OPEN ACCESS

RESEARCH ARTICLE

Spanish Journal of Agricultural Research 23 (2)
April-June, 2025, 21502
ISSN-L: 1695-971X, eISSN: 2171-9292
https://doi.org/10.5424/sjar/2025232-21502

Monetary and non-monetary valuation of Mediterranean agricultural landscapes: The case of oak savannah and sloping olive groves

Khin Z. Win[1], Manuel Arriaza[1] and Anastasio J. Villanueva[1,2*]

[1]*Water, Environmental and Agricultural Resources Economics (WEARE) research group, Universidad de Cordoba, E-14071 Córdoba, Spain.*
[2]*Institute of Agricultural and Fisheries Research and Training (IFAPA), E-18004, Granada, Spain.*

***Correspondence** should be addressed to Anastasio J. Villanueva: anastasioj.villanueva@juntadeandalucia.es

Abstract

Aim of study: This study aims to evaluate the public's monetary and non-monetary preferences for agricultural landscapes, focusing on the role of landscape features, especially those influenced by farm management, and respondents' socioeconomic characteristics, attitudes, and opinions about environmental sustainability.

Area of study: Andalusia, southern Spain.

Materials and methods: The study centers on Mediterranean oak savannah (dehesa) and sloping olive groves (SOG), using an online survey administered to a representative sample (N=1931) of the population in southern Spain. Photographic representations of the experimental plots were shown to respondents through best-worst scaling choice experiments to elicit their non-monetary preferences. The analysis is complemented with a contingent valuation question to assess the respondents' willingness to pay for improving agricultural landscapes.

Main results: The results show that preferences regarding the visual quality of agricultural landscapes are significantly influenced by: (i) farm management, with environmentally sustainable farming practices found to be particularly aesthetically appealing; (ii) biotic elements, such as lush green vegetation, dense trees (especially in dehesa landscapes), and diverse tree species, the positive effects of which contrast with the negative effects of the presence of abiotic elements (inert cover, rocks, negative human-made elements); (iii) the alignment of trees, although only in olive groves; (iv) ephemeral elements, especially those related to seasonality and cloud cover; and (v) environmental attitudes and use values (e.g., frequency of visits to agricultural landscapes).

Research highlights: The findings can help inform the design of actions to improve the aesthetic performance of agricultural landscapes. Specifically, the use of an agri-system-specific approach is recommended, focusing on key scenery and ecological elements and certain areas displaying higher use values. This will enable both public (e.g., policy schemes) and private initiatives (e.g., economic diversification and sustainability labeling) to enhance the welfare contribution of agricultural landscapes.

Keywords: choice experiments; contingent valuation; ecosystem services; Mediterranean agricultural systems; stated preference methods.

Valoración monetaria y no monetaria de los paisajes agrarios mediterráneos: el caso de la dehesa y el olivar en pendiente

Resumen

Objetivo del estudio: Este estudio tiene por objeto evaluar las preferencias monetarias y no monetarias de la sociedad por los paisajes agrarios, centrándose en cómo influyen sobre estas preferencias las características del paisaje, especialmente las influenciadas por la gestión de las explotaciones, y las características socioeconómicas, actitudes y opiniones de los encuestados.

Área de estudio: Andalucía, sur de España.

Materiales y métodos: Este estudio se llev**ó** a cabo en el contexto de la sabana mediterránea de encinas (dehesa) y olivares en pendiente, empleando una encuesta online administrada a una muestra representativa (N=1931) de la población andaluza, pacense y ciudadrealeña. Se mostraron a los encuestados, fotografías de las parcelas experimentales mediante experimentos de elección del tipo mejor-peor para obtener sus preferencias no monetarias. El análisis se complementó con una pregunta de valoración contingente para evaluar la disposición a pagar de los encuestados por la mejora de los paisajes agrarios.

Principales resultados: Los resultados muestran que (i) la gestión agraria tiene un impacto significativo en la calidad visual del paisaje y que las prácticas agrarias medioambientalmente sostenibles son estéticamente atractivas para la sociedad, (ii) la presencia de elementos bióticos (vegetación verde exuberante, densidad de arboleda -particularmente en dehesa-, presencia de otras especies de árboles) son significativamente preferidos por los encuestados, en contraste con los elementos abióticos (cubierta inerte, rocas, elementos antropogénicos negativos), (iii) la alineación de los árboles es apreciada especialmente en los cultivos permanentes, (iv) los elementos efímeros, como los efectos estacionales y la nubosidad, influyen en las preferencias de los encuestados, y (v) las actitudes medioambientales y el valor de uso (frecuencia de visitas a los paisajes agrarios) influyen significativamente en la preferencia monetaria por estos paisajes.

Aspectos destacados de la investigación: Los resultados son útiles para diseñar medidas que fomenten un desempeño superior respecto de la calidad visual de los paisajes agrarios, recomendando el uso de enfoques específicos por agrosistema, centrados en elementos paisajísticos y ecológicos clave y en determinadas zonas que muestren valores de uso más significativos. Ello contribuirá a que tanto las medidas públicas (por ejemplo, los programas políticos) como privadas (como la diversificación económica y el etiquetado de sostenibilidad) mejoren la contribución al bienestar de la sociedad por parte de los paisajes agrarios.

Palabras clave: agrosistemas mediterráneos; experimentos de elección; métodos de preferencias declaradas; servicios ecosistémicos; valoración contingente.

Citation: Win, KZ; Arriaza, M; Villanueva, AJ (2025). Monetary and non-monetary valuation of Mediterranean agricultural landscapes: The case of oak savannah and sloping olive groves. Spanish Journal of Agricultural Research, Volume 23, Issue 2, 21502. https://doi.org/10.5424/sjar/2025232-21502

Received: 15/11/2024. **Accepted:** 17/02/2025. **Published:** 09/02/2026.

This article belongs to the Special Issue “Using Experimental Methods in Agricultural and Resource Economics”. https://sjar.revistas.csic.es/index.php/sjar/announcement/view/27

Introduction

Agricultural landscapes provide multiple public-good services that are highly valued by society (Viaggi et al., 2021; Targetti et al., 2022). They serve the ecological infrastructure, contributing to carbon sequestration, habitat provision, nutrient cycling, and erosion prevention, while providing cultural ecosystem services related to aesthetics, recreation, and local food products (Lefebvre et al., 2015). These landscapes can range from semi-natural landscapes with minimal human influence (e.g., extensive permanent grasslands) to highly engineered landscapes (e.g., greenhouses and monoculture farming), resulting from human management decisions about how to produce food and fibers (private goods) in specific natural contexts. The European Landscape Convention recognizes the formative role of humans in its definition of landscapes as “an area as perceived by people whose character is the result of the action and interaction of natural and/or human factors” (Council of Europe, 2000, p. 2).

At the farm level, farmers shape agricultural landscapes through their management decisions about crop mix and inputs (related to soil, fertilization, phytosanitation, irrigation, etc.), and the inclusion, modification or removal of landscape features, including both point elements (e.g., standalone trees, farm facilities, ponds) and linear elements (e.g., hedgerows, stonewalls, ditches) (Villanueva et al., 2018). A complex landscape with a variety of crop and non-crop plant species, such as cover crops, wildflowers, and boundary shrubs, typically enhances the aesthetic quality of the area while also serving as feeding, nesting, and breeding grounds for pollinators (e.g., bees) and natural enemies of pests (e.g., birds) (Landis, 2017). However, in many regions of Europe, farms’ ecological richness is under increasing threat from the dual pressures of intensification and farmland abandonment (Emmerson et al., 2016). Thus, many farms are becoming larger and more intensively managed, while others are abandoning farmland, which facilitates the re-growth of more continuous forest in marginal areas; in both cases, the result is fewer mosaic patterns and less landscape heterogeneity (van Zanten et al., 2014), eventually causing a loss of habitat for various flora and fauna species (Lasanta et al., 2015; Emmerson et al., 2016).

These changes in agricultural landscapes impact the provision of diverse ecosystem services highly valued by society. For instance, according to the Millennium Ecosystem Assessment (2005), the total economic benefits, comprising the sum of use and non-use values, are often found to be greater in more sustainably managed systems than in more intensive ones. Among these values, high preferences are reported for non-market services such as landscape aesthetics (Huber & Finger, 2020). This makes market failure especially likely in the abovementioned land-use scenarios of agricultural intensification and/or farmland abandonment, thus calling for governmental action. Consequently, understanding people’s preferences for farmland landscapes is of paramount importance for landscape planning, agricultural policy formulation, and fostering public engagement with sustainable farming practices.

As indicated by the European Landscape Convention’s definition, landscape is not only defined by the quality of physical objects but also people’s perception of an area of land (Council of Europe, 2000). Various evolutionary and psychological theories have been proposed to explain the impact of physical landscape features on people’s preferences (Cheng, 2007). Prospect-Refuge theory (Appleton, 1975) asserts that humans have an inherent inclination toward an open landscape with isolated trees, where the expansive view offers them the 'prospect' to gather visual information and the trees provide a 'refuge' to seek safety and shelter. The Biophilia hypothesis posed by Wilson (1986) also claims that humans are biologically oriented toward nature and living beings. Kaplan & Kaplan (1989)'s information-processing theory posits that coherence (ordered elements, such as lines of trees) and legibility (directional elements, such as landmarks) facilitate the observer's cognitive processing of the landscape, whereas complexity and mystery encourage exploration and enhance engagement.

While these theories provide a general conceptualization of how landscape features influence people's preference for certain landscapes, empirical studies (predominantly conducted in the European context) provide evidence of the specific influence of some of these features. Regarding landscape elements associated with farming practices, several studies have identified the attributes that people tend to prefer. These include vegetation cover (Arriaza et al., 2004; Schüpbach et al., 2021; Albaladejo-García et al., 2023; Serée et al., 2023), non-crop elements such as hedgerows, farm boundaries, bushes, and woody islets (Junge et al., 2015; Klein et al., 2015; Häfner et al., 2018; Schüpbach et al., 2021), flowers (Junge et al., 2015; Schüpbach et al., 2021; Serée et al., 2023) and grazing animals (Grammatikopoulou et al., 2012; Häfner et al., 2018). However, people tend to disapprove of monocultures and prefer diversified farmland (Arriaza et al., 2004; Parron et al., 2022; Serée et al., 2023). In terms of structural elements, orderliness and linear features seem to be preferred (Campbell, 2007; Häfner et al., 2018; Schüpbach et al., 2021).

Landscape preferences are not solely determined by factors that are intrinsic to the landscape; individual perceptions are the result of holistic thinking, with individuals considering the context when observing elements and connecting their observation to their knowledge and attitudes (Antrop, 2000). Thus, preference heterogeneity arises from factors extrinsic to the landscape related to sociodemographic characteristics and attitudes. Sociodemographic characteristics found to influence landscape preferences include age (Lyons, 1983), occupation or lifestyle (Junge et al., 2011) and education and income, particularly for monetary preferences (Howley et al., 2012). With regard to individuals' attitudes, their environmental value orientations play a key role in shaping their landscape preferences (Kaltenborn & Bjerke, 2002).

The present study aims to contribute to the existing knowledge about landscape-intrinsic and landscape-extrinsic determinants of preferences for agricultural landscapes by combining non-monetary and monetary valuation methods. The specific research objectives are (i) to identify the landscape features that influence people's preferences for agricultural landscapes, with special attention paid to those related to farm management, and (ii) to determine the landscape features and individual characteristics and attitudes that determine monetary preferences for agricultural landscapes. To do so, an innovative approach is applied, combining stated preference methods for both non-monetary and monetary valuation. Diverse methods have been used in the literature on farmland landscape preferences, including choice experiments for monetary (Campbell, 2007; Grammatikopoulou et al., 2012; van Zanten et al., 2016; Schüpbach et al., 2021; Parron et al., 2022; Albaladejo-García et al., 2023) and non-monetary valuation (Häfner et al., 2018), as well as ranking (Arriaza et al., 2004; Serée et al., 2023) and rating methods (Kaltenborn & Bjerke, 2002; Junge et al., 2015; Klein et al., 2015) for non-monetary preference valuation. However, only a few studies have combined non-monetary and monetary valuation; they include that of Sayadi et al. (2009), who use non-monetary conjoint analysis and contingent valuation (CV), and Howley et al. (2012), who combine the analysis of attitudes toward agricultural landscapes with CV. To the best of our knowledge, this study is the first to combine non-monetary and monetary valuation of agricultural landscapes by using best-worst scaling choice experiments and CV, respectively. The analysis is applied to the relevant case study of two Mediterranean agri-systems in Spain.

Material and methods

Case study

The study focuses on the public's preferences for dehesa (Mediterranean oak savannahs) and sloping olive groves (SOG) in Andalusia (southern Spain). These two agricultural systems are two of the most prominent in terms of area, significantly contributing to rural income and employment in the region (CAPADR, 2023). Moreover, they are both iconic agri-systems in the Mediterranean basin (Wolpert et al., 2020).

Dehesa is a traditional agro-silvo-pastoral system characterized by open woodland with scattered trees, predominantly oak species, such as holm oak and cork oak (*Quercus ilex* L. and *Quercus suber* L., respectively), interspersed with grassland. Tree density varies from 10 to 100 trees per hectare. It is primarily utilized for livestock rearing (bovine, swine, ovine, and caprine), cereal cropping, and forest product collection (Garrido et al., 2017). Dehesa farms cover more than 1 million hectares in Andalusia and are especially concentrated in the north and southwest of the region (Figure 1.a).

SOG are one of the predominant olive grove systems, covering approximately 0.5 million hectares in the region. These groves, characterized by plots with an average slope of over 15%, are predominantly rain-fed, with low to moderate tree density (less than 140 trees/ha) (Villanueva et al., 2018). SOG are found in the mountain ranges of Sierras Béticas and Sierra Morena, running from the center of the region to the northeast (Figure 1.b).

These two agri-systems are multifunctional systems associated with a high level of ecosystem service provision (Garrido

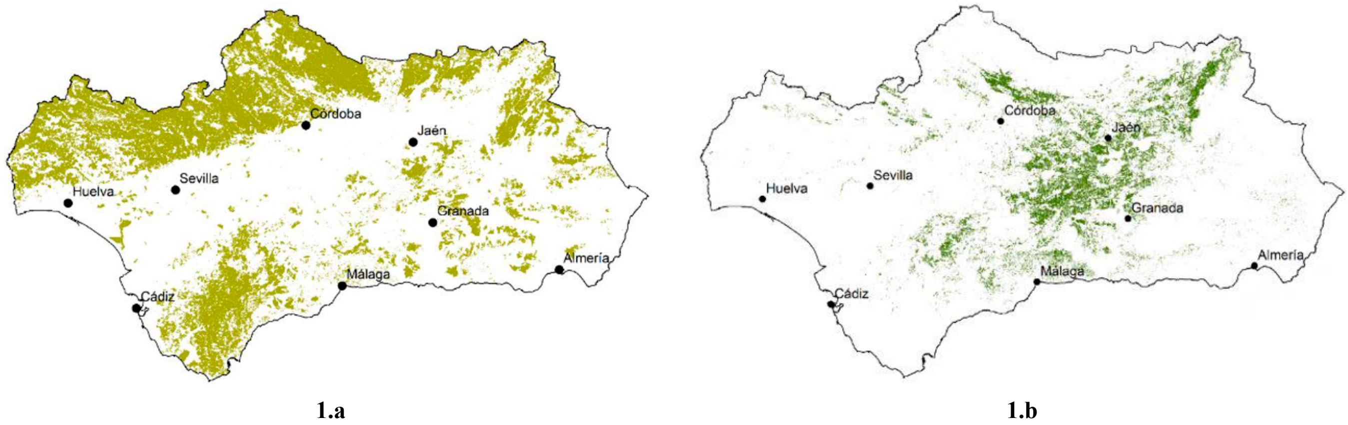

Figure 1. Geographical distribution of dehesa (1.a) and sloping olive groves (1.b) in Andalusia, Spain. Source: Common Agricultural Policy applications, 2023.

et al., 2017; Granado-Díaz et al., 2024). As permanent farmlands with centuries-old trees, these systems have high carbon sequestration capacities. Their relatively extensive farm management, often including the conservation of bushes, other tree and plant species, and vegetation cover, provides habitat for biodiversity. In addition, the aesthetic quality of these traditional landscapes is valued by locals and visitors, boosting the demand for agritourism. Moreover, the animal food products and olive oil produced by these systems play an important role in the region's culinary culture (Arriaza et al., 2009; Garrido et al., 2017). However, these culturally and ecologically high-value landscapes face various threats, such as land abandonment in the case of SOG (Carmona-Torres et al., 2023) and land-use change, increased intensification, and the decline in tree regeneration in the case of dehesa (Garrido et al., 2017). Some areas suffer from both land abandonment and intensification, with these two issues potentially reinforcing each other (Villanueva et al., 2018; Plieninger et al., 2021). The result of these threats is a shift to more simplified landscapes and a consequent further reduction in the provision of cultural (and other) services to levels below what society considers desirable. Problems associated with intensification include over-tilling and over-grazing in SOG and dehesa, respectively; while problems relating to land abandonment include shrub encroachment and early-successional plant establishment (Villanueva et al., 2018; Plieninger et al., 2021). All this underscores the importance of conservation in these agricultural areas, as it is critical for preserving both cultural landscapes and their related ecosystem services.

Information collection

An online survey was conducted in November 2023 and administered to the population aged 18 and above in Andalusia and the neighboring provinces of Badajoz and Ciudad Real, establishing quotas for gender, age, province, and rural/urban residence (N= 1931). A company was hired to administer the survey to a panel of individuals, ensuring the representativeness of the sample based on the aforementioned quotas.

To elicit respondents' preferences, they were shown photographic representations of 12 sample plots (6 SOG and 6 dehesa), which were equally divided into control groups (conventionally managed farms) and treatment groups (sustainably managed farms).[1] The photographs were taken in different seasons (spring, summer, fall, and winter) to capture the seasonal effects. Approximately 30 photographs per plot and seasonal visit were taken by one of the authors using the same transect in each visit. From these images, four were subsequently selected by the authors to be included in the valuation exercises. As a result, a total of 192 photographs were used, with four per plot per season. Landscape elements and attributes in each photo were characterized through group discussions among the researchers.

The survey questionnaire included three parts: best-worst scaling choice experiments, CV questions, and questions about the respondent's socioeconomic status and attitudes toward environmental sustainability. A pilot test involving 76 subjects was conducted in October 2023 to check the questions were suitable and correctly understood. Based on the results of this pilot, some changes were made to the CV and rating questions. Observations of the pilot survey were not included in the final analysis. An English version of the questionnaire is provided as Supplementary Material.

1 The selection of the experimental plots entailed various steps. First, the authors drew up a long list of farms enrolled and not enrolled in agri-environmental schemes (including organic ones), looking for suitable characteristics for the monitoring of environmental services. This study is part of a larger research project involving not only socioeconomic assessments (like this one), but also natural sciences assessments, including measurements of the diversity of species, carbon sequestration, and soil fertility. Second, the list was narrowed down to a few dozen plots in the provinces of Granada, Cordoba, and Jaén, after having contacted the farmers to check availability and accessibility. Finally, these plots were visited by the project research team, resulting in the final selection of 12 plots where all the measurements and photos were taken.

Non-monetary valuation

The best-worst scaling choice experiment method is a stated preference method where respondents choose the best and worst items (in this study, most/least appealing) from a given list in a sequence of choice situations. It is underpinned by the random utility theory, which assumes that the choice of an individual is determined by the comparative utility of different items or options (Louviere et al., 2013). Hence, the 'best' or 'worst' choice reflects the latent utility that the respondents assign to each item (Burton et al., 2021). This method has several proven advantages over other preference elicitation methods, for example, it allows for better preference discrimination, ensures consistency of interpretation, and imposes a lower cognitive burden on respondents (Marley & Louviere, 2005; Louviere et al., 2013).

In this study, respondents were presented with choice cards, each featuring three photos of agricultural landscapes, and asked to choose which photos they found most and least appealing from the three on display in each card. This task was repeated three times for each agri-system case study, so nine different photos (i.e., three trios) were shown for each system. The photos selected for the choice cards were randomized by treatment and control attributes and season. After this, respondents were presented with a fourth choice card for each agri-system, where they were asked to indicate which photo they preferred from the three best photos that they had chosen in the three previous choice cards. This sequence was repeated for SOG and dehesa in random order (i.e., some respondents were first given the four choice cards with photos of SOG, and others were first given the dehesa ones). A sample of the choice tasks used in the survey is shown in Figure 2.

Figure 2. Example of a best-worst scaling choice card.
(Question: Of the following landscapes, which do you like the most and which the least?)

Non-monetary preference data from the best-worst scaling exercises were modeled using binary logistic regression (BLR), employing the 'best' choices as the dependent variables and the elements and attributes of the landscape as independent variables (BLR1 models). BLR1$_{SOG}$ and BLR1$_{dehesa}$ models were used to estimate the respondents' non-monetary preference for SOG and dehesa landscapes, respectively, as follows:

where p_{Best} represents the probability of choosing a certain picture as best, and b are the model coefficients attached to the independent variables (see Table 1 for the description of each variable).

$$BLR1_{SOG}: log\left(\frac{p_{Best}}{1-p_{Best}}\right) = b_0 + b_1 Envima + b_2 Spring + b_3 Summer + b_4 Winter + b_5 Clouds + b_6 Aligned + b_7 Spatialdepth + b_8 Sloping + b_9 Softcontrast + b_{10} Inert + b_{11}\, Othertrees + b_{12} Rocks \quad [1.1]$$

$$BLR1_{dehesa}: log\left(\frac{p_{Best}}{1-p_{Best}}\right) = b_0 + b_1 Envima + b_2 Spring + b_3 Summer + b_4 Winter + b_5 Clouds + b_6 Sloping + b_7 Oldtrees + b_8 Softcontrast + b_9 Inert + b_{10}\, Othertrees + b_{11} Rocks + b_{12} Neg\_humanmade + b_{13} Density \quad [1.2]$$

The models for both non-monetary and monetary valuation were obtained following the same procedure. First, the assumptions were tested using Spearman's correlation coefficient to check for multicollinearity and the Box-Tidwell test for linearity between the log odds of the dependent variable and continuous independent variables. After confirming that the assumptions were met, all the independent variables (i.e., those related to landscape features and respondents' characteristics and attitudes) were individually tested in separate BLR models, along with design variables (sustainable farm management and seasons) in the non-monetary preference model, and with the payment variable in the monetary preference models. This was done to determine their significance in predicting the dependent variables; those that were significant at a 10% level were fitted into the multiple-independent variable model. Stepwise regressions were then performed, and statistically insignificant variables were dropped one by one in each step until only variables that were significant at a 10% level remained.

Table 1. Variables used in the non-monetary preference models (BLR1).

Variable	Description	Measurement	Ratio
Dependent variables			
Best	The photo that was selected as 'best' from the trio included in each choice card	1=Yes, 0=No	0.33
Independent variables (Landscape features)			
Envima	Environmentally managed farm	1=Yes, 0=No	0.58
Spring	Spring	1=Yes, 0=No	0.26
Summer	Summer	1=Yes, 0=No	0.26
Winter	Winter	1=Yes, 0=No	0.24
Clouds	Presence of some clouds	1=Yes, 0=No	0.20
Aligned	Trees or other elements are aligned.	1=Yes, 0=No	0.46
Sloping	Sloping landscape	1=Yes, 0=No	0.67
Spatialdepth	Perception of distance (distant objects can be seen in the photo)	1=Yes, 0=No	0.11
Oldtrees	Presence of mature trees only	1=Yes, 0=No	0.77
Softcontrast	Weak color contrast between the ground and the trees	1=Yes, 0=No	0.41
Inert	Presence of straw, mulch, and other plant residues	1=Yes, 0=No	0.26
Bushes	Presence of bushes	1=Yes, 0=No	0.18
Othertrees	Presence of other tree species	1=Yes, 0=No	0.23
Rocks	Presence of rocks	1=Yes, 0=No	0.20
Animals	Presence of animals	1=Yes, 0=No	0.02
Neg_humanmade	Presence of negative human-made elements (tractor tire marks, powerlines, wire fences, protection for seedlings, warehouses, cars, and roads)	1=Yes, 0=No	0.28
Density	High tree density	1=Yes, 0=No	0.92

Monetary valuation

CV is a widely-used method to estimate the total value of an environmental good, summing use values and non-use values. It quantifies the monetary amount that people are willing to pay for an improvement in welfare or willing to accept for a decline in welfare (Carson et al., 2001). In this study, CV was applied to determine respondents' monetary preference for agricultural landscapes. The following dichotomous CV question was asked: "In the photos of the dehesa [SOG] that you have been shown, you could see that the landscapes were different depending on the selected plot: would you be willing to pay €X per year to make all the dehesa [SOG] landscapes in Andalusia the same as the one that you preferred? (The payment will be made through income taxes.)".[2] The payment vector included the following levels: €2, €6, €10, €14, €18, €22, €26, €30 per year. It was set in line with the results reported by Rodríguez-Entrena et al. (2012) and Granado-Díaz et al. (2018). The payment vehicle used in this case was an addition to the yearly income tax, as is common practice in stated preference methods.

2 As all photos were taken at the same six experimental plots (per agri-system), the fact that each respondent saw different combinations of nine photos (randomly selected from the 96 photos of the experimental plots per agri-system) is not expected to significantly impact the characterization of the status quo among respondents.

The respondents' answers to the CV question for each of the agri-systems are modeled using landscape features ($BLR2_{SOG}$ and $BLR2_{dehesa}$ models) and respondent characteristics and attitudes ($BLR3_{SOG}$ and $BLR3_{dehesa}$ models) as independent variables.

where p_{WTPyes} represents the probability of responding "Yes" to the CV question (variable WTPyes=1), and b are the model coefficients attached to the independent variables (see Table 2 for the description of each variable).

$$BLR2_{SOG}: log\left(\frac{p_{WTPyes}}{1-p_{WTPyes}}\right) = b_0 + b_1Payment + b_2Sloping + b_3Softcontrast \quad [2.1]$$

$$BLR2_{dehesa}: log\left(\frac{p_{WTPyes}}{1-p_{WTPyes}}\right) = b_0+b_1Payment+b_2Softcontrast+b_3Density \quad [2.2]$$

$$BLR3_{SOG}: log\left(\frac{p_{WTPyes}}{1-p_{WTPyes}}\right) = b_0 + b_1Payment + b_2Labels + b_3Apps + b_4Premium + b_5Conshabit + b_6Visit \quad [3.1]$$

$$BLR3_{dehesa}: log\left(\frac{p_{WTPyes}}{1-p_{WTPyes}}\right) = b_0 + b_1Payment + b_2Envawa + b_3Labels + b_4Apps + b_5Premium + b_6Visit \quad [3.2]$$

Table 2. Variables used in the monetary preference models (BLR2 and BLR3).

Variable	Description	Measurement	Ratio
Dependnt variable			
WTPyes	Affirmative response to the CV question about willingness to pay for the maintenance of the respondent's preferred SOG or dehesa landscape	1=Yes, 0=No	0.42
Independent variables (Landscape features)			
Sloping	Sloping landscape	1=Yes, 0=No	0.78
Softcontrast	Weak color contrast between the ground and the trees	1=Yes, 0=No	0.77
Neg_humanmade	Presence of negative human-made elements (tractor tire marks, powerlines, wire fences, protection for seedlings, warehouses, cars, and roads)	1=Yes, 0=No	0.17
Density	High tree density	1=Yes, 0=No	0.99
Independent variables (Monetary Information)			
Payment	The randomly selected amount to pay through annual income tax	€/year	16.01
Independent variables (Respondent's characteristics and attitudes)			
Envawa	Self-assessed environmental awareness	Likert (1-7)[1]	5.15
Labels	Agreement with the statement "Labels on food products should include more information on the sustainability of their production"	Likert (1-7)[2]	5.41
Apps	Agreement with the statement "I would use a mobile application to learn about the environmental and social services associated with the food products I buy"	Likert (1-7)[2]	4.40
Premium	Agreement with the statement "I am willing to pay a slight premium for organic or sustainable products"	Likert (1-7)[2]	4.28
Conshabit	Agreement with the statement "I would be willing to change my consumption habits to reduce the negative impact of agriculture on biodiversity"	Likert (1-7)[2]	5.06
Visits	How often do you visit places with predominantly agricultural landscapes?	Likert (1-6)[3]	3.82

[1] 1:Absolutely unaware – 7:Absolutely aware
[2] 1:Absolutely disagree – 7:Absolutely agree
[3] 1:Never; 2:Once a year; 3:Once every 3 months; 4:Once a month; 5:Once a week; 6:Daily

The descriptions of the variables used in the non-monetary preference valuation models (BLR1) are shown in Table 1. The descriptions of the variables used in the monetary preference models (BLR2 and BLR3) are shown in Table 2. Some independent variables are used in both the BLR1 and BLR2 models, but the values may change due to the different set of photos included for the non-monetary and monetary valuation exercises, respectively.

Qualitative analysis

An analysis based on respondents' qualitative responses was carried out to complement the quantitative analyses comprising non-monetary and monetary valuation exercises. The qualitative analysis was based on the information gathered after the respondent had answered the two pairs of valuation exercises (one pair per agri-system). After the exercises, respondents were asked to select which photo they preferred out of their preferred SOG photo and their preferred dehesa photo. Then, they were asked the following open-ended question: "Can you please describe to us what aspects of the landscape particularly caught your attention to make you prefer that landscape? [up to 1000 characters]". The information gathered was systematically analyzed and the keywords were displayed in a word cloud. This analysis provides further insights to complement the quantitative analyses, helping to confirm their robustness and identify unobservable factors that may influence the respondents' choices.

Results

A total of 2416 completed questionnaires were collected. From these, 1,931 valid questionnaires were selected for the analysis, while 182 incomplete and 48 low-quality responses (failing to pass control questions) were discarded. The rest of invalid responses comprised those filtered to comply with the quotas established for the sample. In the valid questionnaires, a total of 34,758 photos were evaluated in the trios of best-worst scaling experiments (the average number of repetitions per photo was 181) and 1,931 responses were provided to the CV question about the best SOG and dehesa landscapes, with 42% of respondents answering the CV question affirmative. The four most and least liked photos for dehesa and SOG are provided as Supplementary Material (see Figures S1-S4).

Non-monetary valuation

The results of the models for non-monetary valuations are shown in Table 3. Both models ($BLR1_{SOG}$ and $BLR1_{dehesa}$) showed reasonably high statistical power, with Nagelkerke R^2 values of 0.18 and 0.25, respectively. In both agri-systems, environmentally managed farms were significantly more likely to be chosen as the best compared to conventionally managed farms: 2.2 times more likely in SOG and 1.2 times in dehesa (variable Envima). Seasonal effects were also found to be a significant determinant of being chosen as the best photo, though they changed from one agri-system to another, with photos taken in winter being significantly preferred for SOG (variable Winter) and those taken in spring (variable Spring) being significantly preferred for dehesa. However, photos taken in summer (variable Summer) were significantly less likely to be the preferred option for dehesa. Similarly, ephemerality was controlled for using a variable related to cloudiness, with the presence of some clouds (variable Clouds) being positively related to preferences. People preferred the presence of biotic elements in both agri-systems, as shown by the results related to the variables Softcontrast, Othertrees, and Density. In particular, the presence of green herbaceous cover, producing a soft color contrast with the tree canopy (variable Softcontrast), was a significant determinant of preferences in both systems: when it was present, respondents were more likely to choose the photo as the most appealing of the trio on display (2.7 times for SOG and 3.7 times for dehesa). People also significantly preferred a diversity of tree species (Othertrees) on farms, as the likelihood of choosing the photo as the best increases by 1.5 and 3.2 times for SOG and dehesa, respectively. Photos of dehesa farms with a high density of trees were 4.2 times more likely to be chosen as the preferred option than those with scattered trees (Density). In contrast to the general preferences for such elements, abiotic elements were negatively related to the respondents' preferences, as shown by the variables Inert, Rocks, and Neg_humanmade. The photos with inert cover (Inert) and rocks (Rocks) were significantly less likely to be preferred for both agri-systems. Dehesa photos with negative human-made elements (Neg_humanmade) were also less likely to be preferred. Visual layout elements and scope were also found to be significantly related to respondents' preferences, though they seem to be agri-system specific. For instance, tree alignment (Aligned) and long-range visibility (Spatialdepth) increased the likelihood of SOG photos being preferred. However, sloping landscapes (Sloping) were significantly less likely to be preferred for SOG, but more likely for dehesa.

Table 3. Binary logistic regression models (BLR1) for non-monetary valuation, estimating the probability of being selected as the preferred agricultural landscape.

Variables	$BLR1_{SOG}$				$BLR1_{dehesa}$			
	β	Std. Err.	p-value	Odd ratio	β	Std. Err.	p-value	Odd ratio
Envima	0.810***	0.057	0.000	2.248	0.186***	0.064	0.004	1.205
Spring	0.004	0.061	0.948	1.004	0.257***	0.090	0.004	1.293
Summer	-0.032	0.056	0.563	0.968	-0.348***	0.124	0.005	0.706
Winter	0.534***	0.059	0.000	1.706	0.117	0.087	0.181	1.124
Clouds	0.320***	0.049	0.000	1.377	0.180***	0.057	0.002	1.198
Softcontrast	0.991***	0.059	0.000	2.693	1.313***	0.109	0.000	3.717
Othertrees	0.411***	0.041	0.000	1.508	1.172***	0.116	0.000	3.227
Density					1.435***	0.095	0.000	4.200
Oldtrees					-0.218**	0.091	0.017	0.804
Rocks	-0.313***	0.054	0.000	0.731	-0.728***	0.062	0.000	0.483
Inert	-0.372***	0.076	0.000	0.689	-0.472***	0.096	0.000	0.624
Neg_humanmade					-0.156***	0.058	0.007	0.856
Aligned	0.169**	0.066	0.011	1.184				
Sloping	-0.171***	0.066	0.009	0.843	0.251***	0.046	0.000	1.285
Spatialdepth	0.132**	0.052	0.011	1.141				
Constant	-1.651***	0.090	0.000	0.192	-2.661***	0.150	0.000	0.070
Observations				17,379				17,379
Likelihood Ratio Chi-square(p-value)	2360.50*** (p-value<0.000)				3401.65*** (p-value<0.000)			
Nagelkerke R^2				0.176				0.247

*** and ** denote significance at 1% and 5% levels, respectively.

Monetary valuation

The models related to the monetary valuation are shown in Table 4, including landscape features as independent variables ($BLR2_{SOG}$ and $BLR2_{dehesa}$ models), and in Table 5, including respondents' characteristics and attitudes as independent variables ($BLR3_{SOG}$ and $BLR3_{dehesa}$ models). With regard to the models including landscape features, it is firstly worth noting the lower goodness of fit found for these data. Although the likelihood-ratio test was significant at a 0.1% level, the values of the Nagelkerke R^2 (around 0.03) for both models suggest these results should be taken with caution. As expected, the likelihood of respondents answering "Yes" to the CV question decreased as the payment increases (at a rate of -3% per €1 increase, consistent across agri-systems and models -also for BLR3). The effect on willingness to pay seems to be agri-system specific. For SOG, respondents were significantly more likely to be willing to pay for their preferred landscapes when they were sloping (Sloping), contradicting the result for the non-monetary valuation, and when they contained expansive green vegetation cover (Softcontrast). However, for dehesa, the latter was found less appealing (also contrasting with the results from the non-monetary preference models), while tree density (Density) significantly increased the likelihood of respondents being willing to pay.

The models including respondents' characteristics and attitudes (Table 5) showed much higher goodness of fit (likelihood-ratio test significant at a 0.01 level and Nagelkerke R^2 of 0.18). It is worth noting that most of the independent variables related to respondents that were found to be significant determinants of willingness to pay were attitudinal (variables Envawa, Labels, Apps, and Premium) or related to habits (variables Conshabit and Visits), whereas none of the sociodemographic variables (Women, Age, Edu, Low_income, Rural resident) turned out to be significant. With regard to attitudes and opinions, the likelihood of being willing to pay to enhance agricultural landscapes significantly increased if the respondent agrees with paying a premium for organic or sustainable products (Premium), was willing to use an app to learn more about the environmental and social services of their food purchases (Apps), or was more environmentally aware (Envawa), though the latter was only found to be significant for dehesa landscapes. Conversely, respondents who thought food labels should include more information on the sustainability of their production (Labels) were less likely to be willing to pay. With regard to habits, the willingness to pay increased as respondents visit agricultural landscapes more frequently (Visits), and it also increased for respondents who were willing to change their consumption habits to prevent negative impacts on biodiversity (Conshabit, just for SOG).

Table 4. Binary logistic regression models (BLR2) for monetary valuation, estimated by landscape characteristics.

Variables	BLR2$_{SOG}$				BLR2$_{dehesa}$			
	β	Std. Err.	p-value	Odd ratio	β	Std. Err.	p-value	Odd ratio
Payment	-0.027***	0.005	0.000	0.973	-0.031***	0.005	0.000	0.969
Density					1.016***	0.386	0.009	2.761
Sloping	0.679***	0.240	0.005	1.972				
Softcontrast	0.196*	0.102	0.053	1.217	-0.311*	0.173	0.073	0.733
Constant	-0.748***	0.239	0.002	0.473	-0.441	0.418	0.292	0.643
Observations				1,931				1,931
Likelihood Ratio Chi-squared (p-value)	46.31*** (p-value<0.000)				48.82*** (p-value<0.000)			
Nagelkerke R^2				0.032				0.033

***, **, and * denote significance at 1%, 5%, and 10% levels, respectively.

Table 5. Binary logistic regression models (BLR3) for monetary valuation related to respondents' characteristics and attitudes.

Variables	BLR3$_{SOG}$				BLR3$_{dehesa}$			
	β	Std. Err.	p-value	Odd ratio	β	Std. Err.	p-value	Odd ratio
Payment	-0.031***	0.006	0.000	0.970	-0.034***	0.005	0.000	0.966
Premium	0.406***	0.042	0.000	1.501	0.390***	0.039	0.000	1.476
Apps	0.104***	0.039	0.007	1.110	0.134***	0.038	0.000	1.144
Envawa					0.108**	0.043	0.012	1.114
Labels	-0.102**	0.046	0.025	0.903	-0.077*	0.042	0.069	0.926
Visits	0.120***	0.034	0.000	1.127	0.084**	0.034	0.015	1.087
Conshabit	0.091*	0.047	0.054	1.095				
Constant	-2.566***	0.276	0.000	0.077	-2.441***	0.286	0.000	0.087
Observations			1,931				1,931	
Likelihood Ratio Chi-squared (p-value)	275.16*** (p-value<0.000)				287.58*** (p-value<0.000)			
Nagelkerke R^2			0.180				0.185	

***, **, and * denote significance at 1%, 5%, and 10% levels, respectively.

Qualitative analysis

Figure 3 is a word cloud depicting the results of the qualitative analysis about the landscape aspects that particularly caught the respondents' attention in their preferred photo. The larger the font of the words, the more times they appear in the answers written by respondents explaining the aspects that determine their landscape preferences. In keeping with the results of the quantitative analysis, the most influential landscape features determining respondents' preferences were the presence of green vegetation cover (1,118 repetitions of related terms such as green cover, vegetation, greenery, etc.), naturalness (133), biologically diversified environment (89), tree density (77), and the slope of the land (38). Regarding structural elements, besides tree alignment (24), the respondents also looked for other attributes such as spacing (25) and overall layout of the farm (13). Interestingly, it was not only the tangible landscape features that appealed to respondents; some of them also connected the visual quality of landscapes with emotional values (83), such as enjoyment, sentiment, familiarity, nostalgia, and tranquility. Albeit to a much lesser extent, respondents also referenced practical factors, such as workability (13), accessibility (3), and firebreaks (2).

Figure 3. Word cloud of landscape aspects that have the greatest influence on respondents' choice of the most appealing photo (qualitative analysis).

Discussion

Landscape characteristics shaping non-monetary preferences

The results of the non-monetary preference models suggest that farm management has a critical influence on a person's preferences for agricultural landscapes. Many variables under the farmers' control to varying degrees proved to be significant. They include the type of farm management, tree alignment, density of trees and conservation or removal of vegetation cover, other tree species, inert cover, negative human-made elements, and rocks. This finding clearly underscores the considerable power of farmers' decisions in shaping the aesthetic appeal of agricultural landscapes.

In general, people appreciate sustainably managed farms significantly more than they do conventional farms. In terms of specific farm management practices, the presence of green herbaceous vegetation cover, which causes the soft color contrast between the ground and the trees, is a particularly valued attribute in people's choice of agricultural landscapes. This finding is consistent with previous research which demonstrates that people prefer farm landscapes with herbaceous cover to those with exposed bare soil (Arriaza et al., 2004; Rodríguez-Entrena et al., 2017; Schüpbach et al., 2021; Serée et al., 2023). People are also attracted to other biotic elements, such as higher density of trees and diversity of tree species. Prior studies have also shown that respondents dislike fields with a homogeneous appearance (Serée et al., 2023), whereas they like the presence of point elements on farms, such as groups of trees, single bushes, and single trees (Häfner et al., 2018). In contrast, there is less of a preference for the presence of abiotic elements, which can also be influenced by the farmers' management decisions, such as inert cover, rocks, and negative human-made elements. Regarding the first of these elements, a similar result was observed in the study of Junge et al. (2015), in which the greenish-brown color of cut meadows was rated low in visual quality.

Theoretically, the preference for natural and biotic elements is consistent with the biophilia hypothesis, which posits that humans are biologically inclined toward nature and other living beings (Wilson, 1986). This alignment of people's preferences with sustainable farm management and natural vegetation makes intuitive sense as these attributes accommodate biodiversity and other ecosystem services, such as soil erosion prevention and carbon sequestration.

Visual layout factors also play a role in shaping landscape preferences. The visible alignment of trees, a factor that is under farmers' control, is appreciated in olive landscapes. It can be explained by humans' innate preference for symmetry and repetition (Chen et al., 2011). It is also aligned with Kaplan and Kaplan's information-processing theory, which posits that people enjoy a sense of coherence and legibility (Kaplan & Kaplan, 1989). Previous studies have proved that linear elements (Häfner et al., 2018) and orderliness (Campbell, 2007; Schüpbach et al., 2021) are the traits that people prefer in an agricultural landscape. On the other hand, the effect of alignment is not significant in the dehesa system. This might well be explained by the unique nature of the dehesa system, which is characterized by scattered oak trees in a savannah-like landscape. However, there is another possibility that cannot be ruled out: diverging, agri-system dependent (cultural) perceptions about what the landscape should look like may also drive the heterogeneity in preferences for these factors, as suggested in the literature (Junge et al., 2011; Byg et al., 2017).

Other factors beyond the farmers' control that prove to be significant determinants of respondents' preferences for agricultural landscapes are location effects (such as spatial depth and slope) and ephemeral components (such as seasonality and cloudiness). While the latter have been extensively identified as determinants of landscape preferences (Junge et al., 2015; Nekhay & Arriaza, 2016; Tasser et al., 2023), the results for the former require a closer look. For instance, the finding that people prefer landscapes with far-off horizons (Spatialdepth) to ones with closer, more confined vistas can be interpreted through the lens of the information-processing theory (Kaplan & Kaplan, 1989). The depth of the landscape adds layers to the vista, thus enhancing its complexity, while distant horizons stimulate observers' exploratory impulses and keep them engaged with the landscape. The mixed results with regard to the landscape slope, differing between agri-systems and valuation exercises, do not shed particular light on what seems to be an inconclusive matter. In this sense, for instance, Sayadi et al. (2009) find the strongest public's preferences for intermediate levels of slope while Campbell (2007) observes a general preference for mountain agricultural landscapes. Clearly, further investigation is needed to understand the impact of slopes on agricultural landscape preferences.

Monetary preferences: factors and use values

The results show that monetary preferences for agricultural landscapes are mainly shaped by factors beyond physical landscape features, such as respondents' socioeconomic and cultural background, lifestyle, and environmental consciousness. Contrary to the results for monetary preferences relating to landscape features, the results of the monetary preference models relating to respondents' characteristics and attitudes are more robust, as shown by the higher goodness of fit and the larger number of variables found to be significant. This is not surprising: as people have to make trade-offs between money and desirable environmental outcomes, many variables related to both come into play. Interestingly, the results point to the importance of respondents' attitudes toward the environment, together with values stemming from the actual 'use' of the landscape, as determinants of willingness to pay for the improved visual quality of agricultural landscapes, while sociodemographic variables (including gender, age, etc.) seem to play a weaker role. This partly contradicts previous studies which find that age (Lyons, 1983), education and income (Howley et al., 2012) are factors determining landscape preferences. However, it is in line with Kaltenborn & Bjerke (2002), who demonstrate the significance of environmental attitudes for landscape preference, where people's perceptions, attitudes, and beliefs are at the center of the notion of landscape aesthetics, agricultural or otherwise. Each kind of variable identified as significant is discussed further below.

It is observed that attitudes toward sustainability practices are strong determinants of willingness to pay for agricultural landscapes. Higher environmental awareness, willingness to learn about the environmental and social services associated with food products purchased, willingness to pay a premium for organic and sustainable products, and readiness to change consumption habits to reduce the negative impact of agriculture on biodiversity are positively related to the probability of supporting an additional income tax to enhance agricultural landscapes. All this is in line with previous findings showing that pro-environmental attitudes and intentions are determinants of willingness to pay for agricultural landscapes (Torres-Miralles et al., 2017). However, we found a counterintuitive result with regard to people's preferences for labeling information about the sustainability of agri-systems: respondents' agreement with the statement that food labels should include more information on production sustainability was found to have a negative relationship with willingness to pay. One possible interpretation is that this result is connected to labeling saturation (Villanueva et al., 2025), though we recognize that this question is open for further investigation.

In the comparison of the two agri-systems, the results suggest that the intensity of monetary preference depends on the agri-system. Using the results of the monetary preference models, the willingness to pay for the preferred landscapes can be derived following Haneman (1984). The willingness to pay for improved agricultural landscapes shows a significant difference for SOG and dehesa, with calculations showing that respondents would be willing to pay €8/year to improve dehesa landscapes, but almost nothing for SOG. The heterogeneity in the willingness to pay for agricultural landscapes as a result of diverse agri-systems has previously been evidenced by Parron et al. (2022) and Albaladejo-García et al. (2023). In their study, such heterogeneity is related to the level of farming intensification, diversification, and naturalness, while here we show that even for similar (low) intensification levels, preferences can be heterogeneous depending on the agri-system. In addition, regardless of the agri-system, we also show a significant role of the use values, as indicated by the results for the variable Visits. In particular, the results show that frequent visitors to agricultural landscapes have a higher willingness to pay for their preferred SOG and dehesa landscapes. In keeping with the studies by LaRiviere et al. (2014), Rodríguez-Entrena et al. (2017), and Villanueva et al. (2021) this relationship was significant in all models, confirming that people who hold use values for farmland landscapes are more willing to pay for their conservation than non-users.

Non-monetary vs monetary landscape valuation

While results for monetary and non-monetary valuations should be aligned to some extent, differences may arise when changing from non-monetary to monetary preferences (where effects related to income, hypothetical bias, etc. may appear); for example, the different information cues (more information is used for the non-monetary preference models) may drive the differences between them. In this respect, it is worth recalling that the monetary preference models use a different set of pictures;

that is, for each agricultural system, the monetary analysis is based on the single best picture selected from the best of each trio shown in the three choice cards, whereas the non-monetary models use the information from all three trios. That said, evidence from the monetary valuation exercise on the influence of landscape features on people's preferences is weaker than that from the non-monetary valuation. Far fewer landscape features are identified as determinants of preference, with the density of trees being the only variable that is significant in both monetary and non-monetary preference models, indicating its critical role in shaping agroforestry landscape preferences. However, the monetary valuation exercise allows us to expand on the results of the non-monetary one with regard to the role of the specific agri-system in driving people's preferences for agricultural landscapes. In particular, the results of the willingness to pay analysis hint at a systematic preference for dehesa landscapes over olive groves, also identifying certain system-specific aspects such as color contrast (which is also found to be a significant determinant of non-monetary preferences). This preference heterogeneity may derive from different cultural values attached to the agri-systems (Byg et al., 2017) and diverse perceptions about their provision of ecosystem services (Granado-Díaz et al., 2022), though it is clearly a matter that requires further research.

Policy implications

A number of relevant policy implications can be drawn from the findings. First, the farmers' key role in shaping the visual quality of agricultural landscapes firmly supports the use of agricultural policies to incentivize the presence of positive features (green cover, trees, etc.) and the absence of negative ones (visible powerlines, wire fences, etc.). However, the results suggest that there would be stronger social justification for a policy program focused on the visual quality of agricultural landscapes if it was targeted at a certain agri-system (dehesa) and/or certain areas (e.g., those where use values are expected to be higher; specifically, SOG or dehesa areas closer to densely populated areas). For the case of the former, respondents' estimated willingness to pay of €8/year would yield an aggregate value of €69 million, based on the adult population of 8.65 million in Andalusia. This figure should be seen as a budgetary upper threshold for the potential implementation of such a program. In addition, from the private sector perspective, the results hint at the possibility of making use of market opportunities to valorize the provision of these cultural services, especially in dehesa-based agribusinesses. This includes communicating the provision of these services to the consumer through labeling information (Villanueva et al., 2021) and developing business diversification strategies (Martínez-García et al., 2024), in particular those related to agritourism (Schaller et al., 2018).

Limitations and further research

It is worth acknowledging the limitations of the study. First, this study focuses solely on individual landscape elements and their impact on respondents' preferences for the visual quality of landscapes. However, interaction effects between elements are likely to play a role in these preferences, as suggested by the qualitative analysis. There is thus a need for further research to better understand the impact of the combined effects of several elements on landscape preferences. In particular, we would expect to find interaction effects for elements that not only enhance visual attractiveness but also provide environmental services such as carbon sequestration or biodiversity, as suggested in the correlations found by Parron et al. (2022). In this regard, 70% of the surveyed respondents stated that they were considering more services than merely aesthetics when answering the CV question. In addition, as hinted at above, the study lacks a spatially explicit analysis to better support the identification of hotspots for policy implementation. Future studies should make use of spatially-specific analyses based on areas where policies are expected to deliver higher social net benefits. In this sense, as suggested by Glenk et al. (2020) and Granado-Díaz et al. (2020), these analyses should not be restricted to distance-based models but should extend more broadly to area-based or density-based models accounting for welfare discounting effects. Third, the study may be subject to the usual biases that can arise in stated preference valuations (Bateman & Willis, 2001). The study design incorporated a number of measures to minimize any such biases: for example, using a single-dichotomous CV question to reduce strategic bias; ensuring sample representativeness to minimize self-selection bias, a result reinforced by a low abandonment rate (7.5%) when completing the questionnaire; the use of an online survey collecting information about pro-environmental attitudes and the avoidance of "good" and "bad" alternatives to control for social desirability bias, among others. However, the novelty of the study design—a combination of best-worst scaling choice experiments with a CV question for an alternative chosen by the respondent in a hypothetical setting—calls for more in-depth analysis of the potential biases that may arise in these combined approaches.

Conclusions

This study investigates monetary and non-monetary preferences for agricultural landscapes, focusing on SOG and dehesa agroforestry systems. It investigates the impact of farm management practices on people's landscape preferences, identifies specific landscape features that capture these preferences, and examines the individual features that determine the monetary value placed on agricultural landscapes.

To summarize the findings, preferences regarding the visual quality of agricultural landscapes are significantly influenced by:

(i) farm management, with environmentally sustainable farming practices found to be particularly aesthetically appealing; (ii) biotic elements, such as lush green vegetation, dense trees (especially in dehesa landscapes), and diverse tree species, the positive effects of which contrast with the negative effects of the presence of abiotic elements (mulch, rocks, negative human-made elements); (iii) the alignment of trees, just in olive groves; (iv) ephemeral elements, especially those related to seasonality and cloud cover; and (v) environmental attitudes and use values (e.g., frequency of visits to agricultural landscapes).

Since many landscape features under farmers' control have proven to be appealing to the public, the results emphasize the role of farmers' management decisions in enhancing the visual quality of the landscape. They also underscore farmers' role in contributing to societal well-being by providing important ecological benefits. This convergence of public preferences and ecological values supports the promotion of sustainable practices. In particular, the findings of this study can help design actions aimed at improving the aesthetic performance of agricultural landscapes. Specifically, the use of an agri-system-specific approach is recommended, focusing on key scenery and ecological elements and certain areas displaying higher use values. This will enable both public (e.g., policy schemes) and private initiatives (e.g., economic diversification and sustainability labeling) to enhance the welfare contribution of agricultural landscapes as a whole.

Supplementary material (Figures S1, S2, S3 and S4; and Questionnaire): accompanies the paper on SJAR's website.

Acknowledgements: The authors gratefully acknowledge funding support from the Spanish State Research Agency (PID2019-107693RR-C21/AEI/10.13039/501100011033).

Competing interests: The authors have declared that no competing interests exist.

Authors' contributions: Khin Z. Win: Conceptualization, Data curation, Formal analysis, Writing – original draft, Writing – review & editing. **Manuel Arriaza:** Investigation, Methodology, Resources, Validation, Writing – original draft, Writing – review & editing. **Anastasio J. Villanueva:** Conceptualization, Data curation, Funding acquisition, Investigation, Methodology, Project administration, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing.

Funding:

Funding agencies/institutions	Project / Grant
Spanish State Research Agency	PID2019-107693RR-C21/AEI/ 10.13039/501100011033

References

Albaladejo-García JA, Zabala JA, Alcon F, Dallimer M, Martínez-Paz JM, 2023. Integrating socio-spatial preference heterogeneity into the assessment of the aesthetic quality of a Mediterranean agricultural landscape. Landsc Urban Plan 239: 104846. https://doi.org/10.1016/j.landurbplan.2023.104846

Antrop M, 2000. Background concepts for integrated landscape analysis. Agric Ecosyst Environ 77(1-2): 17-28. https://doi.org/10.1016/S0167-8809(99)00089-4

Appleton J, 1975. The experience of landscape. John Wiley & Sons, London, UK. 296 pp.

Arriaza M, Cañas-Ortega JF, Cañas-Madueño JA, Ruiz-Aviles P, 2004. Assessing the visual quality of rural landscapes. Landsc Urban Plan 69 (1): 115-125. https://doi.org/10.1016/j.landurbplan.2003.10.029

Arriaza M, Gomez-Limon JA, Kallas Z, Nekhay O, 2009. Demand for non-commodity outputs from mountain olive groves. Agric Econ Rev 9(1): 5-23.

Bateman IJ, Willis KG (ed), 2001. Valuing environmental preferences: Theory and practice of the contingent valuation method in the US, EU, and developing countries. Oxford University Press, Oxford, UK. 668 pp.

Burton N, Burton M, Fisher C, Peña PG, Rhodes G, Ewing L, 2021. Beyond Likert ratings: Improving the robustness of developmental research measurement using best–worst scaling. Behav Res Methods 53: 2273-2279. https://doi.org/10.3758/s13428-021-01566-w

Byg A, Martin-Ortega J, Glenk K, Novo P, 2017. Conservation in the face of ambivalent public perceptions–The case of peatlands as 'the good, the bad and the ugly'. Biol Conserv 206: 181-189. https://doi.org/10.1016/j.biocon.2016.12.022

Campbell D, 2007. Willingness to pay for rural landscape improvements: Combining mixed logit and random-effects models.

J Agric Econ 58(3): 467-483. https://doi.org/10.1111/j.1477-9552.2007.00117.x

CAPADR, Consejería de Agricultura Pesca y Desarrollo Rural, 2023. The agrarian and fisheries sector in Andalusia. CAPADR, Sevilla.

Carmona-Torres C, Parra-López C, Sayadi S, Reina-Usuga L, 2023. Abandonment factors and alternatives in sloping olive growing: The case of Andalusia, Spain. Land Use Policy 132: 106836. https://doi.org/10.1016/j.landusepol.2023.106836

Carson RT, Flores NE, Meade NF, 2001. Contingent valuation: controversies and evidence. Environ Resour Econ 19: 173-210. https://doi.org/10.1023/A:1011128332243

Chen CC, Wu JH, Wu CC, 2011. Reduction of image complexity explains aesthetic preference for symmetry. Symmetry 3(3): 443-456. https://doi.org/10.3390/sym3030443

Cheng CK, 2007. Understanding visual preferences for landscapes: An examination of the relationship between aesthetics and emotional bonding. Doctoral thesis. Texas A&M University.

Council of Europe, 2000. European Landscape Convention. European Treaty Series No. 176. Council of Europe, Florence, Italy.

Emmerson M, Morales MB, Oñate JJ, Batary P, Berendse F, Liira J, Aavik T, Guerrero I, Bommarco R, Eggers S et al., 2016. How agricultural intensification affects biodiversity and ecosystem services. Adv Ecol Res 55: 43-97. https://doi.org/10.1016/bs.aecr.2016.08.00

Garrido P, Elbakidze M, Angelstam P, Plieninger T, Pulido F, Moreno G, 2017. Stakeholder perspectives of wood-pasture ecosystem services: A case study from Iberian dehesas. Land Use Policy 60: 324-333. https://doi.org/10.1016/j.landusepol.2016.10.022

Glenk K, Johnston RJ, Meyerhoff J, Sagebiel J, 2020. Spatial dimensions of stated preference valuation in environmental and resource economics: Methods, trends and challenges. Environ Resour Econ 75: 215-242. https://doi.org/10.1007/s10640-018-00311-w

Grammatikopoulou I, Pouta E, Salmiovirta M, Soini K, 2012. Heterogeneous preferences for agricultural landscape improvements in southern Finland. Landsc Urban Plan 107(2): 181-191. https://doi.org/10.1016/j.landurbplan.2012.06.001

Granado-Díaz R, Colombo S, Romero-Varo M, Villanueva AJ, 2024. Farmers' attitudes toward the use of digital technologies in the context of agri-environmental policies. Agri Syst 221: 104129. https://doi.org/10.1016/j.agsy.2024.104129

Granado-Díaz R, Gómez-Limón JA, Rodríguez-Entrena M, Villanueva AJ, 2020. Spatial analysis of demand for sparsely located ecosystem services using alternative index approaches. Eur Rev Agric Econ 47(2): 752-784. https://doi.org/10.1093/erae/jbz036

Granado-Díaz R; Gómez-Limón JA, Villanueva AJ, 2022. Spatial discounting in food products from high natural-value agroecosystems. Span J Agric Res 20(4): e0106. https://doi.org/10.5424/sjar/2022204-18480

Granado-Díaz R, Villanueva AJ, Gómez-Limón JA, Rodríguez-Entrena M, 2018. Análisis de la heterogeneidad de la demanda de bienes públicos procedentes del olivar de montaña en Andalucía. ITEA-Inf Tec Econ Agrar 114(2): 158-182. https://doi.org/10.12706/itea.2018.011

Hanemann WM, 1984. Welfare evaluations in contingent valuation experiments with discrete responses. Am J Agric Econ 66: 332-341. https://doi.org/10.2307/1240800

Häfner K, Zasada I, van Zanten BT, Ungaro F, Koetse M, Piorr A, 2018. Assessing landscape preferences: A visual choice experiment in the agricultural region of Märkische Schweiz, Germany. Landsc Res 43(6): 846-861. https://doi.org/10.1080/01426397.2017.1386289

Howley P, Hynes S, Donoghue CO, 2012. Countryside preferences: Exploring individuals' willingness to pay for the conservation of the traditional farm landscape. Landsc Res 37(6): 703-719. https://doi.org/10.1080/01426397.2011.637619

Huber R, Finger R, 2020. A meta-analysis of the willingness to pay for cultural services from grasslands in Europe. J Agric Econ 71(2): 357-383. https://doi.org/10.1111/1477-9552.12361

Junge X, Lindemann-Matthies P, Hunziker M, Schüpbach B, 2011. Aesthetic preferences of non-farmers and farmers for different land-use types and proportions of ecological compensation areas in the Swiss lowlands. Biol Conserv 144(5): 1430-1440. https://doi.org/10.1016/j.biocon.2011.01.012

Junge X, Schüpbach B, Walter T, Schmid B, Lindemann-Matthies P, 2015. Aesthetic quality of agricultural landscape elements in different seasonal stages in Switzerland. Landsc Urban Plan 133: 67-77. https://doi.org/10.1016/j.landurbplan.2014.09.010

Kaltenborn BP, Bjerke T, 2002. Associations between environmental value orientations and landscape preferences. Landsc Urban Plan 59(1): 1-11. https://doi.org/10.1016/S0169-2046(01)00243-2

Kaplan R, Kaplan S, 1989. The experience of nature: A psychological perspective. Cambridge university press, Cambridge, UK. 368 pp.

Klein LR, Hendrix WG, Lohr VI, Kaytes JB, Sayler RD, Swanson ME, Elliot WJ, Reganold JP, 2015. Linking ecology and aesthetics in sustainable agricultural landscapes: Lessons from the Palouse region of Washington, U.S.A. Landsc Urban Plan 134: 195-209. https://doi.org/10.1016/j.landurbplan.2014.10.019

Landis DA, 2017. Designing agricultural landscapes for biodiversity-based ecosystem services. Basic Appl Ecol 18: 1-12. https://doi.org/10.1016/j.baae.2016.07.005

LaRiviere J, Czajkowski M, Hanley N, Aanesen, M, Falk-Petersen J, Tinch D, 2014. The value of familiarity: Effects of knowledge and objective signals on willingness to pay for a public good. J Environ Econ Manag 68(2): 376-389. https://doi.org/10.1016/j.jeem.2014.07.004

Lasanta T, Nadal-Romero E, Arnáez J, 2015. Managing abandoned farmland to control the impact of re-vegetation on the environment. The state of the art in Europe. Environ Sci Policy 52: 99-109. https://doi.org/10.1016/j.envsci.2015.05.012

Lefebvre M, Espinosa M, Gomez y Paloma S, Paracchini ML, Piorr A, Zasada I, 2015. Agricultural landscapes as multi-scale public good and the role of the Common Agricultural Policy. J Environ Plan Manag 58(12): 2088-2112. https://doi.org/10.1080/09640568.2014.891975

Louviere J, Lings I, Islam T, Gudergan S, Flynn T, 2013. An introduction to the application of (case 1) best–worst scaling in marketing research. Int J Res Mark 30(3): 292-303. https://doi.org/10.1016/j.ijresmar.2012.10.002

Lyons E, 1983. Demographic correlates of landscape preference. Environ Behav 15(4): 487-511. https://doi.org/10.1177/0013916583154005

Marley AA, Louviere JJ, 2005. Some probabilistic models of best, worst, and best–worst choices. J Math Psychol 49(6): 464-480. https://doi.org/10.1016/j.jmp.2005.05.003

Martínez-García V, Zabala JA, Albaladejo-García JA, López-Becerra EI, Sánchez-Navarro V, Sánchez-Navarro JL, Boix-Fayos C, Martínez-Paz JM, Alcon F, 2024. Selection of incentives for a business strategy based on crop diversification. Span J Agric Res 22(3), e0104. https://doi.org/10.5424/sjar/2024223-20967

Millennium Ecosystem Assessment, 2005. Ecosystems and Human Well-being: Synthesis. Island Press, Washington, DC. 155 pp.

Nekhay O, Arriaza M, 2016. How attractive is upland olive groves landscape? Application of the analytic hierarchy process and GIS in southern Spain. Sustainability 8(11): 1160. https://doi.org/10.3390/su8111160

Parron L, Villanueva AJ, Glenk K, 2022. Estimating the value of ecosystem services in agricultural landscapes amid intensification pressures: The Brazilian case. Ecosyst Serv 57: 101476. https://doi.org/10.1016/j.ecoser.2022.101476

Plieninger T, Flinzberger L, Hetman M, Horstmannshoff I, Reinhard-Kolempas M, Topp E, Moreno G, Huntsinger L, 2021. Dehesas as high nature value farming systems: A social-ecological synthesis of drivers, pressures, state, impacts, and responses. Ecol Soc 26(3): 23. https://doi.org/10.5751/ES-12647-260323

Rodríguez-Entrena M, Colombo S, Arriaza M, 2017. The landscape of olive groves as a driver of the rural economy. Land Use Policy 65: 164-175. https://doi.org/10.1016/j.landusepol.2017.03.017

Sayadi S, González-Roa MC, Calatrava-Requena J, 2009. Public preferences for landscape features: The case of agricultural landscape in mountainous Mediterranean areas. Land Use Policy 26(2): 334-344. https://doi.org/10.1016/j.landusepol.2008.04.003

Schaller L, Targetti S, Villanueva AJ, Zasada I, Kantelhardt J, Arriaza M, Bal T, Fedrigotti VB, Giray FH, Häfner K, et al., 2018. Agricultural landscapes, ecosystem services and regional competitiveness – Assessing drivers and mechanisms in nine European case study areas. Land Use Policy 76: 735-745. https://doi.org/10.1016/j.landusepol.2018.03.001

Schüpbach B, Weiß SB, Jeanneret P, Zalai M, Szalai M, Frör O, 2021. What determines preferences for semi-natural habitats in agrarian landscapes? A choice-modelling approach across two countries using attributes characterising vegetation. Landsc Urban Plan 206: 103954. https://doi.org/10.1016/j.landurbplan.2020.103954

Serée L, Legras S, Chiron F, Valantin-Morison M, Gardarin A, 2023. People prefer arable fields and flower strips with continuous soil cover and diversified vegetation. Ecol Soc 28(2):9. https://doi.org/10.5751/ES-14098-280209

Targetti S, Marconi V, Raggi M, Piorr A, Villanueva AJ, Häfner K, Kurttila M, Letki N, Mihai C, Nikolov D, et al., 2022. Provision of public goods and bads by agriculture and forestry. An analysis of stakeholders' perception of factors, issues and mechanisms. Bio-based Appl Econ 11(4): 351-371. https://doi.org/10.36253/bae-12843

Tasser E, Lavdas AA, Schirpke U, 2023. Assessing landscape aesthetic values: Do clouds in photographs influence people's preferences? PLOS ONE 18(7): e0288424. https://doi.org/10.1371/journal.pone.0288424

Torres-Miralles M, Grammatikopoulou I, Rescia AJ, 2017. Employing contingent and inferred valuation methods to evaluate the conservation of olive groves and associated ecosystem services in Andalusia (Spain). Ecosyst Serv 26: 258-269. https://doi.org/10.1016/j.ecoser.2017.07.002

van Zanten BT, Verburg PH, Espinosa M, Gomez-y-Paloma S, Galimberti G, Kantelhardt J, Kapfer M, Lefebvre M, Manrique R, Piorr A, et al., 2014. European agricultural landscapes, common agricultural policy and ecosystem services: A review. Agron Sustain Dev 34: 309-325. https://doi.org/10.1007/s13593-013-0183-4

van Zanten BT, Koetse MJ, Verburg PH, 2016. Economic valuation at all cost? The role of the price attribute in a landscape preference study. Ecosyst Ser 22: 289-296. https://doi.org/10.1016/j.ecoser.2016.03.003

Viaggi D, Raggi M, Villanueva AJ, Kantelhardt J, 2021. Provision of public goods by agriculture and forestry: Economics, policy and the way ahead. Land Use Policy 107: 105273. https://doi.org/10.1016/j.landusepol.2020.105273

Villanueva AJ, Granado-Díaz R, Gómez-Limón JA, 2018. La producción de bienes públicos por parte de los sistemas agrarios. UCO Press, Córdoba, Spain. 276 pp.

Villanueva AJ, Salazar-Ordoñez M, Granado-Díaz R, Rodríguez-Entrena M, 2021. Consumers' preferences for traditional meat products: Production system and objective quality cues in Iberian ham. Ital J Anim Sci 20(1): 1987-2001. https://doi.org/10.1080/1828051X.2021.1982419

Villanueva AJ, Granado-Díaz R, Salazar-Ordóñez S, 2025. Consumer preferences toward new circular bioeconomy agri-food products. Sustain Dev 33(2): 2614-2633. https://doi.org/10.1002/sd.3239

Wilson EO, 1986. Biophilia. Harvard University Press, London. 157 pp.

Wolpert F, Quintas-Soriano C, Plieninger T, 2020. Exploring land-use histories of tree-crop landscapes: a cross-site comparison in the Mediterranean Basin. Sustain Sci 15(5): 1267-1283. https://doi.org/10.1007/s11625-020-00806-w