Suitability of discrete choice experiments for landscape management under the European Landscape Convention

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ABSTRACT:

Landscapes throughout the world are increasingly being altered as a result of human actions and natural processes, therefore necessitating urgent management. Acknowledging this situation, the European Landscape Convention (ELC) was approved in 2000 with the explicit objective of protecting, managing and planning European landscapes. In this paper, we provide empirical evidence on the suitability of the Discrete Choice Experiment (DCE) methodology for valuing multidimensional landscapes under the ELC. An application in the Basque Country, Spain, serves as an example to illustrate that the DCE methodology may be suitable for supporting the aims of the ELC because: (i) it is a tool for public consultation; (ii) it offers an insight into the relative attractiveness of key landscape attributes, such as native forests and farming activities; and (iii) it provides policy-makers with quantitative information on the public preferences for potential future landscape protection, management and planning programmes. The results highlight the important role that the conservation of native forests and the promotion of organic farming may play in the management of European landscapes, which in turn is found to be strongly culturally dependent.

Keywords: European Landscape Convention; discrete choice experiment; Llanada Alavesa; random parameter logit; willingness to pay; welfare measure.

1. Introduction

Landscapes, designated as collections of forests, fields, wetlands, urban areas and more, and the areas where they intersect, are an integral part of individual and communal well-being. These areas are continuously changing because they are the expression of the dynamic interaction between environmental and cultural forces. More specifically, the transformations of landscapes can be attributed to factors such as population growth, changes in lifestyle preferences, competing demands for agricultural land, fuel security and natural disasters (van der Heide and Heijman, 2013). Moreover, the current changes are increasingly regarded as a threat because they are often characterised by the loss of diversity, coherence and identity of the existing landscapes (Balej et al., 2010). These rapid and sometimes chaotic landscape changes can result in the need to manage landscapes based on a balanced relationship between social needs, economic activity and the environment.

This is the case for European landscapes, which are complex assemblages of forests, fields, wetlands and human settlements that have been subjected to a high level of transformation throughout history. Forest areas in particular render a number of extremely important economic, ecological and social services, along with being part of Europe's identity and cultural heritage (Edwards, 2006). In fact, forest landscape restoration should be carried out under the assumption that improving the flow of forest goods and services requires a balance between livelihoods and environmental protection, and that this is best achieved within dynamic, multifunctional landscapes (Déjeant-Pons, 2006a).

The approval of the European Landscape Convention (ELC) (Council of Europe, 2000) initiated more research and action programmes relating to landscapes in most European countries than ever before. A significant difference from older regulations regarding landscape protection is that all kinds of landscapes are involved, not only especially valuable locations, such as natural protected sites. Natural, rural, urban and peri-urban areas are considered, which encompass land, inland water and marine areas. European landscapes are recognised as a basic component of the European natural and cultural heritage that can be a favourable resource for economic activity.

The ELC introduces a series of formal landscape definitions as well as a series of recommendations. Landscape is defined as "*an area, as perceived by people, whose character is the result of the action and interaction of natural and/or human factors*". The aim of the ELC is to promote landscape protection, management and planning, and to organise European co-operation on landscape issues. The general public, as opposed to solely academic experts or political officials, is set as the main information source to guide the ELC process (see Jones, 2007). Although general and specific measures are proposed, the ELC is not explicit regarding how to proceed, and gives flexibility for determining how the agreement is implemented (Déjeant-Pons, 2006b). It is clear that the competent public authorities are responsible for organising the public's participation, by collecting their aspirations and translating them into policy actions.

Opened for signature on 20 October 2000, the Convention entered into force on 1 March 2004, after 10 member states had ratified it. Spain ratified the Convention in 2008, and the Basque Country in 2009. Therefore, with the adherence of the Basque Country, the Basque authorities made a commitment to promote the ELC principles and a landscape law so that the quality of different landscapes, including native forests, is preserved and improved. However, due to the nature of landscapes as public goods (i.e. the landscape itself is non-excludable and non-rival in nature) and the complex definition and holistic nature of landscapes, effective governance is often complex and challenging (for different interpretations and connotations of the term "landscape" see van der Heide and Heijman, 2013). The challenge for policy-makers is to find a way to quantify the value of landscapes to the local residents and to incorporate these values into their landscape protection, management and planning decisions (Johnston and Duke, 2007).

In this context, the Discrete Choice Experiment (DCE) valuation technique can enrich the process of landscape decision-making mainly due to its flexibility and ability to take into account the multidimensional nature of landscapes and to provide detailed information about marginal changes in landscapes as well as trade-offs between the landscape attributes themselves and between the landscape attributes and money (Adamowicz et al., 1998; Bennett and Blamey, 2001; Bateman et al., 2002). DCE has been argued to be ideally suited to informing both the election and the design of multidimensional policies (Hanley et al., 2001; Horne et al., 2005) and seems to be an appropriate valuation method to achieve the objective of managing landscapes under the ELC framework, especially given the emphasis it puts on the general public's preferences as the main information source to guide it.

In this paper, we provide empirical evidence on the suitability of the Discrete Choice Experiment (DCE) methodology for valuing multidimensional landscapes under the ELC. An application in the Basque Country, Spain, serves as an example to illustrate that the DCE methodology may be suitable for supporting the aims of the ELC because: (i) it is a tool for public consultation; (ii) it offers an insight into the relative attractiveness of key landscape attributes, such as native forests and farming activities; and (iii) it provides policy-makers with quantitative information on the public preferences for potential future landscape protection, management and planning programmes. The results highlight the important role that the conservation of native forests and the promotion of organic farming may play in the management of European landscapes, which in turn is found to be strongly culturally dependent.

The paper is structured as follows. Section 2 describes the main landscape characteristics of the case study area. Section 3 is devoted to the DCE methodology, concerning the survey design, data collection and econometric specification. Section 4 presents a detailed analysis of the results, and Section 5 provides a discussion and some concluding remarks.

2. Case study description

The DCE involves the landscapes of a specific area known as Llanada Alavesa. This area is located in the province of Araba, one of the three provinces that form the Basque Autonomous Community (BAC) in Spain (see Figure 1). Llanada Alavesa is a wide plain extending into the central and north-eastern part of Araba and encompasses 256,003 people according to Basque Statistic Office (EUSTAT), almost 80% of the population of the province of Araba in 2013. Different types of landscapes, natural habitats and human activities coexist in this area, including forests, farming activities, industry, urban areas, infrastructure and swamps (Latasa et al., 2012; Latasa et al., 2014).

The landscapes of Llanada Alavesa exhibit great richness of flora, fauna and habitat diversity (Loidi et al., 2011; Lozano et al., 2012). Its native forests, which are the cornerstone of the society, culture and landscape, take up 39% of the surface. These forests support centenary and even millenary trees, such as oaks (*Quercus robur*) and gall oaks (*Quercus faginea*). However, the number of these millenary tree species has been reduced mainly due to extraction for firewood, coal and plank production. Ash trees (*Fraxinus excelsior*), maple trees (*Acer pseudoplatanus*) and beech trees (*Fagus sylvatica*) are also found in this area. Moreover, these native forests are home to threatened, vulnerable and rare animals, such as otters (*Lutra lutra*) and European minks (*mustela vitrelola*), and plant species, such as *Pentaglottis sempervirens* and *Littorella uniflora* (Uribe-Echebarría, 2010).

Given the favourable topography of Llanada Alavesa, 45% of its area is devoted to farming, which produces mainly potatoes, cereal and beetroot. Approximately 29% of the total surface of Llanada Alavesa is devoted to intensive farming, which employs chemical fertilisers and pesticides as well as making high use of machinery to achieve a higher level of production. The forest plantation surface, which is mainly devoted to timber crops, is included within this area. However, it represents a very small percentage of the total intensive farming surface (less than 3%). Approximately 16% of the land of Llanada Alavesa is covered by organic farming, which does not use non-natural synthetic products or genetically modified organisms and makes more limited use of machinery, resulting in environment-friendly and high-quality production.

Urban and industrial sites, in addition to infrastructure are also present. Companies working in the automotive industry, wind generation and machine tools are located in this area largely due to its good connectivity. It is estimated that currently 14% of the area of Llanada Alavesa is occupied by urban, industrial and economic activity sites as well as by infrastructure. Henceforth, this landscape attribute definition will be referred to as cemented surface (i.e. 14% is cemented surface).

Recreation areas are also common in this area, including the *Ullibarri* and *Urrunaga* reservoirs. These swamps depict a unique leisure location where fishing, canoeing, cycling and hiking are possible. Llanada Alavesa also presents a large cultural heritage. Romanesque chapels and churches, megalithic monuments, medieval towns, typical Basque farms (*baserri*) or a branch of the way of St James are located in this historical area. In addition, many of the villages of Llanada Alavesa hold ancient rural traditions.

The largest transformations of the landscapes of this area have always been spurred by actions within the primary sector, particularly from agriculture. The most drastic changes have been initiated by land consolidation that took place during the 1960s (i.e. causing field boundaries and bank vegetation to largely disappear). To a lesser extent, changes can also be attributed to agricultural mechanisation and intensive farming practices. Today, the biggest alterations come from infrastructure, urban and non-residential land development projects. In addition, the Partial Territorial Plan of Central Araba and General Urban Planning Plans are also leading to landscape transformation processes of great territorial magnitude. In the last 30 years, the cemented surface of Llanada Alavesa has approximately tripled, mainly due to economic activities, infrastructure and residential land uses (Ruiz and Galdós, 2013).

The current land use trend in Llanada Alavesa is a decrease in the agricultural land together with an increase in the cemented surface and to a lesser extent, in the native forest area (Latasa et al., 2014; Ruiz and Galdós, 2013). As in many parts of Europe, the cemented surface for residential land use, economic activities, and urban and developable areas has potential to continue expanding at a high rate. A gain in the native forest area is also expected due to both forest protection regulations (including the European Nature 2000 network) and a large decrease in cattle farming in the area (which is resulting in meadow and scrublands changing to a native forest state).

The persistent changes in landscapes have raised concerns about the sustainability of development based on social needs, economic activity and the environment. With the adherence of the Basque Country to the ELC, the Basque authorities ought to adopt management measures to preserve and improve the quality of different landscapes, including native forests, farming (intensive and organic), cemented surface as well as recreation areas and cultural heritage.

3. The discrete choice experiment for landscape valuation

In recent years, various DCEs have been applied to the economic valuation of landscape changes in Europe. To our knowledge, the first European DCE study was reported by Bergland (1997) and attempted to measure the value of certain attributes (hedgerows, creeks, fences, vegetation islands and paths) of the agricultural landscape in Norway. A year later, Bullock et al. (1998), Hanley et al. (1998a) and Hanley et al. (1998b) estimated the willingness to pay (WTP) for different attributes of the deer stalking experience in the Scottish highlands, for the conservation and landscape benefits of environmentally sensitive areas in Scotland, and for changes in landscape elements in the UK's public forests, respectively.

Since then, a growing number of DCE studies have been published in Europe. For example, Rambonilaza and Dachary-Bernard (2007) used the DCE method to examine public preferences for three landscape features (hedgerows, farm buildings and scrubland) in the Monts d'Arrèe region in Brittany (France). More recently, Grammatikopoulou et al. (2012) employed a DCE to evaluate a management programme that provides certain landscape attributes (proportion of uncultivated land, number of plant species, grazing animals, water protection zones and state of production buildings) in the southern Finnish agricultural landscape. Another recent DCE application was conducted by Liekens et al. (2013) to evaluate the public preferences associated with land use changes from agricultural land to different types of nature in the Flemish region in Belgium.

Spain also presents widespread use of DCE applications concerning landscape valuation. For instance, Kallas et al. (2007) applied this stated preference (SP) method for valuing the multifunctionality of the agricultural landscape of Tierra de Campos in Castile and Leon. Similarly, Arriaza et al. (2008) estimated the social demand for agricultural multifunctionality from mountain olive groves of Andalusia. Another Spanish example is the DCE conducted by Domínguez-Torreiro and Soliño (2011), which estimated the welfare change associated with multifunctional rural development programmes in Cantabria. In the Basque Country, it is possible to find DCE applications focused on the economic valuation of the Basque forests (Pascual, 2007), the natural area of Mount Jaizkibel (Hoyos et al., 2009) and a regional Natura 2000 network site (Hoyos et al., 2012). Although these studies have been valuable inputs for the survey design, the present study contributes to the recent landscape valuation literature by providing policy-makers with a specific tool to manage landscapes in the context of the ELC.

3.1 Survey design

A valuation survey was conducted in Araba to evaluate the public's preferences for the main attributes of the landscapes of Llanada Alavesa. The respondents were first informed about the current situation of the landscapes of Llanada Alavesa and the need for a policy for the protection, planning and management of them. Further on in the questionnaire, the attributes to be valued and their levels of provision were described.

For the definition of the landscape attributes and levels of provision, we carried out an extensive literature review on European DCEs valuing landscapes, investigated the landscape features of Llanada Alavesa and considered expert advice obtained from bio-geographers and economists as well as conducted a focus group discussion. The focus group was led by a professional in October 2012 to test the appropriateness of the landscape attributes (and their levels), photographic materials, valuation context and payment vehicle.

The attributes and levels considered in the final version of the questionnaire were (see Table 1): (1) *Native forests*, represented by the percentage of the area of Llanada Alavesa covered by native forests; (2) *Intensive farming*, represented by the percentage of the land devoted to intensive farming (including forest plantations); (3) *Organic farming*, measured by the percentage of the land of Llanada Alvesa taken up by organic farming; (4) *Cemented surface*, represented by the percentage of the surface occupied by urban, industrial and economic activity sites as well as by infrastructure; and (5) *Recreation areas*, measured by the level of conservation and protection of the recreation areas (e.g. swamps, picnic areas) and the cultural heritage (e.g. megalithic monuments, the branch of the way of St James) found in the area of Llanada Alavesa. All these attributes were specified on four different levels, the first of which corresponded to the current situation (status quo), whereas the remaining three represent hypothesised changes. Note that the hypothesised future levels of the attributes were estimated and provided by experts in this field and these were found to be both credible and understandable by the focus group participants.

A monetary attribute was also included. The proposed payment vehicle was an annual payment through a new tax to be paid by the citizens of Araba to an organisation exclusively dedicated to coordinating the action plans. This payment vehicle was preferred to voluntary donations since respondents may have incentives to free-ride with the latter (Whitehead, 2006). The usual reminder of the budget constraint was also incorporated. The focus group participants found the payment vehicle and cost levels credible.

The six attributes and their varying levels allowed a large number of alternatives to be constructed $(4^5 \times 5^1)$. In order to reduce the number of alternatives and choice sets, we applied a *D*-efficient main-effects fractional factorial design (Scarpa and Rose, 2008). The design was also constrained so that the sum of the land devoted to the first four attributes considered would not exceed the total land percentage in the current situation (98%). As a result, 120 versions of the choice sets were randomly divided into 20 blocks.

Figure 2 shows an example of a choice set used in the questionnaire. Each respondent was presented with six choice sets and asked to choose one of the three options presented for each set. The choice set included some pictures of the attributes considered and a graphical representation of their levels to facilitate the choice task understanding. The questionnaire also tested the understanding of the choice task by including an additional "rationality" choice set in which respondents faced the same attribute levels as in option A (status quo) but with a higher cost, so we expected respondents always to choose the status quo (Hoyos, 2010). Data on the respondents' social and economic characteristics were collected at the end of the survey.

3.2 Data collection and final number of observations

Data was gathered through face-to-face interviews in order to encourage participation and facilitate the understanding of the choice task. The relevant population considered was that of the Basque province of Araba, accounting for 266,014 residents aged at least 18 (EUSTAT). The pilot survey was conducted in November 2012 with 60 individuals, and the final questionnaire was administered in January 2013 with a stratified random sample of 521 individuals selected from the relevant population. The strata used included the age, gender and size of the town of residence, following official statistical information provided by EUSTAT.

It is important to analyse the validity of responses we obtained from the choice sets for the further analysis of welfare measures. Out of the 521 survey respondents, everyone understood the objective of contributing or not to the proposed initiative. However, a total of 317 respondents chose option A (status quo) in the first choice card. We used a set of follow-up questions to identify protest respondents based on the state of practice in environmental valuation with SP methods (e.g. Hanley et al., 2007; Lindberg et al., 2009; Jacobsen et al., 2011; Martin-Ortega et al., 2011; Schaafsma et al., 2012).

278 respondents were identified as protesters, of whom most stated that they already paid too much tax followed by the opinion that this initiative should be financed entirely by the Government. We devote this high presence of protest responses to the adverse economic situation at the time the survey was conducted. In order to obtain reliable and unbiased welfare estimates, we excluded protest responses from the sample, as is the common practice in the literature (e.g. Glenk et al., 2011; Martin-Ortega et al., 2011; Liekens et al., 2013). Moreover, respondents who failed to pass the rationality test (25 respondents) were also excluded from the final sample.

All in all, the data analysis used 218 completed questionnaires, yielding 1308 observations as each respondent faced six choice sets. The benefit of higher reliability of the results comes at the expense of slightly reducing the representativeness of the sample, which has been the case in many DCE studies (e.g. Glenk and Colombo, 2011; Glenk et al., 2011; Jacobsen et al., 2011; Hoyos et al., 2012). The total number of observations is comparable with other European DCE studies for landscape valuation (e.g. Campbell, 2007; Colombo and Hanley, 2008; Elsasser et al., 2010; Domínguez-Torreiro and Soliño, 2011; Hoyos et al., 2012; Olschewski et al., 2012).

3.3 Econometric specification

In order to convert the individual choice responses into estimated parameters, the DCE employs the behavioural framework of the Random Utility Theory (RUT) developed by

McFadden (1974). The utility function for individual i choosing alternative j on choice occasion t is given by:

$$U_{it,j} = V_{it,j} + \varepsilon_{it,j}, \quad (1)$$

where $V_{it,j}$ is the deterministic part of the latent utility that contains factors observable by the analyst and $\varepsilon_{it,j}$ is an error term. In order to analyse the data, a Random Parameter Logit (RPL) model, which has recently been used in the field of landscape valuation, was applied (Bliem et al., 2012; Schaafsma et al., 2012; Garrod et al., 2013).

In contrast to the traditional Multinomial Logit (MNL) model (McFadden, 1974; Louviere et al., 2000), the RPL specification is not subject to the undesirable Independence of Irrelevant Alternatives (IIA); it accounts for unobserved heterogeneity by allowing (some of) the parameters of the utility function to vary according to some distributions as well as considering that a respondent makes choices in more than one choice situation (Train, 2003; Siikamäki and Layton, 2007).

In the RPL model, the probability that individual i chooses alternative j in choice situation t is:

$$P_{it,j} = \frac{\exp(x'_{it,j}\beta_i)}{\sum_{j=1}^{J_i}\exp(x'_{it,j}\beta_i)}, \quad (2)$$

where $x_{it,j}$ is a $(K \times 1)$ vector of the attribute levels of alternative j (from a total of J_i alternatives) for individual i (from a total of N individuals) in choice card t (from a total of T_i choice cards). In our application, the full vector of K parameters is continuously distributed across individuals with:

$$\beta_i = \beta + \Delta z_i + \Gamma v_i, \quad (3)$$

where β is a parameter vector representing the fixed means of the random parameter distribution, z_i is the vector of observed individual-specific characteristics, Δ is the associated parameter matrix and Γ is the unknown lower triangular matrix to be estimated. The random unobserved taste variation is represented by v_i, a vector of uncorrelated random variables characterised by:

$$\mathrm{E}(v_i)=0, \quad \mathrm{Var}(v_i)=\Sigma=\mathrm{diag}\left[\sigma_1, \sigma_2, ..., \sigma_K\right]. \tag{4}$$

The estimation procedure by maximising the simulated log-likelihood function is described in Greene and Hensher (2003), Hensher and Greene (2003) and Train (2003).

4. Results

4.1 Basic statistics

More than half of the sample respondents (54.6%) live and work or study in Llanada Alavesa. Moreover, we found that almost 57% of the respondents appreciate quite or a great deal that products are protected under a quality label (certificate of origin, organic farming, Basque label …); almost 58% of the respondents are very concerned about biodiversity loss and approximately 57% about landscape quality loss. Table 2 shows the descriptive statistics of socio-economic variables obtained with this application along with their corresponding population values.

The sample mean age (42.28 years); gender decomposition (50.4% male and 49.6% female); personal income (the majority, 47.4%, earning between €500 and €1,500 per month and 24.6% with no personal income); employment status (54.4% salaried employee or self-employed and 11.5% unemployed); education level (6.4% with no official education and 18.8% with a university degree or equivalent qualification); and the percentage of the population of Araba residing in

Llanada Alavesa (76.2%) are generally in line with those of the overall population of Araba in 2013 according to EUSTAT (see Table 2).

Moreover, the last four rows of Table 2 present the additional dummy variables created for the socio-economic variables considered in the model estimation stage: *Resident* (taking the value 1 if the respondent lives in a township of Llanada Alavesa and 0 otherwise), *Low income* (for respondents' net monthly disposable income lower than €500 or respondents with no income at present and 0 otherwise), *Basque identity* (taking the value 1 if the respondent considers himself/herself as having a Basque cultural identity at an above average level and 0 otherwise) and *High recreation* (taking the value 1 if the respondent uses the recreation areas of Llanada Alavesa frequently or very frequently and 0 otherwise).

4.2 Model specifications and estimation results

The data obtained in the experiment were examined using the NLOGIT version 4.0 software (Greene, 2007). Table 3 shows the estimations corresponding to the MNL and different RPL model specifications. We included an alternative-specific constant (ASC) in all the utility specifications for the non-status quo options (*ASC1* and *ASC2*). Their significant and positive coefficients under all the estimated models suggest that all else being equal, respondents tend to favour moving away from the current situation to a situation with change.

The MNL was first estimated in order to obtain a first insight into the data. Then, different RPL specifications were estimated. The general indirect utility function used for the RPL specifications was the following:

$$V_{it,j} = ASC_j + \beta_{NFi} Native\ forests_{it,j} + \beta_{IFi} Intensive\ farming_{it,j} + \beta_{OFi} Organic\ farming_{it,j} + \beta_{CSi} Cemented\ \ surface_{it,j} + \beta_{RAi} Recreation\ \ areas_{it,j} + \beta_{Costi} Cost_{it,j}\ , \quad (5)$$

where ASC_j is the alternative-specific constant under options B and C, $\beta_{NFi}\ ,...,\beta_{Costi}$ are the attribute parameters defined according to (3) and $Native\ forests,...,Cost$ are the attribute levels described in Table 1. The possible randomness of the attribute parameters was tested using the Lagrange Multiplier (LM) test proposed by McFadden and Train (2000) which presents correct empirical size (Mariel et al., 2013). As a result, the coefficients associated with the *Native forests*, *Cemented surface* and *Cost* attributes are random.

We applied the empirical approach proposed by Hensher and Greene (2003) to describe graphically the empirical distributions for the random parameters. Figure 3 shows the empirical shape of each distribution. The parameters associated with the *Native forests* and *Cemented surface* attributes were assumed to be normally distributed, while the lognormal distribution was chosen for the *Cost* attribute parameter. Moreover, the lognormal distribution (with a sign change) for the cost parameter assures finite moments for the distributions of WTPs (Daly et al., 2012). The stability and precision of each and every model was confirmed when using 2,000 Halton draws (Hensher and Greene, 2003).

In the first RPL specification (RPL-1), individual preference heterogeneity is covered by unobserved influences affecting respondents' utility. As expected given the results of the LM test for selecting random parameters, the standard deviations of the assumed random parameters are significant, suggesting the presence of unobserved heterogeneity in the preferences for changes in the levels of the *Native forests*, *Cemented surface* and *Cost* attributes. As a further step, we explored possible factors explaining the preference heterogeneity by estimating the RPL-2 model including the socio-economic variables affecting the parameters' mean. Under this RPL-2 specification, all the estimated coefficients associated with landscape attributes are on average significant and positive except the coefficient for the *Cemented surface* attribute, which on average is insignificant. However, the standard deviation of its random parameter is significant, which suggests that *Cemented surface* attribute is controversial with positive and negative preferences toward percentage increases in it.

Furthermore, the significant coefficient estimates of the interactions between socio-economic and attribute variables means that, all else being equal, (i) having Basque cultural identity increases the utility regarding increases in land devoted to native forests and/or organic farming, (ii)living in a township of Llanada Alavesa results in a utility decrease toward increases in land covered by intensive farming , (iii) earning less than €500 per month or having no income decreases the utility with regard to an increase in the level of conservation and protection of recreation areas and (iv) using recreation areas frequently or very frequently results in a utility increase concerning an improvement in the level of conservation and protection of recreation areas. Explaining the individual preference heterogeneity by both socio-economic characteristics and other unobserved influences improves the log-likelihood, AIC, BIC and Pseudo *R*-squared (see Table 3). Moreover, we allowed for free correlation between random parameters but as no significant correlations were found, we used the RPL-2 specification for welfare analysis.

4.3 Welfare measures

The welfare change, either positive or negative, related to a hypothetical choice scenario can be estimated by using the compensating surplus (CS) following Small and Rosen (1981) and Hanemann (1984):

$$\mathrm{CS} = -\frac{1}{\mu}\left[\ln\left(\sum_{j=1}^{J_i}\exp\,(x_{ij}'^{0}\lambda)\right) - \ln\left(\sum_{j=1}^{J_i}\exp\,(x_{ij}'^{1}\lambda)\right)\right], \quad (6)$$

where μ is the marginal utility of income (usually represented by the coefficient of the cost attribute, β_{Cost}), λ represents the vector of parameters corresponding to landscape attributes and x_{ij}^{0} and x_{ij}^{1} correspond to the vector of landscape attributes before and after the change under consideration. Thus, the Hicksian CS measures a change in the expected utility due to a change in the level of provision of the attribute(s) by weighting this change by the marginal utility of income. Simplifying the above equation, the WTP for a marginal change in the level of provision of each landscape attribute is obtained by dividing the coefficient of the landscape attribute by the coefficient of the cost attribute (Haab and McConnell, 2002).

In this section, we present the unconditional simulation of the WTP results derived from out-of-sample populations by randomly sampling each individual from the full distribution (Krinsky and Robb, 1986). Table 4 reports the simulated WTPs for the RPL-2 model with the tenth and ninetieth percentile points from the resulting distribution of each WTP because its distribution is non-standard (Daly et al., 2012).

In the presence of the RPL-2 model specification, WTP calculations should take into account both the effect of socio-economic variables and the possible randomness of the parameter. A baseline scenario was first specified with all the socio-economic dummy variables equated to zero. By setting the dummies of the socio-economic variables to one, their effect can be examined (see Table 4). Hence, for example, the WTP for a 1% increase in the *Native forests* attribute, with its parameter distributed as normal and the *Cost* attribute parameter as lognormal, when the respondent has Basque cultural identity at an above average level (*Basque identity* = 1) was specified as:

$$\mathrm{WTP}_{NF} = -\frac{\left(\hat{\beta}_{NF} + \hat{\delta}_{BI} \cdot 1 + \hat{\sigma}_{\beta_{NF}} \cdot \upsilon\right)}{-\exp\left(\hat{\beta}_{Cost} + \hat{\sigma}_{\beta_{Cost}} \cdot \upsilon\right)}, \qquad (7)$$

where $\hat{\beta}_{NF}$ and $\hat{\beta}_{Cost}$ are the estimated means of the *Native forests* and *Cost* attribute parameters, respectively, $\hat{\sigma}_{\beta_{NF}}$ and $\hat{\sigma}_{\beta_{Cost}}$ are their corresponding estimated standard deviations, $\hat{\delta}_{BI}$ is the estimate associated with having Basque cultural identity and $\upsilon \sim \mathrm{N}(0,1)$. In order to calculate the WTP means (reported in the last row of Table 4), we used weights corresponding to the proportion of each group in the population.

The mean annual WTP for a 1% increase in the land area covered by native forests is estimated at €1.00 per person, in 2013 values. The WTP increases to €2.58 if the respondent's cultural identity is Basque. Similarly, the mean annual WTP for a 1% increase in the land devoted to organic farming is estimated at €1.64, but the WTP increases to €3.32 if the individual again has Basque cultural identity. The important role that Basque cultural identity plays in this economic valuation study is in line with previous DCE studies conducted in the Basque Country (Hoyos et al., 2009; Hoyos et al., 2012).

The mean annual WTP for a 1% increase in the land area devoted to intensive farming is estimated at €0.37. However, the respondents residing in one of the municipalities of Llanada Alavesa have on average almost a null annual WTP (€0.03). Although the mean WTP to increase the cemented surface in Llanada Alavesa is zero on average, from its distribution we can observe that there are people who are willing to pay for increases in the cemented surface and there are other people who are willing to prevent this increase, leading therefore to a compensated effect. Eventually, the annual WTP to improve the level of conservation and protection of the recreation areas and cultural heritage is estimated at €6.75. In this case, the preferences also differ among the population: respondents with an income less than €500/month or no income have a WTP of €1.06 while the WTP of respondents using the recreation areas frequently or very frequently is estimated at €10.57.

4.4 Compensating surplus for alternative landscape management scenarios

The welfare measures obtained by estimating the mean marginal WTP in the previous section also allow us to estimate the changes in the welfare of the population of Araba associated with different landscape protection, management and planning options. In order to estimate the CS for different options of interest, we proposed three different future scenarios, altering the attribute levels and considering feasible land use changes: (1) *Promotion of native forests and organic farming*; (2) *Promotion of intensive farming and cemented surface*; and (3) *Promotion of recreation areas and cultural heritage*. Table 5 presents the changes proposed in relation to the status quo by showing the attribute levels corresponding to each of these three scenarios. Note that the levels we used to construct the different scenarios are those provided by experts and used in the DCE sets.

Table 6 shows the estimated annual CS (i.e. the estimated social benefits) for each scenario proposed using equation (6). Under scenario 1, which promotes native forests and organic farming and can be associated with the ecological features of the area, the total welfare benefits for the population of Araba are estimated at €5.05 million per annum. Scenario 2, characterised by the promotion of intensive farming and cemented surface and which can be associated with economic (or production) interests, would entail on average a social loss estimated at €6.46 million per annum for the citizens of Araba. Finally, with scenario 3, which enhances the cultural heritage and recreation areas, keeping the rest of the landscape attributes at their current levels, the citizens of Araba would experience on average a social benefit estimated at €4.35 million per annum.

In order to assess the robustness of the welfare estimates, a sensitivity analysis was also carried out. Given that the robustness of the estimated welfare benefits depends on the sample representativeness, we have conducted a sensitivity analysis for the observed sample proportions of the dummy variables that could not be verified with official statistics (i.e. *Basque Identity* and *High Recreation* variables). The 95% confidence interval for the case of B*asque identity* is (10.17%, 20.15%), while that for *High recreation* is (40.39%, 54.11%). Changing the *Basque identity* sample proportion to the lower and upper bound of its corresponding 95% confidence interval, we estimate the social benefits under scenario 1 between €4.53 million and €5.46 million (i.e. -10% and 8%). Similarly, when modifying the corresponding sample proportion of *High recreation*, the social benefits corresponding to scenario 3 vary between €4.15 million and €4.53 million (i.e. -4% and 4%). Given that these are considerable variations, welfare estimates should be seen with a certain degree of caution. Furthermore, the sensitivity analysis highlights the importance of collecting this type of attitudinal information with particular attention.

5. Discussion and conclusions

Landscapes, which are a key element of individual and social well-being, continuously change and evolve through natural and human-induced processes and activities. The ELC highlights that the protection, management and planning of landscapes can provide a range of benefits in the cultural, ecological, environmental and social fields as well as contributing to job creation. In order to aid the optimal design of landscape protection, management and planning, policy-makers need a proper means of accounting for all these benefits in the public preferences for the policy intervention. This paper estimates the public preferences for landscape protection, management and planning under the ELC using the DCE valuation method as a case study of the Basque area of Llanada Alavesa, Spain.

For the purpose of policy, this study presents useful information to help policy-makers resolve the issue of disaggregating protection, management and planning policies into suitable landscape attributes and levels. Taking into account the public's preferences of the population of Araba, the annual per capita mean marginal WTP to increase the land area of Llanada Alavesa under native forests and organic farming is estimated at €1.00 and €1.64, respectively, while for the land area under intensive farming is estimated at €0.37. Further, we found a null mean marginal WTP for percentage increases in the cemented surface. Finally, we estimated the mean marginal WTP to improve the level of conservation and protection of the recreation areas by €6.75 per person and year.

In the face of landscape protection, management and planning, we found different and sometimes conflicting landscape preferences. We applied the RPL model in order to investigate and explain the individuals' preference heterogeneity. Firstly, we identified unobserved influences affecting respondents' utility for changes in the levels of the native forests, cemented surface and cost attributes. A further exploration of the heterogeneity through an RPL model with relevant socio-economic variables helped to describe part of the unobserved heterogeneity. This model identified a strong Basque cultural identity as a main explanatory variable for higher values regarding native forests and organic farming. Interestingly, the mean annual WTP of individuals residing in one of the Llanada Alavesa's municipalities for increases in the land devoted to intensive farming seems to be lower than the mean annual WTP of the overall Araba population. The mean annual WTP for cultural heritage and recreation areas' conservation seems to be higher for high-frequency users of the recreation areas, but as expected by economic theory, this is lower for individuals with low income or no income. Moreover, we found opposite preferences toward percentage increases in cemented surface.

The expected welfare benefits in monetary terms of specific landscape scenarios are useful for facilitating future cost-benefit examinations. Among the three different hypothetical scenarios proposed, we found that the promotion of native forests and organic farming, and the development of recreation areas and cultural heritage would bring on average welfare benefits estimated at €5.05 and €4.35 million per year, respectively. In contrast, the specified promotion of intensive farming and cemented surface would entail on average an annual social loss from the population's point of view estimated at €6.46 million. These results suggest that policy-makers might attempt to enhance the ecological values of the landscapes that could be compatible with an improvement in the conservation level of the recreation areas and cultural heritage.

Under the current trend of increasing cemented surface and forest areas at the expense of decreasing agricultural land in Llanada Alavesa, our study shows that these land transformations are partially in line with public preferences. The promotion of the area under native forests is supported by the population of Araba, while the one under urban areas seems to be much disputed. With regards to the consequence of more limited farm land, the citizens of Araba seem to give more recognition to the organic farming than the intensive farming. Hence, our results can be seen as the starting point for dealing with the trends in the landscapes of Llanada Alavesa under the ELC. It is also important to note that the costs of implementing a given landscape programme would have to be considered to evaluate whether that programme would succeed in a cost-benefit analysis.

Policy-makers should also bear in mind the economic and cultural context in which the landscape management policies will be implemented as well as the potential landscape use conflicts. On the one hand, this study has been developed in a context of economic recession, which was partly reflected in the high number of protest responses. Given that the unemployment rate in the first quarter of 2013 was around 13% both in Araba and in the Basque Country (EUSTAT), and about 27% in Spain (National Institute of Statistics, INE), the society might be more concerned about unemployment and social assistance while environmental issues seem to be in the background in times of economic crisis.

On the other hand, given that the natural environment plays a central role in the Basque cultural tradition and that a matriarchal culture such as that of the Basques feels close attachment to the land, cultural identity is found to be a key factor explaining the social benefits related to the main ecological features of the landscapes of Llanada Alavesa. The positive influence of Basque cultural identity on native forests is in line with other DCEs conducted in the Basque Country (Hoyos et al., 2012), while that on organic farming is found first in this study. In fact, people who support organic farming production may do so for health reasons or just because they want to protect the environment. Native forests are an important pillar of the Basque society and culture, and this is also true in Llanada Alavesa. This is reflected in the local language "*euskera*", which contains the word "*basoa*" (forest) in the roots of several significant words, as well as in the mythology of the country (Hoyos et al., 2009; Palacios, I., 2011). Thus, considering and understanding the cultural values that predominate in a specific area, region or country could help in designing landscape-related policies.

Eventually, since designers and policy-makers have to make choices between different and usually competing uses of landscapes, they should be aware of the preferences of different segments of the population to reduce the potential conflicts that may arise through the landscape changes proposed. For example, the funds for landscape protection, management and planning could be transferred not only to invest in the corresponding landscape programme, but also to compensate for the losses that local farmers could experience if the proposed landscape programme significantly affects their activity. Moreover, some local farmers might need support in terms of information and economic incentives to move from intensive farming to organic farming. In fact, nowadays, both at the European level through the Common Agricultural Policy (see European Commission, 2013) and at the Spanish Autonomous Communities level, there are different programmes that motivate farmers to introduce organic farming. In the Basque Country, the Rural Development Plan (2007–2013) specifies different aids that provide financial support depending on the number of hectares under organic farming, livestock and socio-economic characteristics of the farmers.

This study concludes that the DCE may be a useful tool for establishing the principles and objectives of the ELC since: (i) it supports public participation; (ii) it highlights the trade-offs between different landscape attributes from the general public's point of view; (iii) it takes into account the heterogeneous preferences of the population; and (iv) it offers well-informed advice in terms of the welfare benefits derived from different landscape management programmes. The present study has illustrated how useful results can be successfully obtained from a carefully designed DCE in a specific European landscape.

Acknowledgements

This study has been conducted under the agreement between Diputación Foral de Álava and Universidad del País Vasco: "*Protección, gestión y ordenación de los paisajes de Álava: La Llanada Alavesa*" (Ref: 2010-2970). Amaia de Ayala is grateful to the financial support from the Basque Government through a Ph.D. grant (BFI09.23). David Hoyos and Petr Mariel acknowledge financial support from the Basque Government and the University of the Basque Country (UPV/EHU) via projects IT-642-13, UFI11/03, US12/09 and EHUA12/13. The authors would also like to express their thanks to Pedro José Lozano (UPV/EHU) and Itxaro Latasa (UPV/EHU) for their valuable assistance at survey design of this study.

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Figures

Figure 1. Location of the area of Llanada Alavesa in the Basque Autonomous Community (Spain)

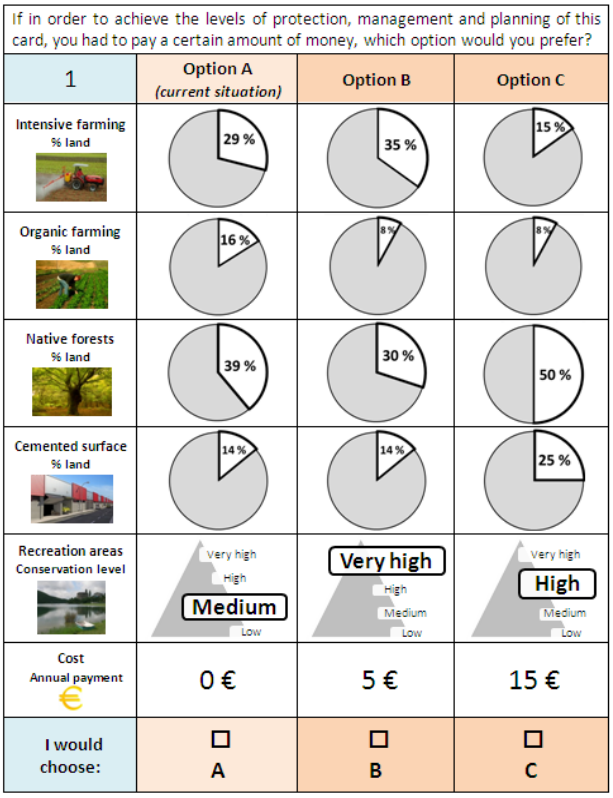

Figure 2. Example of a choice set (translated into English)

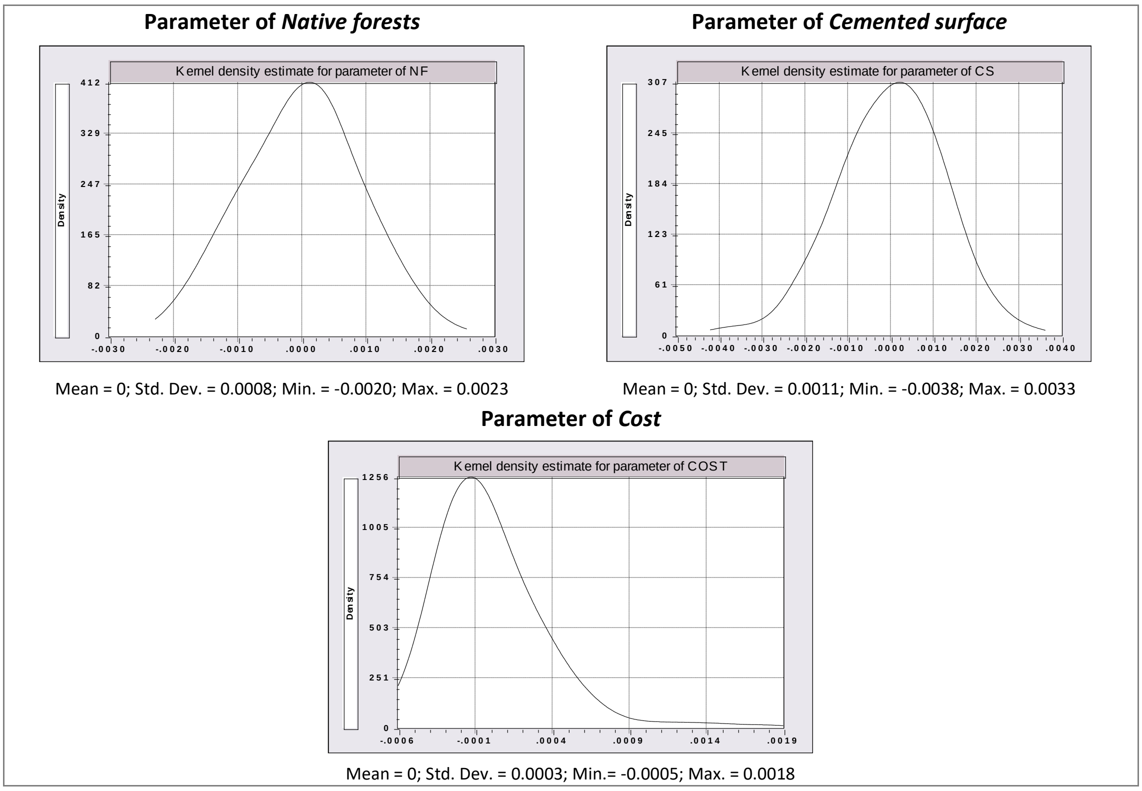

Figure 3. Empirical distributions for 218 individuals derived non-parametrically for three random parameters

Tables

Table 1. Attributes and levels considered in the DCE

Attributes		Levels				
Intensive farming (IF)	% surface 	29%*	20%	15%	35%	
Organic farming (OF)	% surface 	16%*	25%	30%	8%	
Native forests (NF)	% surface 	39%*	45%	50%	30%	
Cemented surface (CS)	% surface 	14%*	16%	20%	25%	
Recreation areas (RA)	Conservation & protection level 	Medium*	Very high	High	Low	
Cost	Annual payment €	€0*	€5	€15	€30	€50

* Levels with an asterisk represent the status quo scenario.

Table 2. Socio-economic variables and summary statistics

Variable	Mean	Std. Dev.	Min.	Max.	Sample	Population values
Age	42.284	14.678	18	76	218	42.2
Gender	0.504	0.500	0	1	218	49.7% (male), 50.3% (female)
Medium income	0.474	0.500	0	1	211	Average disposable personal income = €17,209 per year
No income	0.246	0.431	0	1	211	13.6% (last census of 2011)
Employed	0.544	0.498	0	1	217	63% (occupancy rate)
Unemployed	0.115	0.319	0	1	217	12.2% (unemployment rate)
Higher education	0.188	0.391	0	1	218	10.8%
No education	0.064	0.245	0	1	218	10.2%
Resident	0.762	0.426	0	1	218	79.8%
Low income	0.308	0.462	0	1	211	
Basque identity	0.157	0.363	0	1	217	
High recreation	0.472	0.500	0	1	218	

Table 3. Estimated models

Variable	MNL Coef. (Std. Error)	RPL-1 Coef. (Std. Error)	RPL-2 Coef. (Std. Error)
Native forests	0.036 ***		
	(0.013)		
Intensive farming	0.016	0.014	0.068 ***
	(0.012)	(0.016)	(0.023)
Organic farming	0.056 ***	0.072 ***	0.062 ***
	(0.013)	(0.016)	(0.017)
Cemented surface	0.008		
	(0.017)		
Recreation areas	0.256 ***	0.307 ***	0.293 ***
	(0.043)	(0.047)	(0.078)
Cost	-0.051 ***		
	(0.003)		
ASC1	0.690 ***	1.505 ***	1.570 ***
	(0.123)	(0.134)	(0.143)
ASC2	0.656 ***	1.440 ***	1.488 ***
	(0.118)	(0.132)	(0.141)
Mean of parameter distribution			
Native forests (normal dist.)		0.044 **	0.034 *
		(0.018)	(0.019)
Cemented surface (normal dist.)		-0.015	-0.017
		(0.027)	(0.029)
Cost (lognormal dist.)		-2.487 ***	-2.469 ***
		(0.105)	(0.104)
Std. Deviation of parameter distribution			
Native forests (normal dist.)		0.063 ***	0.062 ***
		(0.014)	(0.015)
Cemented surface (normal dist.)		0.169 ***	0.183 ***
		(0.024)	(0.024)
Cost (lognormal dist.)		1.108 ***	1.091 ***
		(0.087)	(0.087)
Heterogeneity in mean			
Native forests: Basque identity			0.087 ***
			(0.030)
Organic farming: Basque identity			0.093 ***
			(0.022)
Intensive farming: Resident			-0.066 ***
			(0.017)
Recreation areas: Low income			-0.244 **
			(0.101)
Recreation areas: High recreation			0.199 **
			(0.097)
Log-likelihood	-1228.319	-1115.613	-1095.605
AIC	1.890	1.723	1.699
BIC	1.922	1.766	1.763
Pseudo R-squared		0.224	0.237
Respondents	218	218	218
Observations	1308	1308	1308
K	8	11	16

***, **, *: significance at the 1%, 5% and 10% level.
AIC is the "Akaike Information Criterion" and BIC is the "Bayesian Information Criterion" for the selection of models.

Table 4. Simulated WTP based on RPL-2 (€2013/person/year)

Group	*Native forests*	*Intensive farming*	*Organic farming*	*Cemented surface*	*Recreation areas*
Baseline scenario	0.71 (-0.61, 2.45)	1.45 (0.20, 3.23)	1.33 (0.18, 2.96)	0 (-4.17, 4.10)	6.30 (0.86, 13.98)
***Basque identity* = 1**	2.58 (0.20, 6.01)		3.32 (0.45, 7.37)		
***Resident* = 1**		0.03 (0.004, 0.07)			
***Low income* = 1**					1.06 (0.14, 2.35)
***High recreation* = 1**					10.57 (1.44, 23.53)
Mean €/person/year	**1.00** (-0.37, 2.94)	**0.37** (0.05, 0.82)	**1.64** (0.23, 3.65)	**0** (-4.17, 4.10)	**6.75** (1.55, 13.84)

The tenth and ninetieth percentile points of the WTP distributions are in brackets.

Table 5. Alternative management scenarios for the landscapes of Llanada Alavesa

Attributes	Status quo	***Scenario 1*** *Promotion of native forests and organic farming*	***Scenario 2*** *Promotion of intensive farming and cemented surface*	***Scenario 3*** *Promotion of recreation areas and cultural heritage*
Native forests	39%	45% (↑)	30% (↓)	39% (=)
Intensive farming	29%	15% (↓)	35% (↑)	29% (=)
Organic farming	16%	25% (↑)	8% (↓)	16% (=)
Cemented surface	14%	14% (=)	25% (↑)	14% (=)
Recreation areas	Medium	Medium (=)	Medium (=)	Very high (↑)
TOTAL surface	98%	99%	98%	98%

↑/↓: increase/decrease compared with the status quo level; =: equal level.