions directly, while the second group of variables is derived from independent spatial datasets using the locations of the case study areas, following methods proposed by Van Asselen, Verburg, Vermaat, and Janse (2013) and Brander et al. (2012). The first group includes both variables that relate to the characteristics of the beneficiaries that have stated their preferences and to the methods used in the case study (see codebook, S4 of the SI). The second group of explanatory variables was extracted through spatial analysis based on the geographic locations of the case study areas (centroid point of the area). With respect to local/landscape scale cases, the case study area was assumed to be located within a 10 km radius around the centroid and mean values for this area were extracted from spatial datasets. With respect to national scale cases, explanatory variables were obtained from national datasets. For the complete list of data sources for the explanatory context variables see S5 of the S.I.

2.6.1. Research hypotheses

The explanatory variables are included in the meta-regression analyses based on a set of a priori expectations derived from literature, which are translated into research hypotheses. The first set of hypotheses (1.a and 1.b in Table 1) refers to the first research question: are there generic preferences for particular landscape attributes? Based on landscape preference theory (Appleton, 1975 and Kaplan and Kaplan, 1989) and several case studies providing local empirical evidence (e.g. Howley, 2011, Hunziker et al., 2008, Ode et al., 2009 and Vecchiato and Tempesta, 2013), we hypothesize that landscapes dominated by a mosaic of land covers are most preferred across case studies. Building on local empirical evidence we expect that generally landscapes dominated by forest or natural land covers receive higher relative preferences than those dominated by agricultural land cover (García-Llorente et al., 2012 and Van Berkel and Verburg, 2014).

The second set of hypotheses (2.a to 2.d in Table 1) refers to the second research question: which variables explain preference heterogeneity for particular landscape attributes across case studies? Based on the literature reviewed, we hypothesize that regional beneficiaries have a stronger preference for landscapes dominated by agricultural land cover, whereas non-regional beneficiaries prefer landscapes dominated by forests or natural land covers (Soini et al., 2012 and Soliva et al., 2010).

Preferences for landscapes that are dominated by forests or natural land covers are expected to be high in rich peri-urban/green belt areas, while they are expected to be low in sparsely populated rural areas with lower income levels and that economically depend on agricultural production (Buijs et al., 2006, UK National Ecosystem Assessment, 2011 and Zasada, 2011). Hence, we hypothesize that GDP and population density are negatively related to preference scores for the dominance agricultural land cover attributes, whereas they are expected to be positively related to preference scores for the dominance forest/nature land cover attributes.

The share of agricultural land cover in the case study area is expected to be negatively related to landscape preferences for landscapes dominated by agricultural land cover. This hypothesis is based on an expected scarcity effect, i.e. in less favored areas where large scale intensification is a rare phenomenon, agricultural land cover is often perceived as a positive attribute (Sayadi et al., 2009 and Willis and Garrod, 1993). An inverse scarcity effect is expected for the share of forest land cover, which we hypothesize to be negatively related to preferences for forest/nature land cover attributes.

Various case studies in our database explicitly address the consequences of abandonment on stated preferences for landscape changes (Arnberger and Eder, 2011 and Gomez-limon, 1999). We hypothesize that cases that explicitly address abandonment yield relatively low stated preference scores for landscapes dominated by forest or natural land covers. Abandonment cases were identified as those studies where abandonment as a concept was explicitly mentioned in the paper; acknowledging that this may still cover a range of different abandonment types and stages. We explored the relation with other potentially important spatial factors, such as accessibility, share of protected areas and agricultural land use intensity (Ode et al., 2009 and Swanwick and Hanley, 2007), but either we found a strong multicollinearity with other explanatory variables or we found that there was no effect on landscape preferences.

2.6.2. Meta-regressions

As a result of sample size constraints we can only perform a meta-regression analysis for those cases that address land cover composition attributes. We apply a weighted least squares regression analysis in which cases are weighted by the inverse of root sample size, which is common practice in meta-analyses in environmental economics (Nelson & Kennedy, 2008).

We estimate two different regression models. The first meta-regression is applied to all cases that address land cover composition attributes. Explanatory variables in this meta-regression are, among others, the second level attribute type dummy variables (e.g. dominance agricultural land cover, dominance mosaic land cover or dominance forest/natural land cover). This regression tests hypotheses 1.a and 1b. The second type of meta-regression model tests hypotheses 2.a to 2.d. This type of meta-regression is applied to the subset of dominance agricultural land cover and the subset of dominance forest/nature land cover attributes.

In addition to the explanatory variables described earlier in this section, we control for the effects of the number of attributes in the case study and for differences between economic valuation and non-economic valuation studies. Economic valuation studies might find different preference scores because in these studies respondents are forced to make a financial tradeoff, thereby placing the landscape preferences in a fundamentally different context. We control for the number of attributes because the normalized preference scores were obtained based on the relative preference for that particular attribute within the case study. Therefore, normalized preference scores may be affected by the number of attributes in the case study.

To test the robustness of the results, all meta-regression models were estimated with both min–max normalized scores and normalized-rank preference scores. Variance inflation factors (VIFs) were monitored to avoid multicollinearity among the explanatory variables. Given the small sample size of our dataset, explanatory variables with a VIF value above 3 were excluded from the analysis. Allowing explanatory variables with higher VIFs would further inflate the variance of the coefficients, which could cause that coefficients lose statistical significance (Wooldridge, 2009). In addition to the full models presented and discussed in this paper—backward stepwise regression was carried out to assess the stability of the effects of the explanatory variables. Results from the two approaches are similar, unless discussed otherwise in Section 3.3.

3. Results

3.1. Description of the database

Fig. 2 shows the geographic location of case study areas in Europe and the year of publication of the cases. Eastern Europe is underrepresented in the database because there were no cases found in post-socialist countries that matched the search criteria. Many empirical studies in the database originate from Great Britain or Switzerland, but also Ireland, Norway and Spain are well represented. In some countries, such as Ireland and Switzerland, many studies were aimed at measuring preferences for agrarian landscapes on a national scale, identifying, for instance, preferences for Irish agrarian landscapes in general. Furthermore, Fig. 2 shows an exponential growth of published cases over the last two decades. The database consists of 345 cases.

All cases in the database were categorized in accordance to the first level of the typology of landscape attributes (Fig. 1). Fig. 3 shows the number of cases per attribute type. The largest category – 170 cases – contains landscape attributes related to land cover composition. Agricultural management practices were addressed in 41 cases, whereas 66 cases addressed preferences for landscape elements. Cases that focus on landscape attributes describing biophysical features of landscapes are relatively sparse in the database (*n* = 13). The largest class of attributes in the first level of the typology, land cover composition, consists of 56 cases that address preferences for dominance forest land cover/natural land cover attributes, i.e. cases that refer to landscapes where forest and natural land cover types are dominant; 41 cases that address preferences for mosaic land cover attributes; and a category of cases that addresses preferences for dominance agricultural land cover attributes (n = 66).

Fig. 4A displays the count of the different beneficiary groups that are addressed by the case studies in the database. Most studies focused on drawing a representative national (*n* = 104) or regional (*n* = 77) sample of landscape beneficiaries. Seventy two cases focused on preferences from local populations living within the landscape of interest. A smaller number of cases focused on tourists (*n* = 33), students (*n* = 19) and farmers (*n* = 17). Only a few cases addressed experts or politicians (*n* = 6), second home owners (*n* = 2) and hunters (*n* = 2).

In most of the cases in the database, preferences for landscape attributes are measured using a preference rating (*n* = 143; Fig. 4B). For 88 cases a choice modeling methodology with a payment vehicle was applied. In 12 other cases a non-monetary latent class choice model was applied to identify classes of beneficiaries that explain stated preference heterogeneity. Other methods represented in the sample are: multi-attribute contingent valuation (*n* = 35), % respondent choice (*n* = 30), linear model/regression (*n* = 15), and correlation/Anova (*n* = 8).

3.2. Descriptive analysis of preferences for landscape attributes

Fig. 5 provides an overview of the mean values and distributions of the normalized landscape preferences scores of the cases for the second level landscape attribute types, showing both min–max normalization values and normalized-rank transformation values. The preference direction tables display counts of cases that are categorized as positive, neutral or negative. The attribute types point elements, intensive agriculture, farm stewardship, and field margins contain less than 10 cases. For these attribute types preference scores are shown per individual score instead of in a boxplot.

The normalized mean preference scores are highest for mosaic land cover, historic buildings and presence of livestock (Fig. 5), which confirms hypothesis 1.a. For most attribute types, the normalized preference scores – min–max normalization and normalized rank transformation – show similar results. The preference direction, however, indicates slightly different results and requires a different interpretation as compared to the normalized preference scores. While the normalized scores represent relative preferences for a particular landscape attribute within a case study, the preference direction describes whether the landscape attribute is interpreted as positive, neutral or negative. With respect to dominance forest/natural land cover, four cases from studies with less than three attributes obtained a positive preference (i.e. these cases did not obtain a transformed-rank or min–max normalized score). The same effect is observed for preference scores cases for farm stewardship and grey linear elements.

3.3. Meta-regression

Table 2 displays the output of two weighted least squares meta-regression models that explore the influence of explanatory variables on normalized preference scores for cases that address land cover composition attributes (n = 129). The objective of this analysis was to test hypotheses 1.a and 1.b: to assess whether there are generic preferences for particular landscape attributes (e.g. mosaic land cover, dominance forest/natural land cover), while controlling for a number of study and context characteristics. The adjusted R2 values of 0.16 and 0.17 are relatively low, which was expected since the meta-data include a heterogeneous collection of cases and primarily focuses on hypotheses 1.a and 1.b.

In Table 2, the dummy variable mosaic land cover has a significant positive influence on preference scores for both normalizations. The standardized coefficients indicate that normalized preference scores are 0.44 or 0.45 higher for landscapes dominated by mosaic land cover than for the reference category dominance agricultural land cover. To a lesser extent, dominance forest/natural land cover attributes also receive higher normalized preference scores than the reference category (0.21 or 0.19). These results indicate that, when controlling for the other explanatory variables in this regression, preference scores for mosaic land cover and dominance forest/nature land cover are similar to the findings presented in Fig. 5.

The explanatory variables linear elements and historic buildings describe whether the case study also included attributes that describe (both green and gray) linear elements or historic buildings in the landscape. Significantly higher stated preferences for land cover composition attributes were found when the case study also addressed preferences for linear elements. The dummy variable representing the presence of historic buildings obtained a negative coefficient, which indicated that land cover composition attributes are likely to receive lower preferences when the study also addressed preferences for historic buildings. However, the coefficient is not statistically significant, so this relationship is uncertain.

Non-regional beneficiaries have not expressed significantly different preferences for land cover composition attributes than regional beneficiaries. The two case study context variables, population density and GDP per capita, are both positively related to the dependent variable. For these variables, the coefficients were statistically significant with respect to the preference scores obtained through min–max normalization. Thus, in general land cover composition attributes receive a higher preference score in case study areas with a relatively high population density and GDP per capita.

The dummy variable economic valuation study has a negative coefficient, which indicates that cases that have applied economic valuation received lower preference scores for land cover composition attributes. This means that land cover composition attributes receive lower preferences when a financial tradeoff is involved. The explanatory variables number of attributes in the study and national scale case have small and statistically insignificant coefficients, providing evidence for no structural variation between these important differences between case studies.

Table 3 and Table 4 present results from the meta-regression models that aim to explain variation between expressed preferences for dominance of agricultural land cover in landscapes and dominance for forest/nature land cover, using beneficiary and contextual explanatory variables. Table 3 gives the estimated coefficients of a meta-regression analysis with a subset (n = 40) of cases that focus on dominance agricultural land cover. The adjusted R2 value of 0.15 and 0.04 of the regressions is relatively low. The coefficients indicate a strong beneficiary-effect; non-regional beneficiaries have stated significantly lower preferences for dominance agricultural land cover than regional beneficiaries. This result confirms hypothesis 2.a: beneficiaries from outside the landscape often state lower preferences for the dominance of agricultural land cover. These groups do not depend on agriculture for their livelihoods and often use landscape for recreational purposes and rather prefer mosaic or forested/natural landscapes. GDP per capita has no significant influence on preferences for dominance agricultural land cover (Table 3), partly rejecting hypothesis 2.b.

As predicted in hypothesis 2.b, the population density in the case study areas is negatively related to preference scores for dominance agricultural land cover, although the coefficient is statistically insignificant. This indicates that preferences for the dominance of agricultural land cover increase when population density in landscapes decreases. Although not statistically significant at usual critical significance levels, p values for population density are relatively close to 10% significance levels in both model specifications.

Percentage agricultural land cover is negatively related, and significant at $p < 0.05$, to dominance agricultural land cover for the min–max normalization. This result confirms hypothesis 2.c: preferences for attributes that describe the dominance of agricultural land cover increase when the percentage agricultural land cover in the landscape decreases. Especially in case studies conducted in less favored areas, dominance agricultural land cover attributes are highly preferred. Both the number of attributes in the case study and the dummy variable abandonment study demonstrate a negative, statistically insignificant relation to preferences for dominance agricultural land cover attributes. The economic valuation study dummy variable was left out the model because of multicollinearity with the other explanatory variables.

Table 4 displays the coefficients of the meta-regression analysis that explains preference heterogeneity amongst cases (n = 32) that focused on dominance forest/nature land cover. The adjusted R2 values of 0.33 and 0.28 of the regressions in Table 4 are high compared to the other regressions. In accordance with hypothesis 2.a, non-regional beneficiaries often stated a higher preference score for dominance forest/nature land cover attributes than regional beneficiaries. However, although the p-values are relatively low, the coefficients are not statistically significant. A negative relation between GDP per capita in the case study area and preference for dominance forest/nature land cover attributes is found statistically significant for the min–max normalization, which rejects hypothesis 2.b on this explanatory variable. In contrast, a strong significant ($p < 0.05$) positive relation between population density in the case study area and the dependent variable is found. This indicates that preferences for forest/nature land cover attributes are higher in densely populated areas, confirming hypothesis 2.b.

In studies that focus on abandonment of agricultural areas, dominance forest/nature land cover attributes receives a lower normalized preference score than studies that do not explicitly address the consequences of abandonment. This result was found to be statistically significant ($p < 0.10$) under both normalization procedures. No statistically significant effects were found for the other explanatory variables in the meta-regression.

4. Discussion and conclusions

In this study we have reviewed and applied a meta-analysis to study stated preferences for agrarian landscapes across Europe. The methodology builds on both meta-analyses in the field of environmental economics (e.g. Brander et al., 2006, Brander and Koetse, 2011 and Nelson and Kennedy, 2008) and meta-studies in environmental change research (e.g. Geist and Lambin, 2002, Rudel, 2008 and Van Asselen et al., 2013). In order to compare results of stated preference studies from multiple disciplines in a quantitative manner, we analyzed normalized, within-study, preferences for particular landscape attributes. We assumed that these relative preferences for landscape attributes best reflect the relative importance and value of a particular type of landscape attribute in a particular landscape context. The two normalization methods that were used in the meta-regression analysis showed similar results. Although p-values vary, the direction of the coefficients of the explanatory variables of the normalized-rank transformation and the min–max normalization are similar in the regression analyses.

In spite of large variation within landscape attribute types and between the approaches used in the individual case studies, we found cross-case generic preferences for several landscape attributes. The analysis of relative preferences (Fig. 5) indicates high mean preference scores for attributes that describe historic buildings in the landscape, mosaic land cover and the presence of livestock in the landscape. With regard to the land cover composition attributes, these findings were confirmed in a meta-regression analysis presented in Table 2. Mosaic landscapes and, to a lesser extent, landscapes with a dominance of forest or nature, obtained higher preference scores than landscapes dominated by agriculture.

Especially the normalized preference scores for landscapes dominated by agricultural land cover and landscapes dominated by forest/natural land cover are heterogeneous across cases. In order to explain observed preference heterogeneity, many case studies have explored relations between beneficiary characteristics and landscape preferences. One of the most common explanations for preference heterogeneity is the residential location of the beneficiary. Often local residents state high preferences for attributes associated with agricultural land cover, whereas visitors state higher preferences for attributes associated with forest and natural land cover (e.g. Hunziker et al., 2008 and Soliva et al., 2010). These findings were confirmed in our meta-regression analyses presented in Table 2 and Table 3.

With respect to the context variables, the meta-regression analysis has revealed that in relatively densely populated agrarian landscapes – often referred to as green-belt or peri-urban areas – beneficiaries expressed higher preferences for those landscape characteristics associated with forest and natural land cover. In contrast, although not statistically significant, population density proved negatively related to preferences for agricultural land cover. At the same time, the preferences for agricultural land cover are higher in areas with a relatively low percentage of agricultural land cover. A plausible interpretation of this result is that in remote, marginal agricultural areas, agricultural land cover is highly appreciated, motivated by both regional economic viability and aesthetic landscape quality considerations of beneficiaries (e.g. Sayadi et al., 2009).

An important question is whether the case studies included in our analysis are representative for agrarian landscapes in the European Union. Fig. 2 shows a considerable number of case study areas in Western Europe, Scandinavia, the Iberian Peninsula and Switzerland, while Central and Eastern European agrarian landscapes are underrepresented. For these regions only a small number of studies that meet our criteria are available, which is likely due to the fact that these areas are not often subject to study and because of differences in research funding and interests between regions. Fig. 6 compares the distribution of different types of agricultural landscapes across the case study areas to the distribution of the EU-27 as a whole based on a landscape typology of (Van der Zanden et al., in review). This landscape typology accounts for a number of important characteristics of agricultural landscapes: management intensity (Temme & Verburg, 2011); linear elements (Van der Zanden, Verburg, & Mücher, 2013) and field size. Large-scale extensive arable landscapes and medium-scale intensive arable landscapes are underrepresented in the case studies. Not surprisingly, these landscape types mainly occur in Eastern European countries. At the same time, large-scale very intensive arable landscapes and enclosed large-scale intensive grassland landscapes are overrepresented in our database, mainly as a result of the large amount of case study areas in the United Kingdom. We conclude that our sample of cases is considerably representative for Western and Northern European countries, but that our findings have no validity in post-socialist EU member states. Representativeness in terms of landscape types is, of course, only one aspect of representativeness. The distribution of cases indicates that the data also have bias in representing the cultural preferences as they occur across Europe.

As in any meta-analysis, our study is constrained by cases that were retrieved and that met our selection criteria. Because of the limited number of cases, a meta-regression analysis was not feasible for cases that addressed agricultural management attributes or landscape elements attributes. Also, the normalization of preference scores has its drawbacks. For instance, cases with exactly the same preference score might have obtained a different normalized relative preference score as a result of different other attributes in the study. The wide variation in methodologies and study design complicates a further quantitative synthesis.

This meta-analysis makes contributions to landscape preference research and meta-studies in environmental science in several ways. First, this study provides an overview of the stated preferences studies from different scientific disciplines. Second, innovative methodologies are applied to enable comparison of a methodologically scattered collection of case studies, including the typology of landscape attributes and the normalization of the dependent variable. Third, additional evidence is provided with respect to assertions (Kaplan and Kaplan, 1989 and Ode et al., 2009) that in general mosaic landscapes are more appreciated than landscapes dominated by forest or natural land cover and agriculturally dominated landscapes. Fourth, relations between relative preferences for landscape attributes and spatially explicit proxy variables are explored and provide useful insights. For instance, the clear positive relation between population density and preferences for forest and nature attributes in agrarian landscapes, provides additional evidence on the high importance of agrarian landscape quality to beneficiaries in green belt areas (UK National Ecosystem Assessment, 2011). With respect to GDP per capita, the research hypothesis was rejected. Case study evidence suggests a strong relation between preference estimates and GDP per capita, especially in studies that involve financial tradeoffs (Campbell, 2007). With respect to normalized relative within-study preferences, however, GDP per capita did not appear to be a strong predictor of preference estimates.

A potential future application of this meta-analysis is up-scaling and spatial extrapolation of preferences for particular attributes based on a number of key spatial proxy variables that describe socio-economic and landscape characteristics, which can serve as a European indicator of landscape quality or the value of cultural ecosystem services. Although, to ensure the external validity of spatial extrapolation of preferences for landscape attributes, a larger number of comparable cases with a comprehensive spatial distribution across European landscapes is required. Future agrarian landscape preference case studies should examine preferences for a number of general attribute types to enable further cross-case comparison of relative preferences.

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Figure 1.

Overview of the typology of landscape attributes.

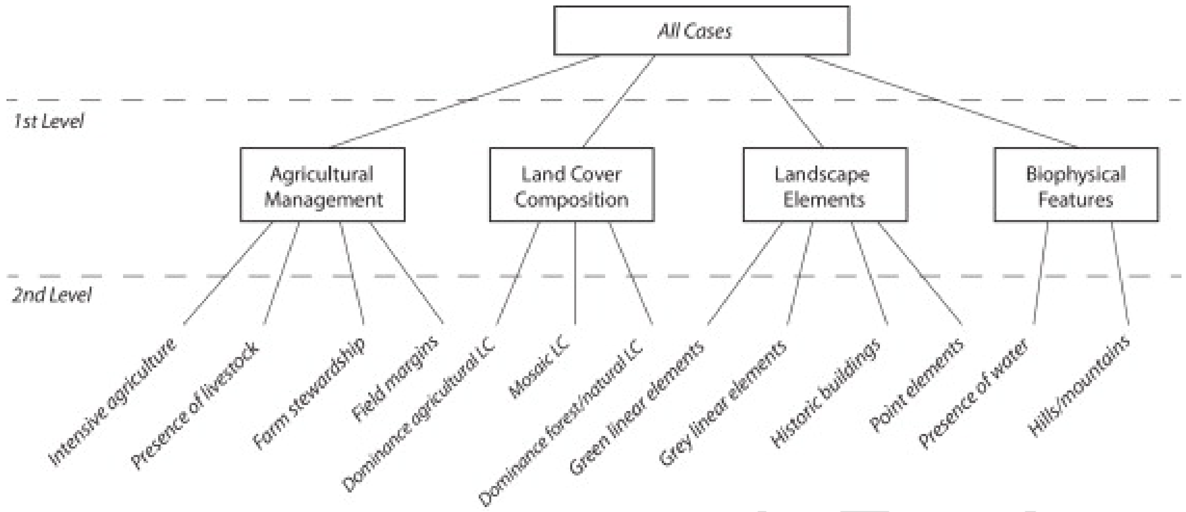

Figure 2.

Overview of the geographic location year of publication of the cases in this meta-analysis. (A) Shows landscape- and national scale case study areas on the map of Europe. One national or landscape scale dot refers to one case study area. Often multiple studies and cases originate from one case study area. Inset (B) reveals the increase in the number of empirical landscape preference studies during the period 1990-present and (C) shows the number of cases and studies per country.

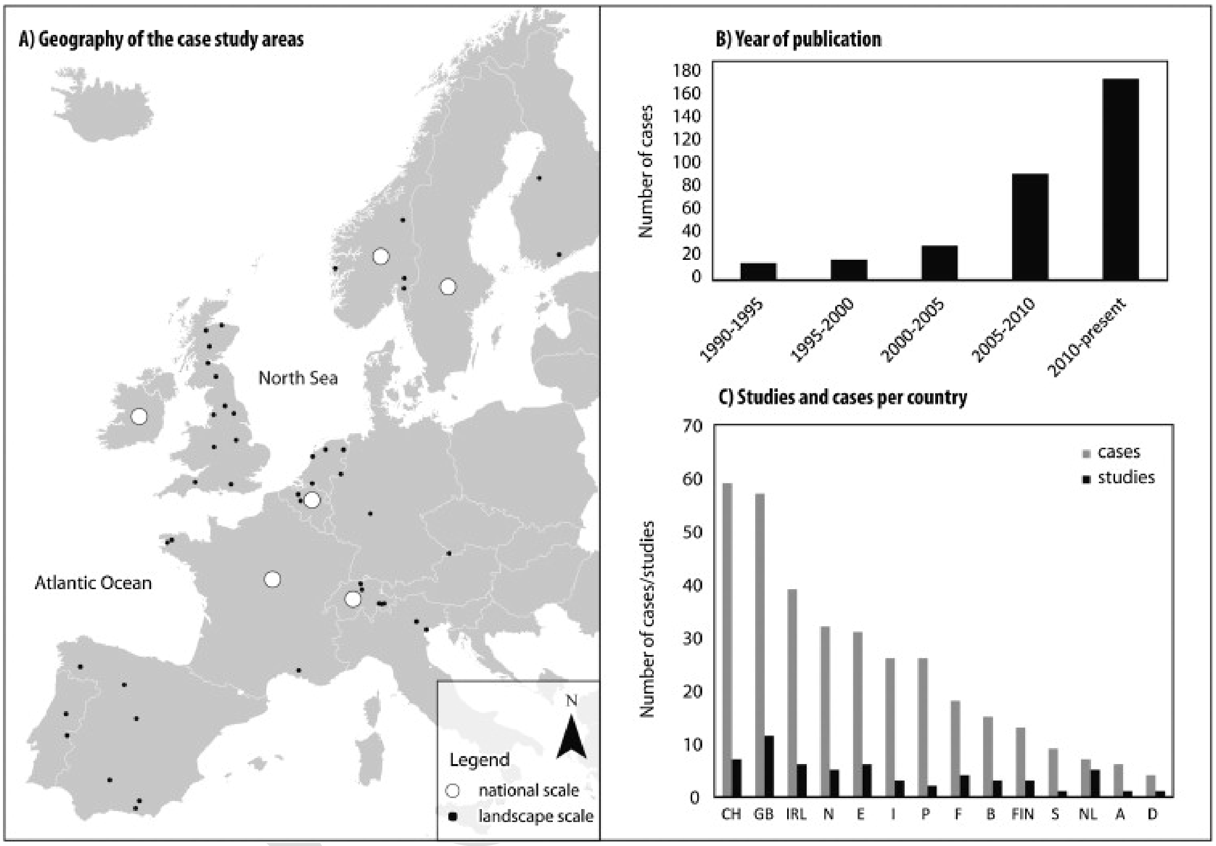

Figure 3.

The number of cases per landscape attribute-type. The bar chart shows the count of the first level of the attribute typology. Fifty five cases in the database did not fit either of the attribute types and were left out of the analysis. The pie charts show the count of the second level of the attribute typology for the largest types.

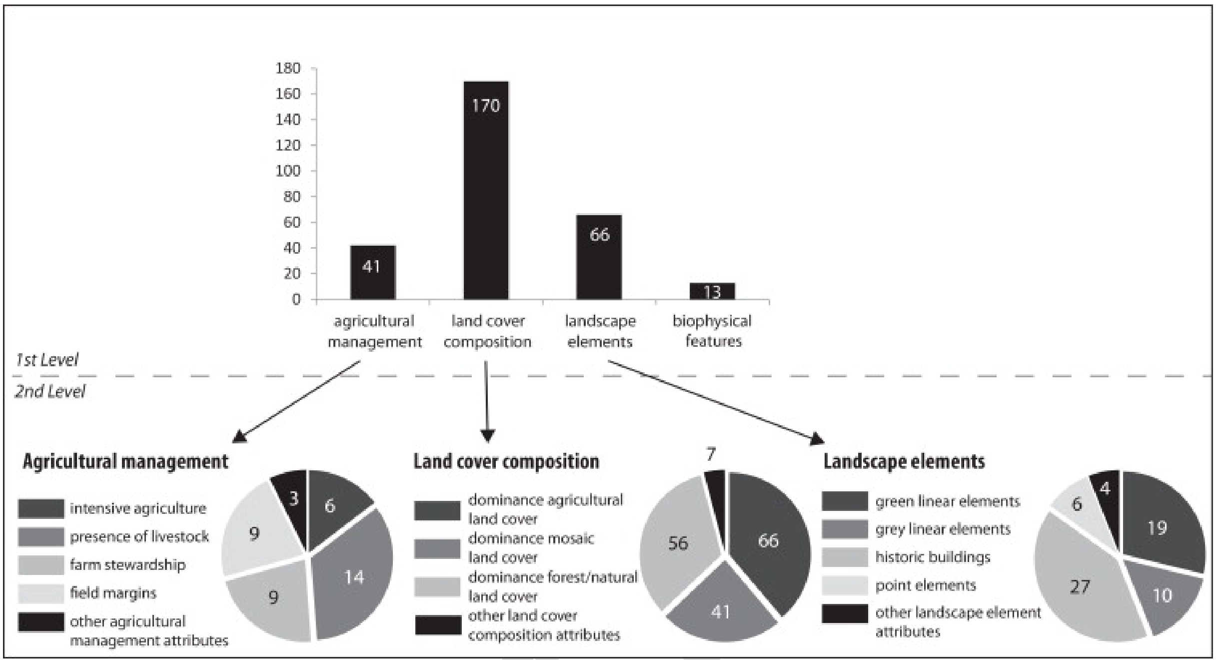

Figure 4.

(A) Count of different beneficiary groups that were addressed and (B) count of different methods that were applied in the cases.

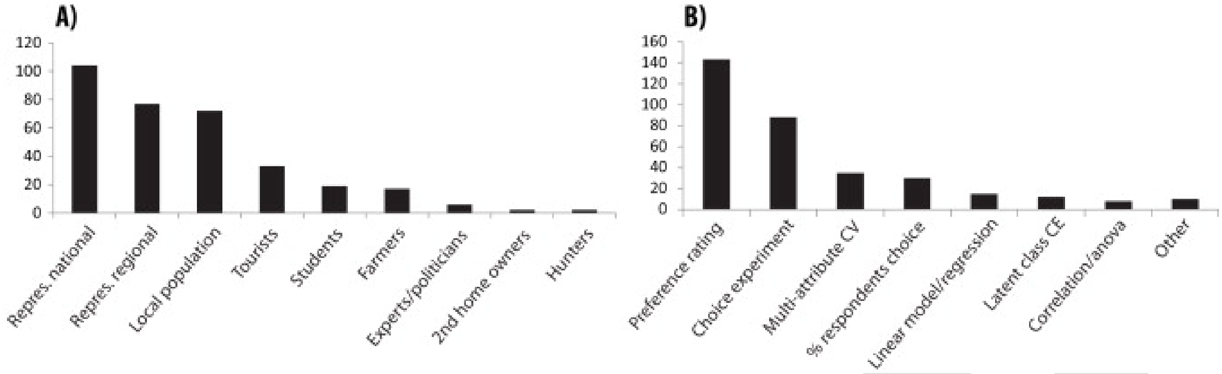

Figure 5.

Normalized preferences for landscape attributes. The grey boxplots show min–max normalized scores; black boxplots show preference scores obtained through normalized-rank transformation. White bars in the boxplots indicate mean preference score. The numbers in the boxplots refer to the number of cases. For attribute types that consist of less than 10 cases, normalized scores of the cases are displayed individually.

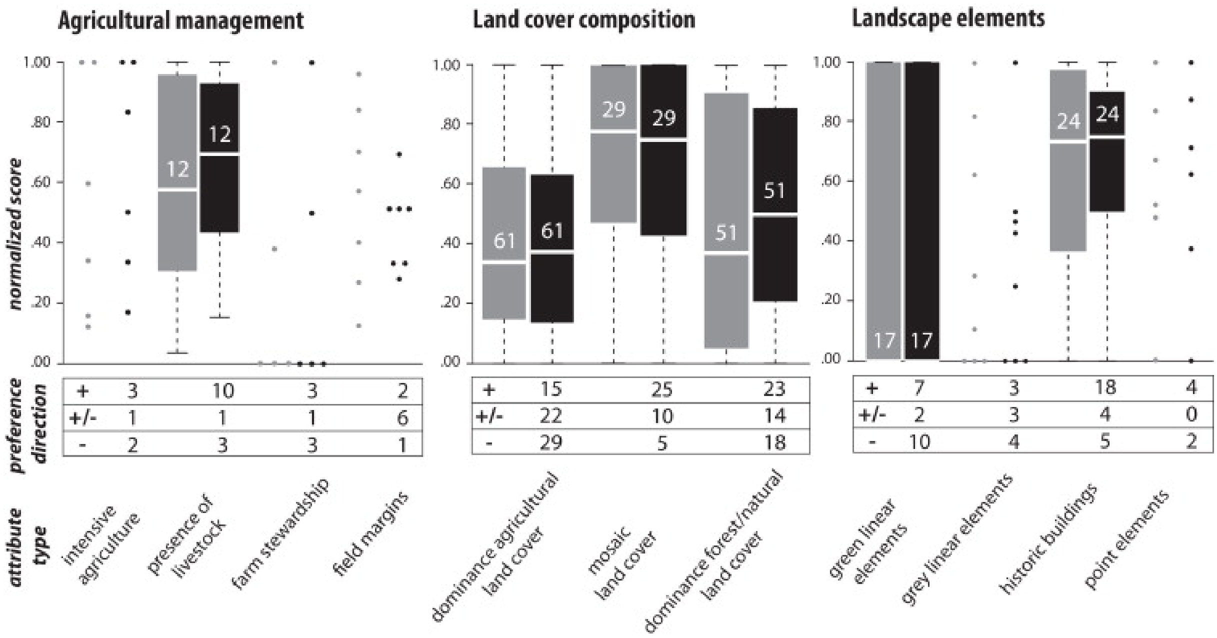

Figure 6.

Share of agricultural landscape types in the case study areas compared to the coverage of these landscape types in the EU-27 as a whole. The agricultural landscape types were derived from Van der Zanden et al. (in review).

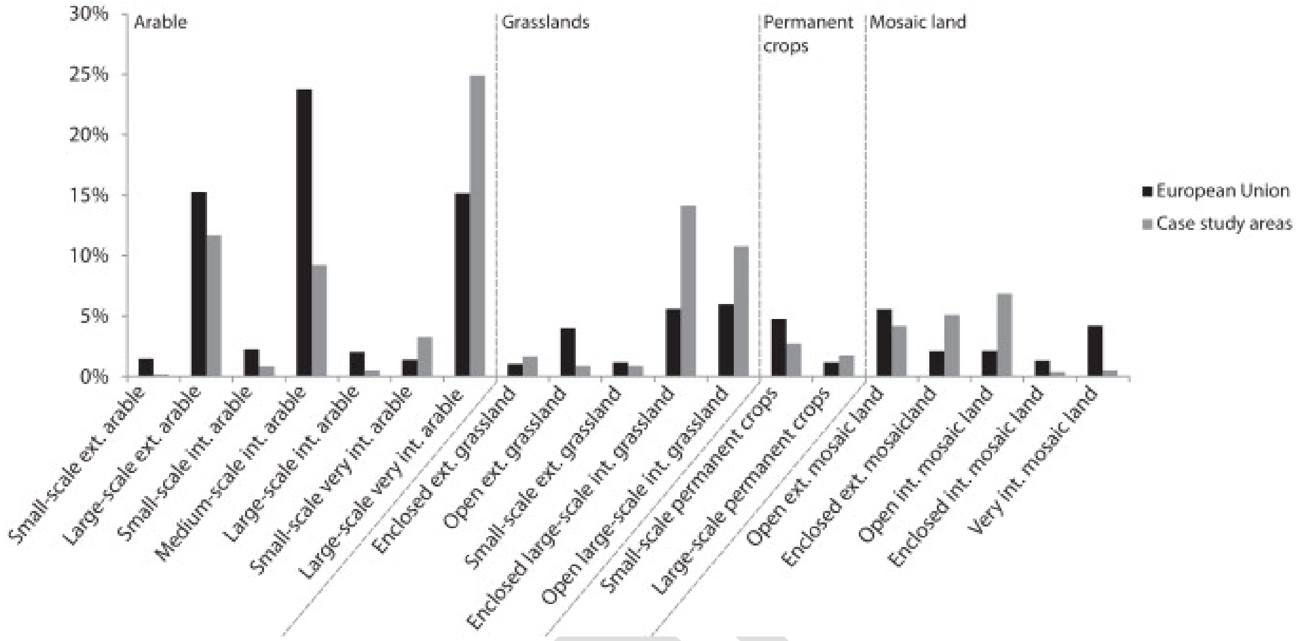

Table 1.

Hypotheses derived from literature review with regard to generic preferences for landscape attribute types (1.a and 1.b) and variables that potentially explain variances in stated preferences for landscape attributes (2.a–2.d).

Hypothesis no.	**Description**	**Reference**
1.a	*Mosaic land cover* attributes receive higher preference scores than *dominance agricultural land cover* or *dominance forest/nature* land cover attributes	Howley (2011), Kaplan and Kaplan (1989), Ode et al. (2009)
1.b	*Dominance forest nature* land cover attributes receive higher preference scores than *dominance agricultural land cover* attributes	García-Llorente et al. (2012), Van Berkel and Verburg (2014)
2.a	Regional beneficiaries state higher preferences for *dominance agricultural land cover* and lower preferences for *dominance forest/nature land cover* attributes than non-regional beneficiaries	E.g. Soini et al. (2012), Soliva et al. (2010)
2.b	GDP per capita and population density are negatively related to preference scores for *dominance agricultural land cover* attributes and positively related to preference scores for *dominance forest/nature land cover* attributes	Buijs et al. (2006), UK National Ecosystem Assessment (2011), Zasada (2011)
2.c	The % agricultural land cover in a landscape is negatively related to preference scores for *dominance agricultural land cover* attributes; the % forest land cover in a landscape is negatively related to preference scores for *dominance forest/nature land cover* attributes	Sayadi et al. (2009), Willis and Garrod (1993)
2.d	In abandonment studies, *dominance forest/nature land cover* attributes receive lower preference scores and *dominance agricultural land cover* attributes receive higher preference scores	Arnberger and Eder (2011), Gomez-limon (1999)

Table 2.

Estimated coefficients for the meta-regressions including all cases that address preferences for land cover composition attributes. The dependent variable is landscape preference score, obtained via min–max normalization and normalized-rank transformation.

Variable	**Min–max normalization**		**Normalized-rank transformation**	
	Standardized coefficient	***p* Value**	**Standardized coefficient**	***p* Value**
Mosaic land cover	0.44***	0.000	0.45***	0.000
Dominance forest/natural land cover	0.21**	0.017	0.19**	0.031
Linear elements attribute in study	0.16*	0.090	0.26***	0.005
Historic buildings attribute in study	−0.11	0.216	−0.10	0.217
Non-regional beneficiaries	−0.02	0.902	−0.00	0.952
Population density case study area	0.18*	0.073	0.14	0.145
GDP per capita case study area	0.22**	0.038	0.17	0.102
Economic valuation study	−0.21*	0.063	−0.11	0.307
Number of attributes in study	0.09	0.301	0.03	0.671
National scale case	0.05	0.618	0.08	0.365
n	129		129	
Adjusted R^2	0.16		0.17	
AIC	118		118	

* Statistically significant at 10%.

** Statistically significant at 5%.

*** Statistically significant at 1%.

Table 3.

Estimated coefficients for meta-regression models with all cases that address *dominance agricultural land cover* attributes. The dependent variable is landscape preference score, obtained via min–max normalization and normalized-rank transformation.

Variable	Min–max normalization		Normalized-rank transformation	
	Standardized coefficient	***p* Value**	**Standardized coefficient**	***p* Value**
Non-regional beneficiaries	−0.33*	0.064	−0.40**	0.041
GDP per capita case study area	0.16	0.355	0.11	0.543
Population density case study area	−0.27	0.134	−0.25	0.209
Percentage agricultural land cover (CORINE)	−0.43**	0.024	−0.20	0.313
Number of attributes in study	−0.08	0.655	−0.21	0.274
Abandonment study	−0.16	0.411	−0.05	0.799
n	40		40	
Adjusted R^2	0.15		0.04	
AIC	24		25	

* Statistically significant at 10

** Statistically significant at 5%.

Table 4.

Estimated coefficients for meta-regression models with all cases that address *dominance forest/nature land cover* attributes. The dependent variable is landscape preference score, obtained via min–max normalization and normalized-rank transformation.

ariable	Min–max normalization		Normalized-rank transformation	
	Standardized coefficient	***p* Value**	**Standardized coefficient**	***p* Value**
Non-regional beneficiaries	0.20	0.252	0.27	0.132
GDP per capita case study area	−0.25*	0.095	−0.24	0.105
Population density case study area	0.39**	0.019	0.36**	0.036
Percentage forest land cover (CORINE)	0.01	0.966	−0.01	0.941
Economic valuation study	−0.26	0.248	−0.23	0.318
Number of attributes in study	0.28	0.133	0.22	0.231
Abandonment study	−0.37*	0.080	−0.43*	0.050
n	32		32	
Adjusted R^2	0.33		0.28	
AIC	34		30	

* Statistically significant at 10

** Statistically significant at 5%.