Integrating economic landscape valuation into Mediterranean territorial planning

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Abstract

Recent and rapid landscape changes have occurred over large areas in Mediterranean Basin. Wildfires and human activities are the most important disturbances at landscape-level due to their ecological and socio-economic impacts. The increasing demand which society places on the forest landscapes has led us to develop a tool to identify the economic landscape value around natural protected areas. Our research focused on the integration of social, ecological and economic components of landscape management based on stated social preferences and contingent valuation method (CVM). Landscape value research has been motivated by the need to assist land use planning and environmental management. Geographic Information Systems (GIS) have provided new opportunities to spatially distributed modeling of landscape quality. Correlations were found between the representativeness of the landscape and its sense of belonging, and the contingent rating. Landscape with intensive agricultural practices and mining areas were the least preferred landscapes. There was a notable variation in the economic landscape value attributed to the study area based on the considered CVM scenario, ranging from 1,253,075.1 Euros to 3,650,827.8 Euros. We added the geospatial allocation of willingness to pay according to five landscape quality categories. Our approach could be used to identify priority areas for conservation based on maximizing

landscape value, and would be useful in detecting interesting or conflict areas associated with new management and planning alternatives. In this sense, this approach offers managers to seek territorial management strategies to increase economic efficiency in the allocation of resources.

Keywords: landscape assessment; Mediterranean areas; Contingent Valuation method; social preferences techniques

1. Introduction

Mediterranean landscapes have been configured by great natural and cultural processes and disturbances. Socio-economic changes in land use and population decline during the last 50 years have led to extensive revegetation with an increase in shrubland (Alados et al., 2004; Rodríguez y Silva and Molina-Martínez, 2012). Thus, changes in European agricultural policies have traceable effects on landscape esthetics (Schüpbach et al., 2008). The abandonment of rural areas and the impact of climate change have increased fire frequency and severity (Flannigan et al., 2006; Cardil et al., 2014) and ecological and socio-economic impacts on landscape (Molina et al., 2011; Chuvieco et al., 2012, 2014).

Environmental services and landscape goods are rarely incorporated into economic valuation of natural resources, even though these resources may constitute a large proportion of the total ecosystem value (Troy and Wilson, 2006; Román et al., 2013). For planning decisions, it is important for society to know not only what ecosystem goods and services will be affected by public and private actions, but also what their economic value is relative to other marketed and non-marketed goods and services, such as those provided by physical capital (e.g., roads), human capital investment (e.g., education), etc. (Costanza et al., 2006). It is essential that the socio-cultural and economic values of the landscape be fully taken into account in planning and decision-making (De Groot, 2006).

Geographic Information Systems (GIS) have emerged as a powerful tool used to assess landscape resource (Walpole and Sinden, 1997; Sayadi et al., 2005; Jackson et al., 2013). Landscape quality can be assessed by three general approaches: objectivist, subjectivist and holistic. While the objectivist approach values quality as inherent in the physical landscape, the subjectivist approach considers quality as a product of the mind (eye of the beholder) (Lothian, 1999). The holistic approach adheres to the axioms: ‘‘the whole is more than the sum of its parts’’ and ‘‘the whole is, to a large extent, independent of the individual parts’’ (Bishop and Hulse, 1994). A holistic approach to landscape assessment includes biological, physical and human components (Palang et al., 2000). This paper suggests that the holistic approach is the reliable way to identify landscape value similar to other studies (Antrop and Van Eetvelde, 2000; González and León, 2003; Arriaza et al., 2004).

Landscapes have been the focus of a wide range of disciplines such as urban planning, forest management, rural development and territorial planning. It is important to distinguish between landscape evaluation (the process of rating the quality of landscape) and landscape valuation (the assignment of economic value to landscape). From an economic point of view, landscapes are thought of as a physical entity, valued for its esthetic attributes (Hanley et al., 2009). Although the link between esthetics and economics is not easily established (Christie et al., 2006), economics provides the justification for landscape conservation. Non-market valuation methods have been widely used to identify the economic values of natural resources. Landscape can take the form of monetary values through indirect methods such as Travel Cost (Hesseln et al., 2003; Fezzi et al., 2014), Hedonic Technique (Hunt et al., 2005; Cavailhes et al., 2009) and Contingent Valuation (Bateman et al., 1994; Lee and Han, 2002; González-Cabán et al., 2007). Public preferences methods have been conducted in conjunction with stated preference approaches (González and León, 2003; Hynes et al., 2011; García-Llorente et al., 2012). In this sense, contingent valuation (CVM) is the main stated preference method over the last three decades. CVM is a means of eliciting a willingness to pay value for the preservation of landscape attributes. In the United States, the legal status of evidence of resource impacts based on stated preferences (the US Water Resources Council, 1983; US District Court of Appeals, 1989; US Department of Interior, 1994), is giving a significant contribution to the improvement of these indirect methods.

Economic methods have considered recreational resources of which landscape resource is stated but not clearly linked as an indicator of territorial planning. This paper aims at developing a landscape-level tool to identify the economic value around a natural protected area. A new scheme has been developed as for the integration of three aspects: landscape evaluation (landscape quality), landscape valuation (socio-economic value) and a spatially distributed modeling of landscape quality based on a previous landscape units characterization. Then, landscape value was estimated by the integration of social preferences and contingent valuation method. This paper comments the different components that were used to generate landscape value, and then it proposes a technique for the spatial integration of different aspects. The results could emphasize in the economic resources behind landscapes and the role of the rural population on landscape conservation.

2. Methods

2.1. Study area

The study was carried out in the province of Huelva, in southern Spain (Fig. 1), bordering with Portugal and covering about 200,000 ha of great economic and recreational importance on a regional scale. This district has been exploited for thousands of years due to its mineral deposits, in particular pyrites. At present, the area is mainly exploited by traditional agroforestry systems with cereal cultivation on the floodplains and swine farming in the oak forest stand (Molina et al., 2011). The dominant climate has an Atlantic influence with frequent wet winds, despite the warm summers induced by the Mediterranean climate.

The ‘‘Aracena and Picos de Aroche Natural Park’’ covers 184,000 ha, of which the different species belonging to the Quercus family amount to 100,000 ha, with a population of 41,000 inhabitants. There are a high number of hamlets and villages, dating back to Roman and Arabic times. The landscape of these villages is full of contrasts, with gently rolling hills and beautiful wooded valleys. The presence of chestnut trees has been other of the sources of work and income for the study area. This species and clumps of peonies offer colorful landscapes for spring season. In autumn, pickers and some tourists spend the day picking chestnut fruit and filling their baskets. Another non-timber forest resources, wild mushroom picking is becoming an important source of tourism. However, ‘‘Aracena and Picos de Aroche Natural Park’’ tourism turns into the ‘‘Cave of Wonders’’, that is located in Aracena village. In 2014, the number of visitors reached 144,530 people of different nationalities, mainly from Spain and other European countries. According to all these possibilities of rural development, landscape resource should have a priority role in the study area.

2.2. Socio-economic landscape framework

This paper proposes a methodology based on the landscape quality assessment and socio-economic value (Fig. 2). The operational process involved in obtaining a landscape valuation model comprises the following stages:

- Landscape units characterization using a Geographical Information System (GIS) and field itineraries.
- Landscape quality assessment based on social preferences and DELPHI methods.
- Conversion of landscape quality to the form of monetary units through contingent valuation method.
- Development of criteria to integrate landscape units characterization, landscape quality and socio-economic landscape value. The integration of these three components is a new and critical phase in landscape assessment. Mediterranean landscape assessment using GIS can be used to improve manager decision making, mainly for prevention or mitigation purposes. The generation of the inputs of the landscape model will be presented briefly to reduce the total length of this paper. For more details, we refer to more extended publications.
- Vegetation characterization in Andalusia region (Rodríguez y Silva and Molina-Martínez, 2012)
- Socio-economic landscape assessment according to social preferences and contingent valuation (Molina et al., 2006; Molina et al., 2009).
- Integration landscape vulnerability to manager make decisions about fire prevention (Molina et al., 2006; Chuvieco et al., 2010, 2012, 2014; Román et al., 2013)
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2.3. Characterization of landscape units

We have developed a GIS dataset due to a quick and easy way to vegetation characterization. GIS software has proven to be an indispensable tool in landscape characterization because of the wide number of vegetation attributes that can be assessed. The landscape unit cartography was created by the integration of information from these three sources: the Map of Andalusia Land Use, the Spanish National Forest Inventory and the Andalusia Forest Map (Table 1). The integration required three steps:

(1) Land use mapping: The Map of Andalusia Land Use presented advantages over other digital mappings, such as updated and greater spatial resolution of the land uses. In this sense, we identified dense forests, isolated forests, shrublands, grasslands, agricultural lands, anthropic lands and wetlands. Agricultural lands were classified as woody crops (olive crop, chestnut crop, other fruit crops . . .), herbaceous crops, other crops (gardens, grape crops . . .) and abandoned agricultural lands. In anthropic lands, a differentiation was made among urban areas (villages, residential settlements . . .), industrial areas, mining areas and intensive agricultural lands.

(2) Forest characterization: The Spanish National Forest Inventory improved the information of forest lands according to canopy composition and crown cover fraction. Later, these parameters were taken into account in landscape quality evaluation.

(3) Shrublands or treeless areas characterization: The Andalusia Forest Map presented advantages over other two digital mapping in reference to shrub characterization, both composition and spatial distribution. Shrub characterization was assessed according to dominant species in two typologies: Mediterranean shrublands and colonized shrublands.

Because the information from a single digital coverage was insufficient for the spatial resolution and objectives sought after, this landscape unit's characterization obtained a final product of much higher quality by overlapping heterogeneous information sources. Field trips and itineraries were used to validate and improve this GIS characterization. The field inventory was carried out in circular plots of 15 m2 using the stratified random sampling method. For a random stratified inventory, a maximum sampling error of 30% is allowed with a fiducial probability of 95% (Regional Government of Andalusia, 2004). The sample amounted to 420 plots located across the different vegetations units incorporating variables such as UTM coordinates, land use, canopy and shrub composition.

2.4. Landscape quality evaluation

Simultaneously within the vegetation inventory, a photographic review was taken as a visual recognition key of the most representative landscapes on the study area. Later, these photographs were used to assess the landscape quality through social preferences methods. Evaluation of the landscape quality is complex because of the great factors that can influence in the decisions. Social preference methods have emerged in recent years for valuing the esthetics of landscape (Sayadi et al., 2005; De la Fuente et al., 2006; Brown and Brabyn, 2012). These techniques differ in their degree of complexity and the link between the social preferences and the economic value.

In this paper, landscape evaluation was performed based on four landscape unit groups (anthropic, agricultural, treeless and forest landscapes), and individually for each landscape unit. Landscape quality assessment was based on the contingent rating in which respondents were asked to rate landscapes individually on a numeric scale of 1–10. The landscape quality was identified by analyzing the answers given to 22 scale rating photographs involving the most representative landscapes (main or most extend landscapes that comprise the number of landscape units) (Appendix I). The number of photographs to be assessed was kept small to reduce the time of evaluation and prevent respondent fatigue. Landscape rating was collected by means of 120 personal interviews (81% completion rate) with random tourists from Huelva province. In spite of the first part of the questionnaire included socio demographical information of the interviewees such as age and sex, this paper did not analyze if significant difference would exist in landscape value based on these social characteristics.

The social preferences method for assessing landscape, solely through visual attributes, lacks in holistic approach (consolidation of both subjective and objective points of view). Therefore, an improved landscape quality assessment can be attained through the ‘‘expert-opinion’’ where experts can evaluate non-visual attributes or ecological parameters such as naturalness, rarity and associated biodiversity. Four participants (natural park representation, agrarian organization representation and two university professors) were used for ‘‘expert-opinion’’ approach based on the specific knowledge of the area under discussion. Two analysis of variance (ANOVA) were used to determine if significant differences ($p < 0.05$) exist in landscape values according to ‘‘experts’’ and ‘‘non-experts’’ valuation. SPSS software was used in all analyses. If significant differences were detected, a Tukey HSD test was performed to determine which specific landscape was different from another.

Statistical analysis allowed us to classify landscapes rating on five categories. We selected natural breaks classification method (Jenks method) in relation to other classification methods such as equal interval, defined interval and geometrical interval. This method is a data clustering method designed to determine the best arrangement of values into different classes. Jenks optimization method seeks to reduce the variance within classes and maximize the variance between landscape classes.

2.5. Socio-economic landscape valuation

Although the Contingent Valuation method (CVM) has been used by such U.S. Federal Agencies as the US Water Resources Council (1983), the US District Court of Appeals (1989), the US Department of Interior (1994), and by different authors (Bateman et al., 1994; Lee and Han, 2002; Gonzalez and León, 2003; MacMillan et al., 2006; González-Cabán et al., 2007; Hynes et al., 2011; García-Llorente et al., 2012), two sources of error (bias) have been discussed in the literature for the surveys: sampling error and error due to a hypothetical market scenario for landscape goods (Schläpfer et al., 2004). Preliminary sampling lead to solve these two major biases associated with standard contingent valuation. The question ‘‘Do you agree to pay up to about...?’’ attempted to minimize the rejection responses. In order to prevent bias caused by the direct presence of the interviewer (respondents tend to exaggerate their response based on a ‘‘social acceptable response’’), the surveys were handed out and answered in the direct absence of this person (the interviewer remain closed for questions or clarifications). To prevent bias because of the insufficient detail of bad-informed people, the survey incorporated two questions about the familiarity of the study area.

Contingent valuation information was obtained from 584 tourists in the most western province of Andalusia. Random samples of tourists were interviewed at different hotels, hostels, campsites, hamlets and villages along the Natural Park according to the different landscape quality categories. We must note that our sample suffered from over-representation of ‘‘Quality II, III and IV’’ and under-representation of ‘‘Quality I and V’’, and underrepresented elder tourists (aged upper to 50). The ratio of male and female respondents was very close to the national average (0.98 men to 1 woman). A total of 493 interviews were completed out of 584, for a completion rate of 84%. The final questionnaire was divided into three closely connected parts. The first part included information about the study area and respondent’s personal information. The second part, using a discrete change in entrance fees, was aimed at tourists and an estimation of their Willingness to Pay (WTP). In the bidding approach (Vaux et al., 1984; Christie et al., 2006), respondents are asked whether or not they would pay or accept some specific sum (the question is then repeated using a higher or lower amount, depending on the initial response). Reference monetary values (bids) were defined by preliminary survey (30 tourists) in relation to avoid infinity and zero value answers. When respondents disagreed to paying anyentrance fee at all, different interpretations can be found: enough taxes, lack of worth... This fact assumes that non-respondents WTP is zero. In this sense, excluding these bids from the mean WTP calculation would lead to biased estimates of population assessment (Hynes et al., 2011).

In this research, we used two approaches: either taking all respondents into consideration, valuing those who refuse to pay an entrance fee as zero WTP (known as ‘‘all respondents’’), or taking only affirmative answers into consideration (known as ‘‘only affirmative respondents’’). Then, preliminary results suggested a potential decline of WTP according to visit frequency including the travel duration and number of visits per year. Socio-economic landscape value can be underestimated under routine conditions or due to unfamiliarity with the study area (Castellano et al., 2001). In this sense, it was helpful to distinguish between ‘‘all tourists’’ and ‘‘selected tourists’’ updated through correspondence with those who spent between three days (associated to the time need for the area familiarity) and thirty days per year (associated to routine conditions) in the research area. Four CVM scenarios were used to identify mean WTP according to all these possible approaches: scenario 1 (‘‘all respondents and all tourists’’), scenario 2 (‘‘all respondents and selected tourists’’), scenario 3 (‘‘only affirmative respondents and all tourists’’) and scenario 4 (‘‘only affirmative respondents and selected tourists''). The economic valuation of the study area was calculated by multiplying the mean WTP and the average annual visitors. This former data was obtained from official statistics of the ''Cave of Wonders'' (144,530 visitants in 2014). The use of Geographic Information Systems (GIS) provided a tool to link this socio-economic value and the landscape quality assessment (expressed landscape ratings). In this sense, each landscape quality category (identified by natural breaks classification method) was converted to form of monetary units through proportional allocation of the annual economic value of ''Aracena and Picos de Aroche Natural Park'' according to its extend and contingent rating.

3. Results

3.1. Characterization of landscape units

''Aracena and Picos de Aroche Natural Park'' landscapes are composed of a cluster of interacting land areas including different woodlands areas, as well as treeless areas (shrublands, grasslands) and arable croplands. Information generated from vegetation composition, including shrub and canopy strata, was integrated to provide the different landscape units. With the help of GIS, aerial photographs and field itineraries, we could identify 33 landscape units (Table 2), including four types of wetlands and three types of mountain peaks. The largest landscape unit was ''Mediterranean open oak-woodlands: herbaceous crop or pasture under oak trees'' (55,552.60 ha), followed by ''Mediterranean shrublands'' (24,098.02 ha) and ''Mediterranean open coniferous forests with understory'' (22,526.8 ha).

3.2. Landscape quality evaluation

Social preferences (‘‘non-expert’’ score) were significantly increased in ‘‘forest landscapes’’ when compared with ‘‘treeless, agricultural and anthropic landscapes’’ (Table 3). In relation to these three former landscape unit groups, ‘‘anthropic landscapes’’ could be pointed out as the least amazing group to observe. At the landscape unit scale, landscape value ranged from 3.20 to 8.67 according to the ‘‘non-expert’’ opinion (Table 4). Landscape with intense agricultural practices (‘‘landscape 4’’) and mining areas (‘‘landscape 7’’) were the least preferred landscape units. Ten significant groups were identified according to ANOVA Tukey test (Table 4). The highest score was expressed in terms of a riparian forest (‘‘landscape 15’’), followed by Mediterranean open oakwoodland (‘‘landscape 9’’) and natural grassland (‘‘landscape 21’’). Significant differences were observed among Mediterranean dense and open forests (‘‘landscape 2, 8 and 13’’), Eucalyptus plantations (‘‘landscape 6 and 12’’), Mediterranean shrublands (‘‘landscape 11, 19 and 20’’) and colonized shrublands (‘‘landscape 18’’). In agricultural oody, significant differences were found between herbaceous crops (‘‘landscape 17’’) and oody crops (‘‘landscape 5, 14 and 16’’) pointing to the landscape value of chestnut cropland (‘‘landscape 14’’).

The ‘‘expert’’ score varied significantly according to forest and treeless landscapes, agricultural landscapes and anthropic landscapes (Table 3). There was no significant difference between treeless and forest landscapes groups. At the landscape unit scale, landscape value ranged from 3.89 to 8.88 according to the ‘‘expert’’ opinion (Table 4). Seven significant groups were identified according to expert opinion (Table 4). ‘‘Expert’’ value was less than 8 in all landscapes, except in mixed hardwood forests (‘‘landscapes 2 and 13’’). Similar to the ‘‘non-expert’’ opinion, significant differences were observed between these forest landscapes and Eucalyptus plantations (‘‘landscapes 6 and 12’’). While Mediterranean open coniferous forest (‘‘landscape 8’’) and woody croplands (‘‘landscape 16’’) had a lower score than in the ‘‘nonexpert’’ valuation, a higher value was found in colonize shrubland landscape (‘‘landscape 18’’). Chestnut cropland (‘‘landscape 14’’) was significant increased when compared with the rest of woody croplands. Similar to ‘‘non-expert’’ opinion, mining areas (‘‘landscape 7’’) and modern agricultural practices (‘‘landscape 4’’) were the least preferred landscape units.

We used the DELPHI method to weigh ‘‘non-expert’’ opinion at 40% and ‘‘expert’’ opinion at 60% of the landscape quality assessment (final score in Table 4). Final assessment ranged from 3.93 (‘‘mining landscape’’) to 8.40 (‘‘dense mixed hardwood forest’’). A weighted score was calculated from landscape units that were composed by different photographs. According to final values, we identified five categories of quality landscape using Jenks optimization method: Quality I (>7.53), Quality II (6.58– 7.53), Quality III (5.45–6.58), Quality IV (4.21–5.45) and Quality V (< 4.21). While four landscape units were classified as ‘‘Quality I’’ (riparian forests; mixed hardwood forests; mountain peaks in forest area; Mediterranean open coniferous forests with understory), three landscape units were ranked in ‘‘Quality V’’ (mining areas; industrial areas; intensive agricultural areas). For landscape visualization (Fig. 3), the criterion to convert the quantitative scale of the landscape value to five landscape categories was based on the premise of simplicity required by the support tools used in routine decision-making.

3.3. Socio-economic landscape valuation

Willingness to Pay (WTP) was obtained from an entrance fee payment that ranged from 0 to 300 Euros. The percentage of respondents that proposed to abstain from paying a monetary value for the study area was 39.73%. The above result would represent empirical evidence favoring a procedure that excluded these responses from the dataset.

If non-respondents exclusion is possible (‘‘only affirmative respondents’’), WTP could increase to 9.29 Euros (‘‘all tourists’’) or 13.16 Euros (‘‘selected tourists’’).

An increased WTP was detected for ‘‘selected tourists’’ (visitors who spent between three and thirty days per year in the study area) as opposed to those for frequent, occasional or en route visitors. Consequently, ‘‘selected tourists’’ expressed satisfaction with their use of the landscape resource. The difference between the ‘‘selected tourists WTP’’ and ‘‘all tourists WTP’’ corresponded to the WTP for landscape resource (Castellano et al., 2001), resulting in a difference between 3.43 Euros WTP (‘‘all respondents’’) and 7.3 Euros WTP (‘‘only affirmative respondents’’).

There was a notable variation in the value attributed to ‘‘Aracena and Picos de Aroche Natural Park’’ depending on the CVM scenario: ‘‘all respondents and all tourists’’, ‘‘all respondents and selected tourists’’, ‘‘only affirmative respondents and all tourists’’ and ‘‘only affirmative respondents and selected tourists’’ (Table 5).

4. Discussion

This research has proposed an integration framework for landscape resource based on two groups of factors: those associated to the landscape quality and those related to the socio-economic landscape value (González and León, 2003). This approach is innovative because of the integration of different tools, such as social preferences, contingent valuation and GIS, used to estimate landscape value for each unit area (hectare). Despite previous studies have relied on modeling the landscape (Bishop and Hulse, 1994; Palang et al., 2000; Brown and Brabyn, 2012; Jackson et al., 2013), its economic value has not traditionally been incorporated to natural resources valuation (Molina et al., 2009).

‘‘Choice modeling’’ method has been widely used to contingent rating studies (Antrop and Van Eetvelde, 2000; Sayadi et al., 2005; De la Fuente et al., 2006; Hanley et al., 2009). In our study, the final score was expressed as an integration of non-expert and expert opinions provided an improved landscape quality assessment according to the holistic approach. Although expert analysis is important in the evaluation process in a scientific, the public role should be highlighted to explore the diversity of social preferences (Garcia-Llorente et al., 2012). Landscape esthetic preferences depend on our relation with physical surroundings. The dominant or most representative landscape unit is a generalized interpretation of landscape and provides an overall context for an area. A linear correlation between the quality rating and Mediterranean representativeness of the landscape unit has been noted by our results according to Table 1 (representativeness of each landscape unit) and Table 4 (quality rating of each landscape unit). Landscapes associated with the largest Mediterranean representativeness such as Mediterranean open oak-woodlands (‘‘landscape 9’’), grasslands (‘‘landscape 21’’), mixed hardwood forests (‘‘landscape 2’’), Mediterranean open coniferous forests (‘‘landscape 8’’) and Mediterranean shrublands (‘‘landscape 11‘‘) have shown the highest social preferences.

The respondents of the present study expressed their strongest positive preference for wildland landscape units in a similar way to other studies (Otero, 1999; Kaltenborn and Bjerke, 2002; Arriaza et al., 2004; Sayadi et al., 2005; Brown and Brabyn, 2012). Color contrast was required to reach higher social preferences (Arriaza et al., 2004; De la Fuente et al., 2006) pointing to mixed forests and grasslands surrounded by mountains (‘‘landscapes 2, 11 and 21’’). The results showed moderately values for water views or landscapes associated with riparian areas (‘‘landscape 15’’) and sand dunes (‘‘landscapes19 and 20’’). In this study, flat and undulating forests (‘‘landscapes 8 and

9'') were found in relation to higher social preferences, but this may not be the case in other areas (Brown and Brabyn, 2012). So at least these landscapes represent a well-known local context, and the interpretations of landscape are generated by human relationships with and within landscapes: childhood, sense of place, stories and myth. In this sense, respondents were more willing to pay for landscapes when they have a greater sense of belonging to these areas, which may influence their social preferences for landscapes rating (Kaltenborn and Bjerke, 2002; Stephenson, 2008; García-Llorente et al., 2012). It is worth noting that the wildland scenes are very representative of the study area (''landscape 9'' or herbaceous or Mediterranean open coniferous forest ''covers about 12% of the study area'' and ''landscape 11 or Mediterranean shrublands in open forests'' about 12% according to Table 1). Scene displaying traditional human activities such as swine farming (''landscape 9 or pasture under oak-woodlands'') was perceived as the second highest social preferences. The least valued landscapes were associated with intensive agricultural practices (''landscape 4'') similar to Kaltenborn and Bjerke (2002) and García-Llorente et al. (2012) studies. Social apathy was associated with mining areas (''landscape 7'') and industrial areas (''landscape 3'') because of their negative visual impacts (Abello and Bernaldez, 1986). Colonized shrubland (''landscape 18'') as well as recent cropland (''landscape 17'') were seen as unattractive. Woody croplands (''landscapes 5, 14 and 16'') were seen as more attractive than croplands, although they also represented a high human modification of the original landscape.

Contingent valuation (CVM) is a stated preference methodology that provides society the opportunity to make an economic decision concerning the relevant landscape good (González and León, 2003). Although CVM has been the most controversial of the non-market valuation methods, it has become an important tool to economic valuation of natural resources (Bateman et al., 1994; Christie et al., 2006; MacMillan et al., 2006; González-Cabán et al., 2007). Bias resulting from the direct presence of the interviewer and the insufficient detail of bad-informed people could be resolved by our study design and implementation. When respondents disagreed to paying any entrance fee (39.73% of the respondents) are excluding of the statistical analysis, a selection bias problem could be generated (Schläpfer et al., 2004; Hynes et al., 2011). This fact could affect the reliability of the willingness to pay (WTP) estimates obtained for social preferences assessment. In this sense, this research allows us to compare four CVM scenarios (all tourists, selected tourists, affirmative tourists and affirmative selected respondents) showing significant differences among them. In this sense, ‘‘Aracena and Picos de Aroche Natural Park’’ landscape value ranged from 1,253,075.1 Euros to 3,650,827.8 Euros.

The following step in the process, once economic landscape value was determined under the four scenarios, was the preparation of a GIS-based data layer portraying the 33 landscape units. GIS and statistical analysis allowed us to identify five landscape categories providing proportional economic value to each category (Table 4). Differences were performed between the least favorable scenario (all respondents) and the most favorable scenario (affirmative selected respondents), In both annual value and value per unit area. As an example, ‘‘Quality I’’ increased from 8.87 Euros/ha to 25.84 Euros/ha, and as a consequence, its annual value increased considerably, ranging from 24,010.77 Euros to 69,955.27 Euros.

Socio-economic forest vulnerability is a critical component of forest management (Molina et al., 2011; Chuvieco et al., 2014). Landscape goods are rarely incorporated into territorial planning, even though this resource could constitutes a large proportion of the ecosystem value, mainly in Protected Areas (Costanza et al., 2006; De Groot, 2006; Troy and Wilson, 2006; Román et al., 2013). Our results reflect the relevance of landscape provided by forest areas in the ‘‘Aracena and Picos de Aroche Natural Park’’. This paper presents an approach to generate a spatially explicit value for satisfying manager needs. The integration of landscape vulnerability and the automation of calculation by means of GIS facilities the comparison of different management alternatives (Chuvieco et al., 2012). Obviously, all indirect methods of valuation include limitations and uncertainties due to the sampling bias and CVM scenario (Schlapfer et al., 2004; Hynes et al., 2011). The novelties of the valuation are the integration of social, economical and ecological components of landscape management and the spatial assessment of economic landscape value including expert and non-expert preferences. This approach allows us to determinate the value of each landscape and the effects of disturbance changes in landscape quality, prioritizing the most valuable areas. The methodology using GIS increases its flexibility enabling an extrapolation to other territories at different spatial scales, depending of input datasets.

In order to ensure the cost-efficient of the conservation activities, forest managers require information on the socioeconomic consequences of landscape alteration. The final integration was undertaken using qualitative and quantitative criteria. The contingent rating was classified in five categories using Jenks method for the final economic allocation. Landscape value (s/ha) decreased according to these quality categories (Fig. 3). The potential impacts associated to ‘‘Aracena and Picos de Aroche Natural Park’’, mainly forest fires, should lead to management decisions, by prioritizing ‘‘Quality I areas’’ with more valuable and susceptible resources. Therefore, landscape vulnerability should provide a tool to improve budget allocation and landscape management in the process of sustainable territorial planning. The integration of socio-economic landscape value and the automation of calculation by means of GIS

(Chuvieco et al., 2012, 2014; Roma´n et al., 2013), constitutes the central axis of this research based on the fundamental premise of providing a versatile tool for used during operational management by government agencies. Landscape model using GIS increases the flexibility of this methodology enabling an extrapolation to other territories. The methodological procedure offers an objective and integral approach that includes socio-economic concerns about landscape in management decisions. In this sense, the landscape valuation is more complete than the former models, since it includes expert and non-expert aspects.

5. Conclusions

Since there is a growing social importance on environmental services and landscape goods, landscape resource and recreation activities could offer a basic rural activity that could reactivate the economy of Mediterranean wilderness areas. In this sense, there is a need for not only an assessment of landscape quality (‘‘expert opinion’’) but also an economic valuation of the landscape. It is possible to suitably consider the opinion of both the ‘‘experts’’ and the ‘‘non-experts’’ while deliberating landscape management strategies for reducing visual and ecological impacts. In spite of the integration between esthetic and economic value is not easily established, landscape valuation plays an important role in the identification and conservation of vulnerable sites, mainly in natural protected areas. The high socio-economic value of Mediterranean protected areas should lead to preventive management actions against Mediterranean disturbances, such as forest fire, in order to preserve its tourism activity, and as a consequence, its economic value. This paper offers a means for prioritizing conservation activities and identifying opportunities for sustainable landscape development. The results of the study should provide insights to policy-makers involved in rural development.

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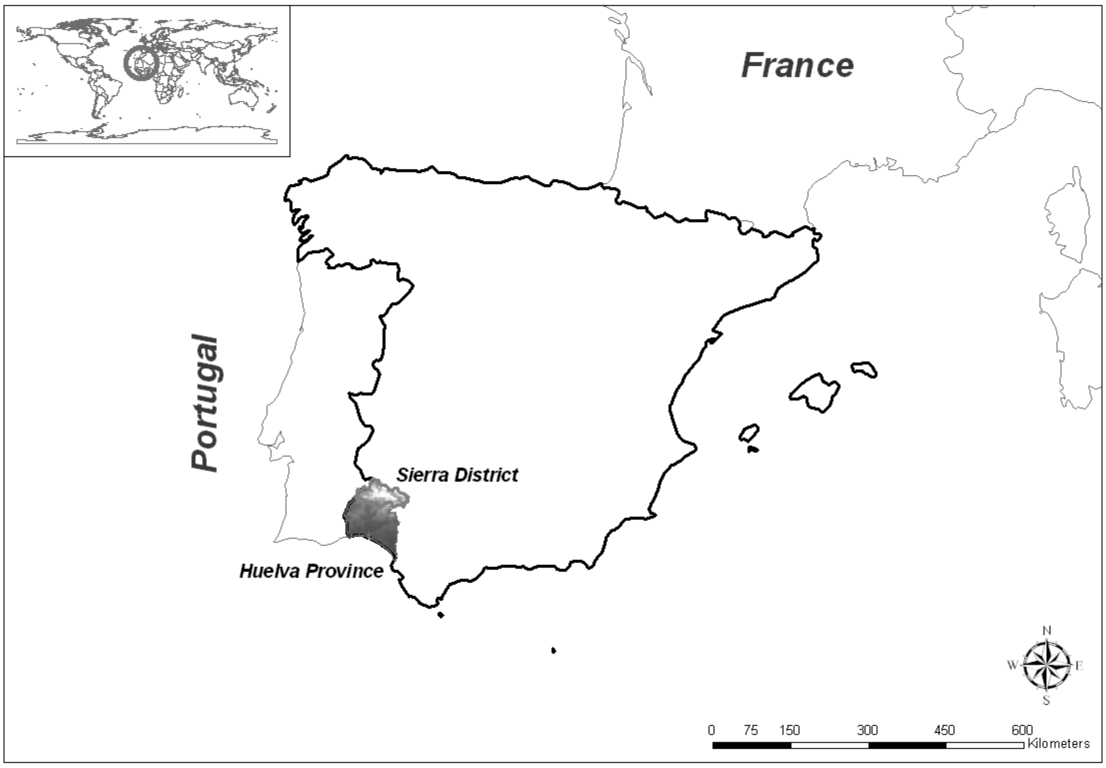
Figure titles

Figure 1. Study area location

Figure 2. Framework for landscape valuation.

Figure 3. Spatial distribution of landscape value according to the most favorable scenario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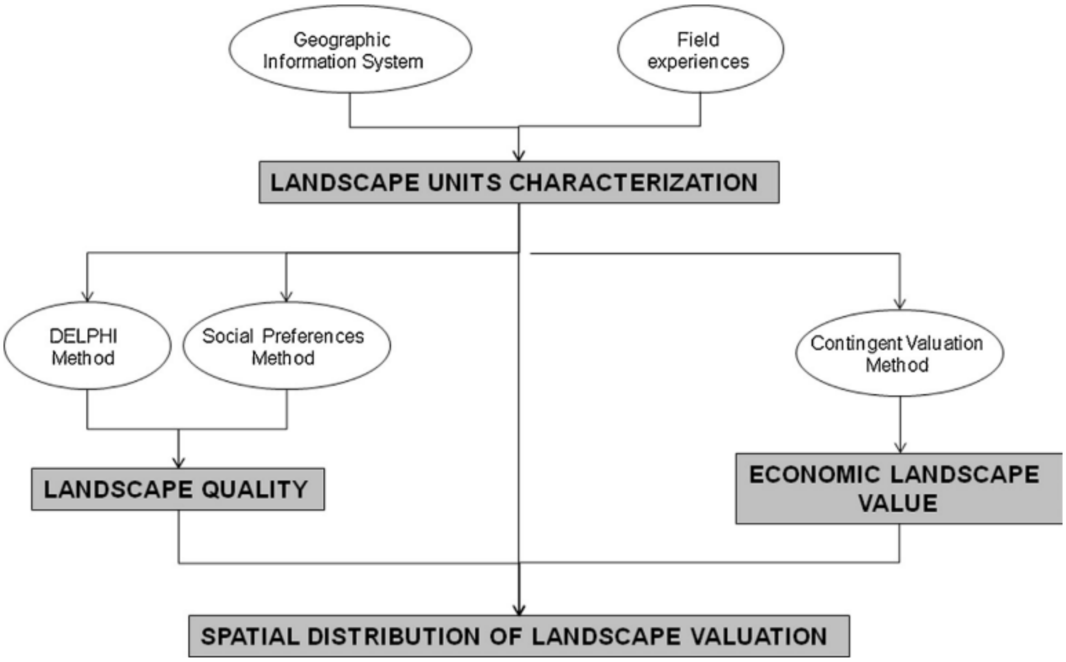
Geographic Information System
Field experiences
LANDSCAPE UNITS CHARACTERIZATION
DELPHI Method
Social Preferences Method
Contingent Valuation Method
LANDSCAPE QUALITY
ECONOMIC LANDSCAPE VALUE
SPATIAL DISTRIBUTION OF LANDSCAPE VALUATION

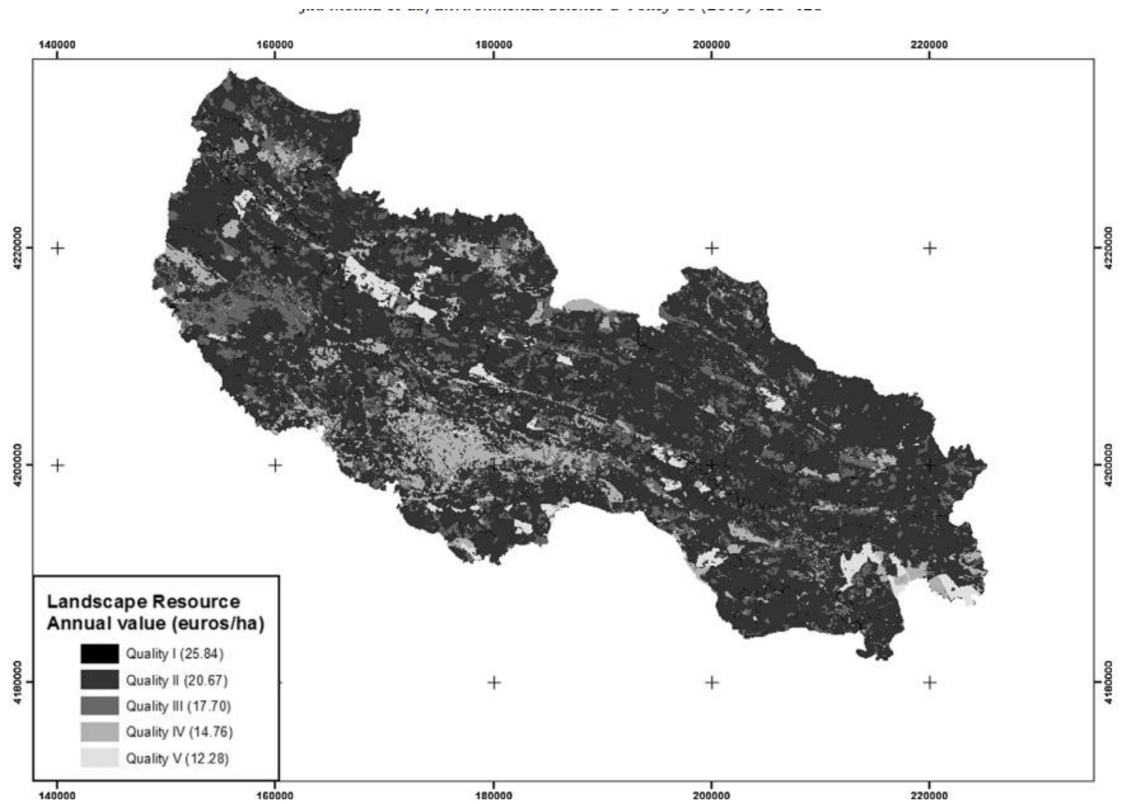
Landscape Resource
Annual value (euros/ha)
Quality I (25.84)
Quality II (20.67)
Quality III (17.70)
Quality IV (14.76)
Quality V (12.28)
140000
160000
180000
200000
220000
4220000
4200000
4180000

Table 1. Cartographic material used to landscape units characterization.

Cartographic material	Scale or spatial resolution (m)	Year
Map of Andalusia land use	1:25,000	2011
Spanish national forest inventory	1:50,000	2002
Andalusia forest Map	1:200,000	1996
Google earth	Depend on the size	2013

Table 2. Landscape unit area and landscape quality category based on landscape rating

Landscape unit	Area (ha)	Representativeness (%)	Quality rating (1–10)	Quality category
Wetlands surrounded by forests	1063.24	0.57	6.79	II
Wetlands surrounded by shrublands	26.28	0.01	6.7	II
Wetlands surrounded by grasslands	2.89	0.00	4.99	IV
Wetlands surrounded by agricultural areas	0.66	0.00	5.85	III
Intensive agricultural areas	45.30	0.02	3.95	V
Urban and residential areas	1668.72	0.89	4.71	IV
Industrial areas	166.85	0.09	4.2	V
Woody croplands	4097.16	2.19	5.09	IV
Mosaic of woody croplands and shrublands	2812.10	1.51	4.97	IV
Herbaceous croplands or pasture lands	4356.93	2.33	5.13	IV
Mosaic of herbaceous and woody croplands	753.43	0.40	5.11	IV
Mediterranean open oak-woodlands (herbaceous crop or pasture under oak trees)	55,552.60	29.75	7.53	II
Mediterranean open oak-woodlands (understory under oak trees)	356.24	0.19	7.2	II
Mosaic of herbaceous croplands and shrublands	134.64	0.07	4.99	IV
Eucalyptus forests (without understory)	4972.21	2.66	5.44	IV
Mediterranean shrublands	24,098.02	12.90	7.2	II
Colonized shrublands (*Cistus* spp., …)	4933.50	2.64	4.58	IV
Eucalyptus forests (with colonized understory)	4033.83	2.16	6.2	III
Mining areas	311.43	0.17	3.93	V
Dense *Pinus* forests with dispersed understory	1099.19	0.59	6.57	III
Dense *Quercus* forests with dispersed understory	14,517.23	7.77	5.85	III
Dense mixed hardwood forests with dispersed understory	17,846.36	9.56	7.35	II
Mediterranean open coniferous forests with understory	22,526.81	12.06	7.2	II
Mediterranean open mixed hardwood forests (*Quercus* and *Castanea*) with understory	21.51	0.01	8.4	I
Olive croplands	6884.65	3.69	6.21	III
Castanea croplands	54.53	0.03	6.86	II
Grasslands	10,767.48	5.77	7.21	II
Mosaic of dense mixed hardwood forests and riparian forests	13.47	0.01	7.68	I
Mosaic of mixed hardwood forests and coniferous forests	791.92	0.42	6.96	II
Riparian forests	2653.00	1.42	8.01	I
Mountain peak in forest area	18.66	0.01	8.4	I
Mountain peak in agricultural area	137.21	0.07	6.21	III
Mountain peak in natural grasslands area	19.31	0.01	5.13	IV

Table 3. Landscape quality evaluation based on landscape unit groups (value on a scale of 0– 10).

Landscape units group	Non-expert score	Expert score
Anthropic landscapes	4.36 (±0.36)a	4.15 (±0.38)a
Agricultural landscapes	5.53 (±1.23)b	5.42 (±0.94)b
Treeless landscape	5.88 (±1.89)b	6.28 (±0.76)c
Forest landscapes	7.07 (±1.13)c	6.97 (±1.06)c

Table 4. Landscape quality evaluation based on landscape unit groups (value on a scale of 0– 10).

Landscape photographs	"Non-expert" opinion Score	Expert opinion Score	Final evaluation Score
Landscape 1	5.10 (± 2.11)	4.44	4.71
Landscape 2	7.68 (± 1.54)	8.88	8.40
Landscape 3	4.67 (± 1.84)	3.89	4.20
Landscape 4	3.78 (± 2.00)	4.06	3.95
Landscape 5	6.35 (± 1.48)	6.12	6.21
Landscape 6	5.15 (± 1.76)	5.64	5.44
Landscape 7	3.90 (± 2.21)	3.94	3.93
Landscape 8	7.67 (± 1.40)	5.84	6.57
Landscape 9	8.27 (± 1.27)	7.03	7.53
Landscape 10	5.91 (± 1.45)	5.80	5.85
Landscape 11	7.31 (± 1.69)	7.13	7.20
Landscape 12	6.11 (± 1.65)	6.26	6.20
Landscape 13	6.31 (± 1.60)	8.04	7.35
Landscape 14	6.58 (± 1.29)	7.04	6.86
Landscape 15	8.67 (± 1.22)	7.56	8.01
Landscape 16	6.18 (± 1.37)	4.36	5.09
Landscape 17	4.13 (± 2.02)	5.80	5.13
Landscape 18	3.20 (± 1.81)	5.50	4.58
Landscape 19	7.24 (± 1.76)	6.48	6.79
Landscape 20	7.12 (± 1.77)	6.43	6.70
Landscape 21	7.97 (± 1.36)	6.70	7.21
Landscape 22	5.81 (± 1.91)	4.45	4.99

Table 5. Landscape quality evaluation based on landscape unit groups (value on a scale of 0– 10).

Landscape quality	Area (ha)	Annual value (€)	Annual value (€/ha)
I	2706.65	24,010.77–69,955.27	8.87–25.84
II	133,083.47	944,470.10–2,751,708.74	7.1–20.68
III	26,672.77	162,081.26–472,222.91	6.08–17.70
IV	23,750.88	120,306.73–350,513.03	5.06–14.75
V	52,358	2206.23–6427.84	4.21–12.28