"This is an Accepted Manuscript of an article published by Elsevier in Land Use Policy on 2020, available at: https://doi.org/10.1016/j.landusepol.2020.104559"

Public participation in defining landscape planning scenarios and landscape quality objectives (LQO): Landscape Guidelines for Galicia (NW Spain) case study

Abstract

Since the adoption of the European Landscape Convention (ELC) in 2000, greater importance has been given to citizen participation in landscape policies and, specifically, in defining landscape quality objectives (LQO). Although the task of identifying and defining LQO is undertaken by professionals, the ELC provides for a compulsory public consultation. In most cases, no clear relationship between the results of public participation and the resulting definition of LQO and planning scenarios has been found. The objective of the present study is therefore to propose a methodology for designing landscape planning scenarios and defining LQO by the systematic, objective and quantified analysis of the results of a public participation process and taking advantage of the capacity of a Public Participation GIS (PPGIS) to capture public perception of landscape. The results of a picture-based survey and of the assessment of more than two thousand landscape scenes through the PPGIS allowed us to calculate indices of satisfaction and of the level of intervention required for each landscape type and area. From the values of these indices, four types of landscape planning scenarios were identified (protection, planning and management focused on protection and on planning), and the LQO for each landscape type and area were determined according to the resulting scenario. Application of the proposed methodology to the Landscape Guidelines for Galicia revealed information about the public perception of each landscape type and the preferred measures for landscape improvement involving protection, management and planning.

Keywords: landscape perception; landscape assessment; PPGIS; European Landscape Convention

1. Introduction

Since the adoption of the European Landscape Convention (ELC) in 2000, member countries of the EU have incorporated landscape protection, management and planning in their legislation. The ELC, specifically articles 5 and 6, introduce public involvement and participation as a key factor in developing these landscape policies. The first step towards implementing the ELC is the identification, characterization and assessment of current landscapes, which subsequently leads to the formulation of landscape quality objectives (LQO) for the landscapes identified. The next step involves determining guidelines for the achievement of LQO, by specifying the particular actions required for the protection, management and planning of each landscape type.

The ELC states that, once the different landscape types have been identified and assessed, usually through instruments such as landscape atlases or inventories (Miklós, 2002; Santé et al., 2018; Mata Olmo & Sanz Herráiz, 2003; Stahl et al., 2011; Van Eetvelde & Antrop, 2011), the LQO for each landscape type must be defined after a public consultation process. The ELC defines LQO as *"the formulation by the competent public authorities of the aspirations of the public with regard to the landscape features of their surroundings"*. These aspirations are usually understood as expectations about what the landscape could offer to the public (Sevenant & Antrop, 2010). Although LQO were formulated by public authorities in the past and were generally restricted to outstanding or picturesque landscapes, the ELC marked a paradigm shift in landscape consideration, by opening it up to the whole territory and including the public in the decision-making process. Thus, LQO can no longer be established using methods applied when landscape was restricted to outstanding landscapes, but must be defined within the context of the

exercise of democracy (Luginbühl, 2006). Currently, LQO must take into account the different values attributed by diverse groups of people to the same landscape.

Analysis of the development of the ELC in Europe, especially in France, Belgium, the United Kingdom, Switzerland, Italy, Portugal and Norway, shows that most of the concepts related to public participation are interpreted and executed in different ways in each national, regional or local territory (Jones & Stenseke, 2011; De Montis, 2014). Despite the lack of a clear definition of public participation in landscape planning, greater importance has been given to citizen participation in landscape policies, and specifically in the definition of LQO.

Although the task of defining LQO is undertaken by professionals, the convention provides for a compulsory public consultation (Jones & Stenseke, 2011). There is therefore increasingly more information available about how LQO are defined from the results of public participation processes. However, there is no official or standard procedure for defining LQO (Prieur & Durousseau, 2006), and no defined, systematic methodology for establishing a relationship between public landscape evaluation, LQO and landscape planning scenarios has been reported. In most of the public participation processes, there is no clear relationship between the questions the public are asked and the definition of LQO and landscape planning measurements. Procedures must therefore be developed to incorporate public perceptions in landscape planning (Conrad et al., 2011) and to define LQO. This paper proposes a methodology for designing landscape planning scenarios and defining LQO by the systematic, objective and quantified analysis of the results of a public participation process.

1.1.State of the art on LQO definition

There is a clear lack of formal research on the definition of LQO. This can be proved by the very few papers of Web of Science (all databases) that include the search phrase "landscape quality objectives" in the search fields "title" (4 papers) or "topic" (13 papers) in the period 1900-2020. LQO are usually defined directly by public authorities, in the best of cases after a public consultation, but in most cases asking only for opinion of public administrations or representatives or certain selected stakeholders. Van Eetvelde and Antrop (2011) described two case studies in Flanders; in the first one, LQO are formulated exclusively by the Flemish administrative authorities and by an independent committee of experts, and in the second one, by the administration and the landowners.

Other methods of defining LQO, such as that proposed by Chmielewski and Sowinska (2010), recognize the importance of considering the expectations of local communities concerning the LQO, but do not explicitly explain how the public opinion is taken into account. Most landscape planning instruments use surveys to define LQO; for example, Burgui et al. (2017) defined LQO through personal interviews and qualitative analysis, and Sevenant and Antrop (2010) used a questionnaire including questions about landscape preference. In most previous experiences, no clear unifying thread has been identified in relation to the citizen participation process and the resulting definition of LQO, that is, the way in which the results of these social research techniques are translated into LQO is not evident.

The only objective and quantified methodologies previously used for the definition of LQO include the use of landscape scenarios and calculation of landscape indices and metrics. On one hand, Loupa Ramos (2010) proposed the development of "exploratory landscape scenarios" as a tool for identifying future landscapes from which to trigger discussions with the public in

order to define the LQO. On the other hand, Sowinska-Swierkosz and Chmielewski (2016) formulated LQO as a set of indicators that link social and expert opinion. Many other studies can be found that calculate landscape indices related to social aspects and landscape perception but do not involve them in LQO definition (Dramstad et al., 2006; Walz et al., 2007; Uuemaa et al., 2009).

1.2. Theoretical background

The methodology proposed in the present paper integrates both of the above mentioned approaches -landscape scenarios and indicators – by calculating quantitative indicators that reflect the public perception of different landscape types, and the results of which are combined to determine the preferred landscape planning scenarios.

Scenarios are a widely-used tool in landscape planning to encourage people to discuss about future alternatives (Soliva et al., 2008). Scenario-based studies became frequent in the seventies (Shearer, 2005) in order to stimulate creative ways of thinking and facilitate the exchange of information (Gantar & Golobic, 2015). Currently, two different approaches can be distinguished in relation to the use of scenarios for landscape planning. The most frequent one is the public assessment of predefined scenarios, that is, scenarios are proposed by the technical team to be used as the starting point from which citizens debate the desired future landscape (Palang et al., 2000; Tress & Tress, 2003; Soliva et al., 2008; Lindemann-Matthies et al., 2010; Loupa Ramos, 2010; Larcher et al., 2013).

The other option is a participatory scenario development process, in which scenarios are designed by stakeholders. Carlsson et al. (2015) used this approach combining scientific and stakeholder knowledge to build robust scenarios. Different methodologies can be applied for

building scenarios, among which GIS-based modelling is increasingly being used. Smith et al. (2009) present a scenario development tool using a GIS based approach which allows stakeholders and experts to build landscape scenarios from different forest management strategies. In Bohnet et al. (2011) three landscape scenarios were derived from a participatory research supported by a GIS-based toolkit.

Both scenario approaches can be improved by using visualization methods (Pettit et al., 2011) such as photorealistic design techniques (Tress & Tress, 2003), GIS modelling (Tobias et al., 2016) or a combination of both (Grêt-Regamey et al., 2007), since most attention has focused on the visual aesthetic of landscape (Scott, 2011).

The present paper develops a new approach based on the participatory definition of theoretical scenarios from the public assessment of real landscapes. Different methods can be used for landscape assessment, and each has certain advantages and disadvantages. Arriaza et al. (2004) distinguishes between direct and indirect methods: while direct methods seek to compare public preferences for landscapes (de Vries et al., 2013; Dunkel, 2015), indirect methods consider the presence and/or intensity of designated features (Bulut & Yilmaz, 2008; Schirpke et al., 2013). Although landscape assessment by aggregation of elements (indirect method) makes comprehensive landscape evaluation easier than in direct methods, it does not capture the interactions between such elements (Hayden et al., 2015). The methods used in the present study for capturing landscape preferences integrate both types of approaches: direct and indirect methods.

Other common technique for landscape assessment is the use of landscape indices (Uuema et al., 2009), which can reflect different landscape values (e.g. natural, cultural,

productive and aesthetic), including social aspects and landscape perception. Focusing on indicators or metrics of public landscape assessment or perception, a good example are the 14 indicators identified by Hedblom et al. (2019) as proxies for the perception of the landscape values. This type of indices can be calculated from the results of public surveys (e.g. indices of perceptual priority and cognitive preference designed by Xu et al., 2019) or from physical landscape attributes (e.g. Landscape Perception Degree proposed by Li et al., 2012). More recently, social media photos are increasingly being used to quantify the landscape preferences (Seresinhe et al., 2018; Tieskens et al., 2018; Bubalo et al., 2019).

In this paper, a new procedure based on the combination of the participatory scenario development approach and of landscape indices is developed, in which the public preferences are analysed through quantitative landscape indices, from which the scenarios desired by the public are determined. It is therefore the citizens themselves who design the desired scenario.

1.3. Public Participation Geographic Information Systems (PPGIS) for landscape planning

As public participation processes are highly demanding of resources and time, the designed methodology makes use of ICT with the joint objectives of ensuring that the entire population can participate in the process and of obtaining as much information as possible in an efficient way. With this aim, a Public Participation Geographic Information System (PPGIS), that is a GIS-based system to support public participation, was developed. Previous studies have shown that the use of a PPGIS enhances the ability of citizens to express their opinions and perspectives about landscape (Brown & Kyttä, 2014, 2018; Santé et al., 2018; Sieber, 2006). Most of the PPGIS specifically designed for landscape planning are aimed at assessing landscape values (e.g. Beverly, 2008; Brown & Brabyn, 2012; Brown & Raymond, 2007; Brown et al.,

2014; Zhu et al., 2010). More recently, Cerveny et al. (2017) have used a PPGIS for landscape value mapping and to evaluate sentiments and experiences associated with certain locations. Santé et al. (2018) have used a PPGIS to allow people to locate places of special landscape interest, landscape values and degraded areas and de Vries et al. (2013) to identify highly valued places. The PPGIS described in this paper was designed for the specific purpose of defining LQO.

1.4 Objective

This paper focuses on the development of a new methodology that facilitates and objectifies the definition of LQO from the results of a public participation process in a transparent and quantified way. This methodology is based on the combination of the two most frequent approaches for LQO definition – landscape scenarios and indicators – and takes advantage of the capacity of a PPGIS approach to capture public perception of landscape. The proposed methodology, which includes direct and indirect methods to capture public opinion and the technique developed for designing landscape planning scenarios, is described. Use of this methodology for establishing landscape scenarios and LQO in the Landscape Guidelines for Galicia is explained, and the main results and conclusions are presented.

2. Methodology

2.1. Study area

The autonomous region of Galicia (NW Spain) comprises an area of 29 000 km2 and has a population of almost three million people (Fig. 1). The ELC was signed by Spain in 2007, and a year later the Galician Government passed Law no. 7/2008 concerning Landscape Protection, which included landscape inventories and guidelines, among other instruments, for landscape

protection, management and planning. The Landscape Inventory of Galicia (Santé et al., 2018) divided Galicia into 12 big landscape areas and 50 landscape regions (Fig. 1) and identified 258 different landscape types, as a combination of 5 geomorphology categories, 5 climate categories and 12 land use patterns, resulting in 28 350 landscape units (Fig. 2), which are defined as homogeneous regions in terms of landscape type.

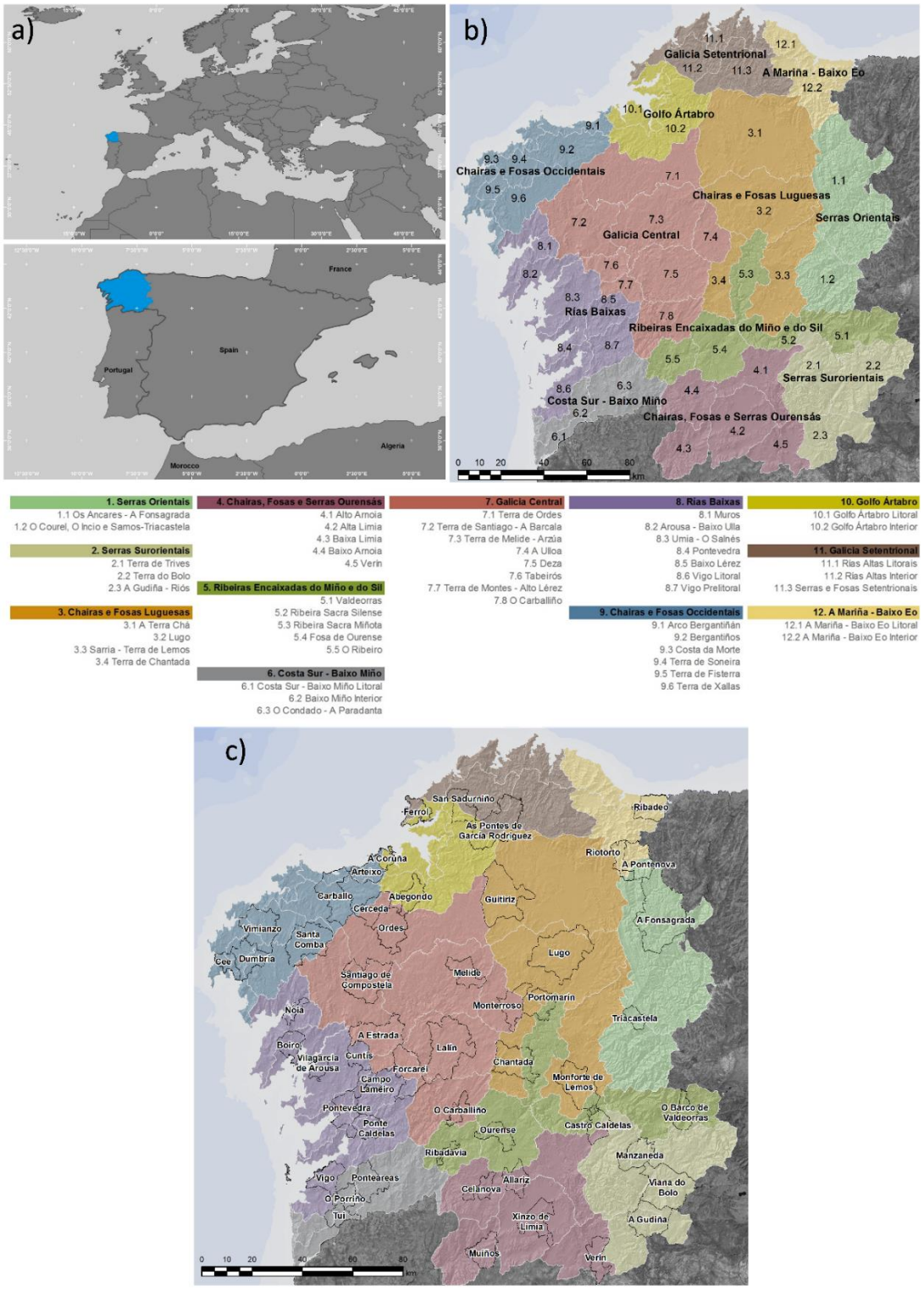


Figure 1. a) Location of Galicia in NW Spain; b) landscape regions and areas of Galicia; c) municipalities where participatory workshops were conducted.

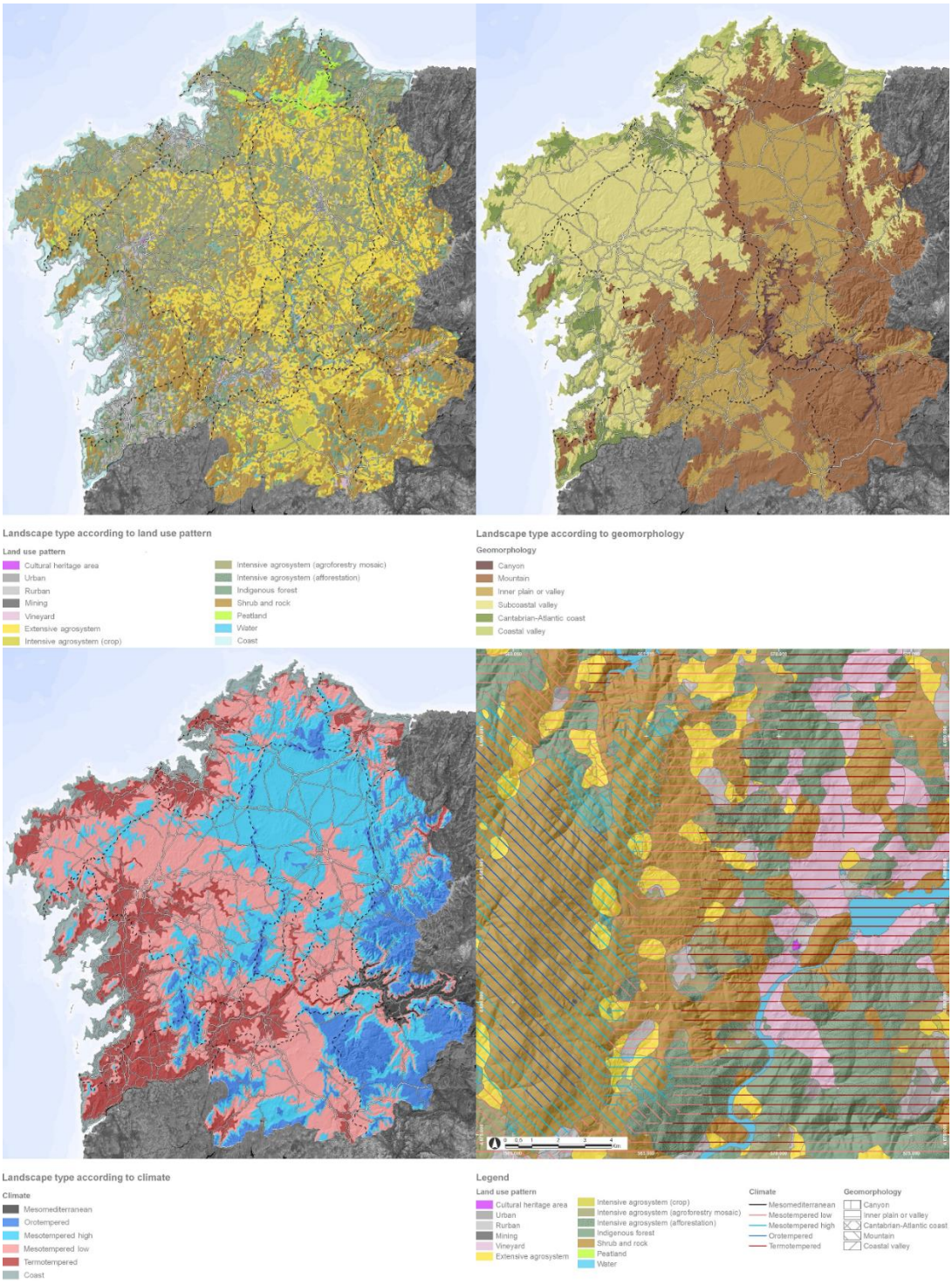


Figure 2. Categories of land use patterns, geomorphology and climate that define the landscape types of Galicia and example of landscape types and units

The Guidelines are an instrument for defining, for each landscape unit delimited in the landscape inventory, the LQO that should be achieved, as well as the rules and recommendations for integrating these LQO in urban and regional planning. Act 7/2008 states that the LQO *"must reflect the citizenship's aspirations related to the public assessment and degree of compromise with landscape protection, so the determination of these LQO must be done through a public participation process"*. Thus, a methodology for LQO definition is proposed which comprises four stages: (1) collection of public opinion, (2) calculation of landscape indices, and (3) definition of landscape planning scenarios and of LQO.

2.2. Collection of public opinion

A web-platform was designed and implemented for facilitating public participation and was available to the public for three months (https://sixot.es/Paisaxe/) in 2016, so that any person could input information or opinions at any moment and from any place. However, with the aim of promoting public participation, participatory workshops were carried out throughout the whole of Galicia, so that the spatial equity of the process was guaranteed and information about local landscapes was obtained. A total of 64 workshops were conducted: one in each of the 50 landscape regions (Fig. 1), and another 14 workshops that were solicited by different associations and administrations.

Workshops were designed so that participants could represent the community by following the same process described in Santé et al. (2018). A database of potential stakeholders was created by searching different sources and registers of companies, associations and public administrations. Firstly stakeholders were contacted by email and some days before the workshop by phone. Workshops were facilitated by sociologists, with the support of the technical team,

who started by introducing the Landscape Guidelines of Galicia, explaining its objectives and contents, as well as the overall process for public participation. The central part of the workshop was dedicated to train people in use of the web platform and to use it. A questionnaire of satisfaction with the workshop was voluntarily filled in by participants.

As mentioned in the introduction, the design of the web platform attempted to integrate both direct and indirect methods in order to overcome the shortages of each. For this purpose, two different activities were implemented: a picture-based survey for a direct assessment of landscape types, and a PPGIS for an indirect approach based on the assessment of the components of landscape scenes.

2.2.1 Picture-based survey

A picture-based survey, similar to that used by Dramstad et al. (2006), was designed to determine the relationship between citizens and the landscape in their region by awarding scores to pictures representing predefined landscape types. The scores were then used to calculate a numerical index for evaluating the level of satisfaction of participants with each landscape type, in a similar way to the landscape measurements calculated by Dramstad et al. (2006) and Tempesta (2014) from scores assigned to pictures.

To complete this survey, the user must previously select the landscape area and region where he or she lives in order to orient the survey to known and familiar landscapes. Six pictures corresponding to the most representative landscape types of that region are then shown. The first three pictures represent the three most extensive landscape types in that landscape region (according to the data of the existing landscape inventory; Santé et al., 2018), and the next three pictures correspond to landscape types that - although possibly not the most extensive - were

selected by the technical team as being characteristic of or significant to the regional landscape, for example, the landscape type of a well-known national park. All pictures were selected by the technical team from those included or used for the elaboration of the mentioned inventory.

Participants expressed their level of satisfaction with each of the six landscape types by selecting one of the following responses to the question "how much do you like this landscape type in your landscape region?", from the drop-down list below each picture: very much; moderately; not at all (Fig. 3). The offered answer options were always three in order to facilitate the election, since as the number of options increases, the cognitive effort for the evaluation increases. The opinions collected via these questions were used to calculate an index of the degree of satisfaction with the current landscape, as explained in detail in section 2.2.

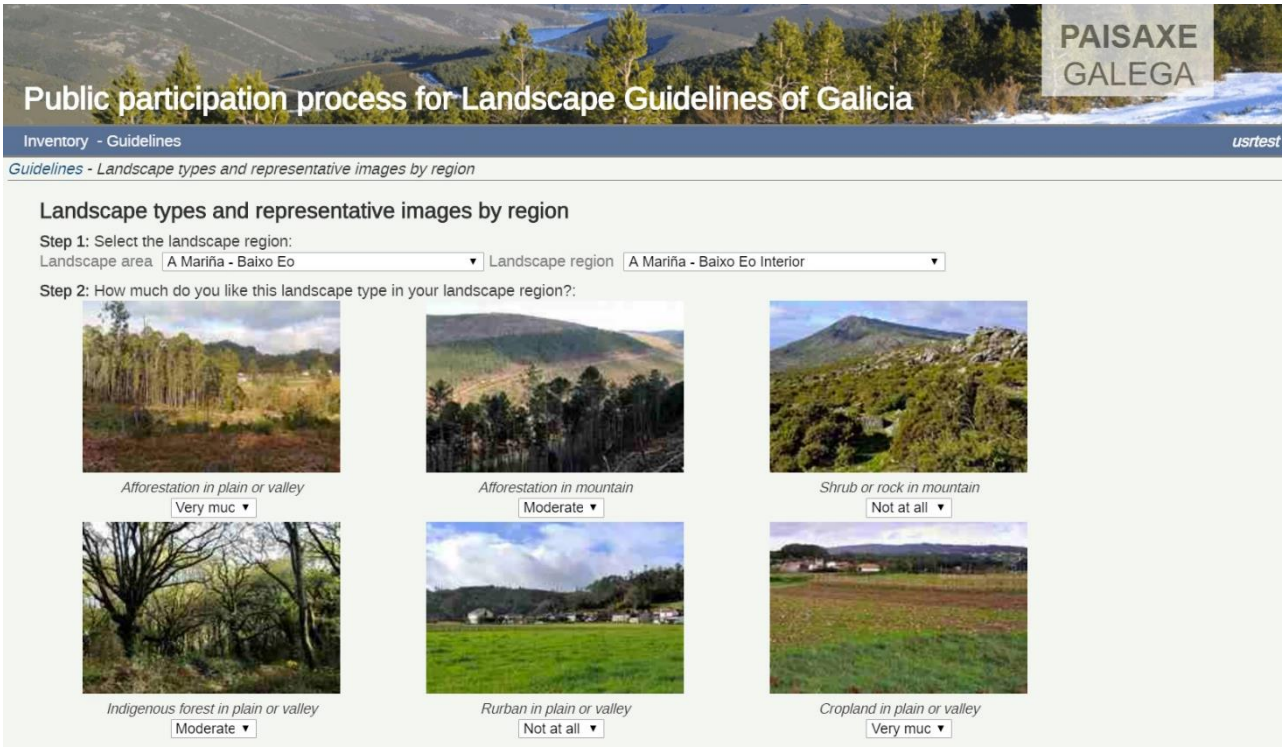


Figure 3. Picture-based survey

2.2.2. Public Participatory Geographic Information System (PPGIS)

The second activity implemented in the web platform made use of a PPGIS consisting of a geographical viewer through which the participants could analyse different landscape scenes. Once the participant selects his or her landscape region, a map of this region appears in the viewer, in which a series of landscape scenes are located by points. The scenes correspond to representative examples of the landscape types identified in the Landscape Inventory of Galicia (Santé et al., 2018), as well as to elements that characterize the landscape and may be present in any landscape type, such as roads, cultural heritage, wind parks, etc. Each landscape scene is located by a point but is composed of diverse landscape components present in that location.

Participants were asked to assess landscape scenes that were known by them. For this, they selected the point corresponding to a known scene in the viewer and assigned it a global score by selecting one of the following responses to the question "Do you like this landscape scene?", from a drop-down list: "very much", "moderately" or "not at all" (Fig. 4). The responses to this question were then used to calculate an index of the degree of satisfaction with the landscape scenes.

In the final part of the form, the participants were required to indicate the existing components of that scene from a list of 24 predefined components (Table 1). When a component was selected, another drop-down list with three possible measures or actions for this component and a text box appeared. The user then selected one of the three predefined actions and/or typed their own proposed action in the box supplied.

The 24 components of the list correspond to the land uses that define the landscape types and to other elements that characterize the landscape (Table 1). Three predefined measures or

actions were considered for each component, corresponding to a protection, management or planning measure, according to the definitions of these concepts established in the article 1 of the ELC (Fig. 4). Considering that planning measures entail a higher degree of intervention in the landscape than management measures, and that the latter imply a higher degree of intervention than the protection measures, an index of required intervention in the landscape was calculated from the selected measures.

Table 1. Landscape components selectable for each landscape scene

Land use	Landscape element
Cropland	Beaches and dunes
Meadow and pasture (extensive agrosystem)	Agricultural terraces, traditional fences and hedges
Agroforestry mosaic	Material cultural heritage (archaeologic, historical and ethnographic elements)
Afforestation	Intangible cultural heritage (legends, celebrations and traditions)
Indigenous forest (e.g. oak or chestnut forest)	St. James way, traditional ways and hiking routes
Vineyard	Traditional rural settlements
Shrub, rock or cliff	Lookouts and viewpoints
Urban area	Industrial state
Rurban area	Thermal power or hydroelectric plants
Cultural heritage area	Wind farms
Mining	Big infrastructures and transportation networks
Water (rivers and lakes)	
Peatland	

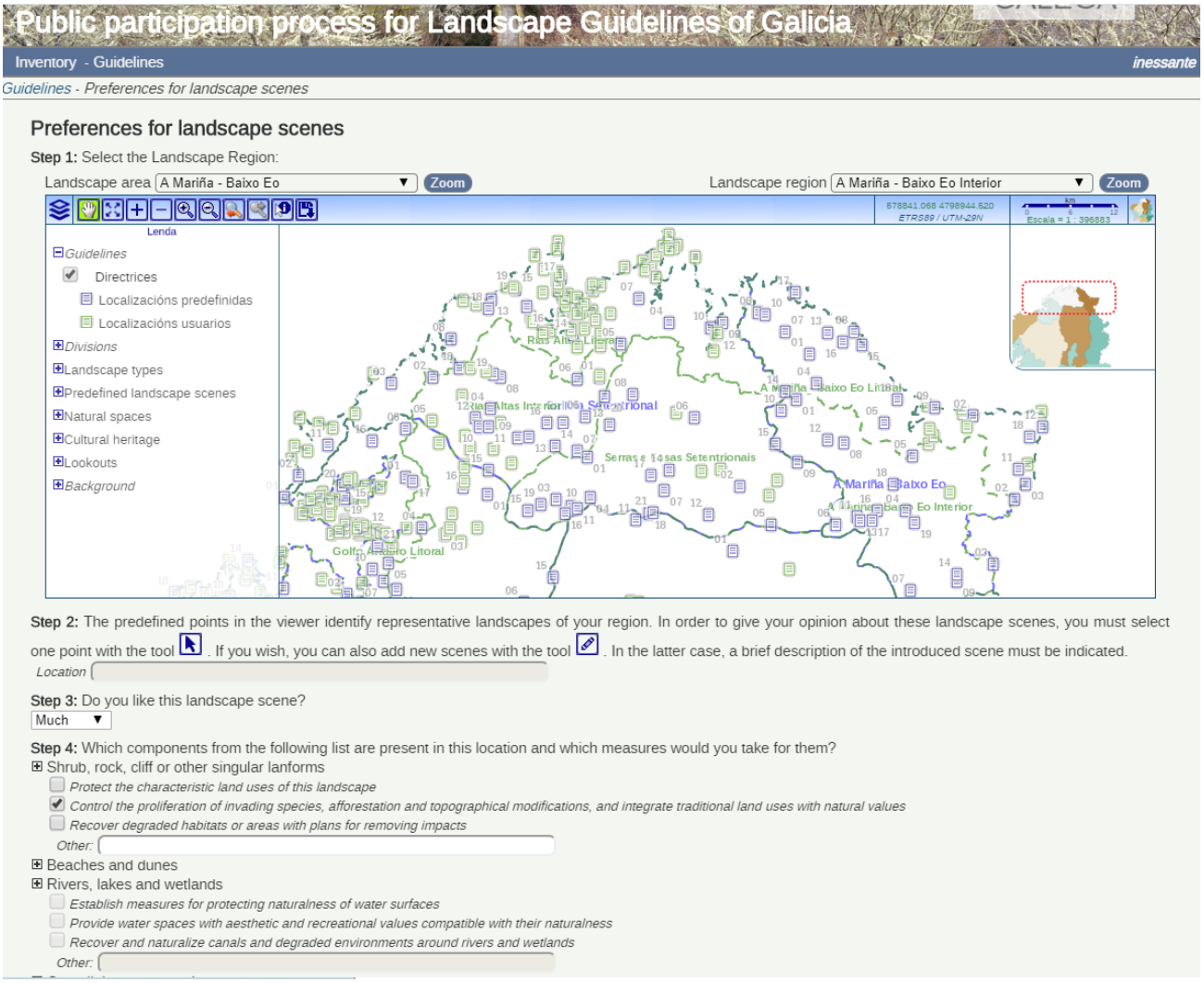


Figure 4. Public Participatory GIS

In addition to assessing the predefined scenes, the users were able to propose, locate and assess new landscape scenes. Viewer navigation tools were used for this purpose, to identify the desired location on the map and create a point for a new landscape scene, which was then assessed in the same way as the predefined scenes.

2.3. Landscape indices

The information obtained by public participation via the web platform was used to estimate the degree of public satisfaction with landscape, as well as the degree of required

intervention in the landscape. The methodology used for the calculation of these indices is developed below.

Index of satisfaction with the landscape type (S_t)

The satisfaction index reflects the pleasant feeling that people gets from the landscape perception and was obtained from the results of the picture-based survey. The responses to the question "how much do you like this landscape type in your landscape region?" reflect the degree of satisfaction of participants with the landscape types that occupy the greatest extension or characterize the region, calculated using the following equation:

$$S_t = \sum (V_{vt} \ x \ Nv_t) / N_t \quad (1)$$

where S_t is the index of satisfaction with the landscape type *t*, N_{vt} is the number of times that the score *v* is assigned to the landscape type *t*, N_t is the number of total answers for the landscape type *t* and V_{vt} is the score assigned to the landscape type *t*: V_v is 1 if the response is "very much", 0.5 if it is "moderately" and 0 if it is "not at all". The resulting value (S_t) reflects the degree of satisfaction with each landscape type.

Index of satisfaction with the landscape scene (S_s)

The regional landscape assessment can be addressed by the global evaluation of the most representative landscape types but also by the indirect evaluation of landscape components and of smaller areas with particular or outstanding characteristics. For this, assessment of landscape scenes was therefore included in the landscape evaluation of a specific region. From the responses to the question "Do you like this landscape scene?" implemented in the PPGIS, the index of satisfaction with the landscape scene was calculated using the following equation:

$$S_S = \sum (V_{vS} \ x \ N_{vS}) / N_S \quad (2)$$

where S_s is the index of satisfaction with the landscape scene *s*, N_{vs} is the number of times that the score *v* is assigned to the scene *s*, N_s is the number of total answers for the scene *s* and V_{vs} is the score assigned to the scene *s*: V_v is 1 for the response "very much", 0.5 for the response "moderately" and 0 for the response "not at all".

Index of satisfaction with the landscape area (S_{LA})

This index was obtained as the average of the index of satisfaction with the landscape types of a specific landscape area (S_{tLA}) and the index of satisfaction with the landscape scenes of a landscape area (S_{sLA}):

$$S_{LA} = (S_{tLA} + S_{sLA}) /2 \quad (3)$$

where S_{LA} is the index of satisfaction with the landscape area, $S_{tLA} = \sum S_t /T$, in which *T* is the number of landscape types assessed in that landscape area, $S_{sLA} = \sum S_s /S$, and *S* is the number of landscape scenes assessed in that landscape area. This index reflects the degree of global satisfaction with the landscape in a specific landscape area.

Index of intervention for landscape type (I_t)

This index is obtained from the measures selected in the PPGIS for each landscape type in the landscape scenes (see example of Fig. 4). Each of the three types of measures is assigned a numerical score that indicates the corresponding degree of intervention in the landscape in terms of the required amount of resources and the level of landscape transformation involved. In this way, the index of required intervention (I_t) was calculated using the following equation:

$$I_t = \sum(V_{vt} \ x \ N_{vt})/N_t \quad (4)$$

where I_t is the index of intervention for landscape type *t*, N_{vt} is the number of proposed measures for the landscape type *t* that imply a degree of intervention *v*, N_t is the total number of measures

selected for the landscape type *t*, and V_{vt} is the score assigned according to the degree of intervention *v* of the proposed measure for the landscape type *t*: V_v is 1 if the proposed measure is a planning measure (high degree of intervention), 0.5 if it is a management measure (intermediate degree of intervention) and 0 if it is a protection measure (low degree of intervention).

Index of intervention for element (I_e)

A similar index of required intervention was calculated for the elements characterizing the landscape scenes from the measures selected in the PPGIS for each element. This index is calculated by the following expression:

$$I_e = \sum(V_{ve} \ x \ N_{ve})/N_e$$

where I_e is the index of required intervention for the element *e*, N_{ve} is the number of proposed measures for the element *e* that implies a degree of intervention *v*, N_e is the total number of measures selected for the element *e*, and V_{ve} is the score assigned according to the degree of intervention *v* of the proposed measure for the element *e*: V_v is 1 if the proposed measure is a planning measure (high degree of intervention), 0.5 if it is a management measure (intermediate degree of intervention) and 0 if it is a protection measure (low degree of intervention).

Index of intervention for landscape area (I_{LA})

The index of required intervention for a specific landscape area was calculated as the average of the indices of intervention for landscape types and elements assessed in that area, by using the following expression:

$$I_{LA} = (I_{tLA} + I_{eLA})/2$$

where I_{LA} is the index of intervention for landscape area, $I_{tLA} = \sum I_t /T$, in which *T* represents the number of landscape types assessed in that landscape area, and $I_{eLA} = \sum I_e/E$, in which *E*

represents the number of elements assessed in that landscape area. This index reflects the degree of global intervention required by population for the landscape of that specific area.

2.4. Landscape planning scenarios

A new procedure for participatory scenario development is proposed, in which the public opinion for each landscape type is first analyzed through quantitative indices and the planning scenarios are then designed from the results of these indices. Cartesian axes are used in designing these scenarios, in which the index of satisfaction with the landscape type (S_t) and the index of intervention for the landscape type (I_t) are represented. The intersection of the values of both indices enables identification of the different situations of acceptance and desire for modification of the current landscape, from which the landscape planning scenario is determined (Fig. 5). The four considered scenarios correspond to the definition of landscape protection, management and planning established in the article 1 of the ELC and mentioned in the article 6.E as the three types of aims for landscape instruments:

Scenario 1: **Management (protection)**; high level of satisfaction and intervention required.

Scenario 2: **Planning**; low level of satisfaction and high level of intervention required.

Scenario 3: **Protection**; high level of satisfaction and low level of intervention required.

Scenario 4: **Management (planning)**; low level of satisfaction and intervention required.

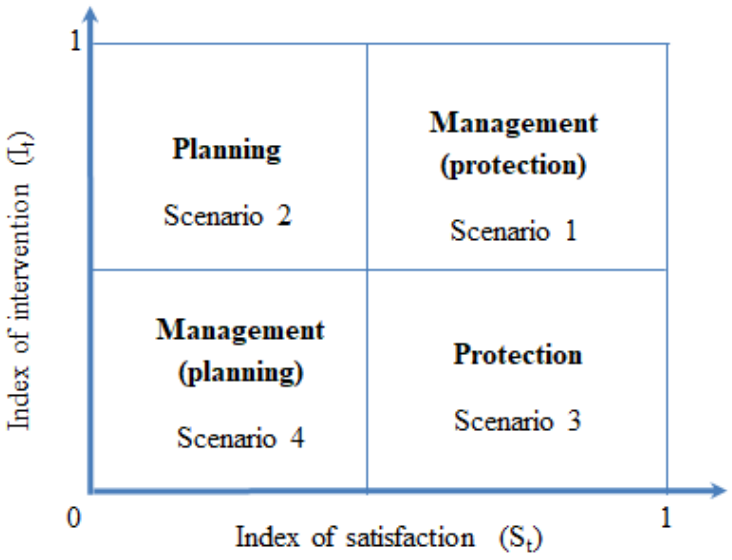


Figure 5. Landscape planning scenarios

These types of scenarios are also similar to the guidelines for maintenance, improvement or restoration of landscape quality defined by Sowinska-Swierkosz and Chmielewski (2016). Scenario 2 involves the demand for planning measures, as a low level of satisfaction with the landscape makes people feel that it is necessary to invest resources and carry out actions to restore, improve or transform that landscape. Scenario 3 implies protection, i.e. the degree of satisfaction with the landscape is high so there is no need to intervene or modify the landscape beyond conserving the current characteristics and quality. Scenarios 1 and 4 mainly correspond to management measures, although with different bias, as in the first there is a high level of satisfaction with the landscape and in the second the level of satisfaction is low, so that the tendencies are towards respectively protection and planning. Scenario 1 corresponds to well-valued landscapes but in which there is a recognised need for active intervention to ensure maintenance of that status. By contrast, in scenario 4, despite the low level of satisfaction with the landscape, the public did not feel the need for landscape intervention or improvement.

In addition, the planning scenarios for each landscape area are defined from the indices of satisfaction and intervention for landscape area. The LQO for each landscape type and area were established according to the resulting scenario for each landscape type or area, aimed at conserving the current landscape characteristics, improving them or ensuring their appropriate management. The elaboration of LQO was also supported by the measures proposed by citizens through use of the PPGIS.

3. Results

3.1. Results of the public participation process

Almost four thousand people were invited and finally a total of 776 people participated in the workshops. At the end of the public participation process, 882 users had registered into the web, corresponding both to participants in workshops and to other people who accessed the web independently. Some of the users registered in the workshops were used to introduce the opinions of several persons in order to facilitate participation to people without computer skills, so one only user could complete several surveys. Finally, 988 picture-based surveys were completed, 948 predefined scenes were assessed and another 1254 new scenes were located and evaluated. A total of 2202 scenes were assessed, for which 25 626 protection, management or planning measures were selected, and 1399 new measures were proposed by use of the PPGIS.

The results of the questionnaire of satisfaction showed that workshops were “well” or “very well” assessed by 86% of participants and 93% indicated as “very important” or “important” this type of public participation processes. Regarding the web-platform and PPGIS, they were useful for 94% of the participants and easy to use for 75%. The negative aspects most

frequently indicated were the speed of the geographical viewer, the ease of use and the lack of flexibility in the answers.

3.2. Results of landscape indices and definition of landscape planning scenarios

3.2.1 Assessment of landscape types

3.2.1.1 Satisfaction with landscape types

Landscape types characterized by natural values, such as indigenous forest, coastal landscape and some canyon landscapes (water, indigenous forest and vineyards) are among the most appreciated (Table 2). The remaining aquatic landscapes and the extensive agrosystems came in second place, although very close to the previous types. The final landscape types with positive assessments correspond to agricultural - cropland or vineyards in plains or valleys - and to shrub landscapes in mountainous areas.

Table 2. Index of satisfaction with each landscape type in Galicia and in the 12 big landscape areas (BLA)

Landscape type	Index of satisfaction												
	Galicia	BLA 1	BLA 2	BLA 3	BLA 4	BLA 5	BLA 6	BLA 7	BLA 8	BLA 9	BLA 10	BLA 11	BLA 12
Sheet of water in canyon	**0.93***	**0.92**	**0.93**			**1.00**					0.88		
Sheet of water in plain or valley	**0.90**			**0.99**	0.75	**0.92**	**0.93**	**0.92**	**0.93**	**0.92**		0.86	**0.91**
Sheet of water in mountain	0.84		0.79						0.88				
Shrub or rock in canyon	0.64					0.64							
Shrub or rock in plain or valley	0.65	0.67			0.63	0.75		0.66	0.62	0.60	0.82	0.43	
Shrub or rock in mountain	0.80	0.78	**0.94**	0.64	0.80	0.86	0.86	0.79	0.79		0.81	0.71	0.80
Indigenous forest in canyon	**0.94**					**0.91**					**0.98**		
Indigenous forest in plain or valley	0.87	0.75	**0.92**	**0.91**	0.75	**1.00**		**0.96**				**1.00**	0.71
Indigenous forest in mountain	**0.97**	**0.93**			**1.00**			**0.95**				**1.00**	**0.95**
Intensive agrosystem (cropland) in plain or valley	0.80			0.71	0.88			**0.94**		0.78			0.68
Intensive agrosystem (cropland) in mountain	0.62		0.51	0.67	0.79			0.50					
Intensive agrosystem (afforestation) in canyon	*0.25*										*0.25*		
Intensive agrosystem (afforestation) in plain or valley	*0.26*			*0.16*	*0.13*	0.40	0.33	*0.26*	*0.25*	0.34	*0.14*	0.33	*0.23*
Intensive agrosystem (afforestation) in mountain	0.38		*0.29*	0.47	0.39	*0.15*	0.38		0.50			0.47	0.42
Intensive agrosystem (agroforestry mosaic) in canyon	0.25										0.25		
Intensive agrosystem (agroforestry mosaic) in plain or valley	0.26			0.16	0.13	0.4	0.33	0.26	0.25	0.34	0.14	0.33	0.23
Intensive agrosystem (agroforestry mosaic) in mountain	0.42		0.29	0.47	0.39	0.4	0.38		0.5			0.47	0.42
Extensive agrosystem in plain or valley	**0.90**	0.80		0.89	**0.96**	**0.93**		**0.91**	**0.91**	**0.93**		0.83	
Extensive agrosystem in mountain	0.85	0.86	0.84	0.81	**0.93**	0.74		**0.90**					
Vineyard in canyon	**0.96**		**0.93**			**1.00**							
Vineyard in plain or valley	0.78				0.88	0.86	0.63		0.74				
Urban in plain or valley	0.34			0.32	0.50	*0.21*	0.38	0.35	0.33	0.31	0.30		
Cultural heritage area in plain or valley	0.34			0.32	0.50	*0.21*	0.38	0.35	0.33	0.31	0.3		
Rurban in plain or valley	0.74	0.69		0.67	**0.94**	0.60	0.87	0.72	0.72	0.68	0.73		0.76
Rurban in mountain	0.51		0.51										
Mining in plain or valley	*0.20*				*0.13*		*0.21*	*0.18*		*0.17*		0.33	
Mining in mountain	*0.16*	*0.10*	*0.21*			*0.21*						*0.12*	
Coastal valley	**0.95**						**1.00**		**0.97**	**0.95**	**0.99**	0.82	**0.95**

* Highest scores in bold, lowest in italics

On the opposing side are the landscape types with a very low index of satisfaction, including the mining landscapes, followed closely by afforested landscapes, although in this case

these landscapes are better tolerated when they are on mountains, indicating a preference for afforestation in traditional forest areas. The remaining landscape types with an index of satisfaction lower than 0.5 correspond to built landscapes, with urban landscape obtaining the lowest scores.

The analysis of the most outstanding scores and of those different from the regional average show that afforestation landscapes in plains or valleys were awarded some of the lowest scores in landscape areas 3 and 4, which correspond to the regions of Galicia where the highest levels of afforestation have occurred in recent years. However, the same areas were characterized by the highest levels of satisfaction for afforestation in mountain zones. Area 11 obtained the maximum scores for the landscapes of indigenous forest, both in mountain areas and in plains or valleys, and at the same time some of the highest scores for the afforestation landscapes (the most extensive landscape type in this area). Afforestation landscapes also obtained a high score (0.5) in area 8, where afforestation is one of the most frequent landscape types; however, in area 10, where afforestation is also the third most extensive landscape type, the lowest score was obtained for afforestation in plains or valleys.

Landscape area 5 is a very particular zone, characterized by the canyons of the two main rivers of Galicia, and with exceptional landscape values, as reflected by the maximum scores of the indices of satisfaction for aquatic landscapes, vineyards in canyons and indigenous forest in valleys. It can also be highlighted the high public satisfaction with the landscape types linked to productive agricultural values in area 7, especially when these landscapes were located in the fertile valleys in this area, and in area 4.

3.2.1.2 Required intervention in the landscape types

The landscape types that demand a higher level of intervention are those related to mining, followed at some distance by the rurban landscape (Table 3). A lower degree of intervention was indicated for the urban landscape, although the index value (0.51) still reflects a need for intervention. Finally, the last landscape types which the participants wished to modify are the afforestation and agroforestry mosaic landscapes.

Table 3. Index of required intervention in each landscape type in Galicia and in the 12 big landscape areas (BLA)

Landscape type	Index of intervention												
	Galicia	BLA 1	BLA 2	BLA 3	BLA 4	BLA 5	BLA 6	BLA 7	BLA 8	BLA 9	BLA 10	BLA 11	BLA 12
Sheet water in canyon	0.46	0.43	0.41			0.48					0.50		
Sheet water in plain or valley	0.44			0.44	0.35	0.48	0.42	0.42	0.47	0.44		0.45	0.50
Sheet water in mountain	0.48		0.49						0.47				
Shrub or rock in canyon	0.38					0.38							
Shrub or rock in plain or valley	0.41	0.35			0.36	0.40		0.45	0.49	0.40	0.41	0.42	
Shrub or rock in mountain	0.41	0.35	0.41	0.42	0.36	0.38	0.43	0.45	0.49		0.41	0.42	0.42
Indigenous forest in canyon	0.45					0.47					0.42		
Indigenous forest in plain or valley	0.43	0.42	0.42	0.44	0.41	0.47		0.44				0.44	0.37
Indigenous forest in mountain	0.42	0.42			0.41			0.44				0.44	0.37
Intensive agrosystem (cropland) in plain or valley	0.48			0.59	0.48			0.42		0.49			0.43
Intensive agrosystem (cropland) in mountain	0.50		0.50	0.59	0.48			0.42					
Intensive agrosystem (afforestation) in canyon	0.54										0.54		
Intensive agrosystem (afforestation) in plain or valley	0.46			0.44	0.57	0.49	0.42	0.39	0.38	0.46	0.46	0.46	0.51
Intensive agrosystem (afforestation) in mountain	0.47		0.50	0.44	0.57	0.49	0.42		0.38			0.46	0.51
Intensive agrosystem (agroforestry mosaic) in canyon	0.46										0.46		
Intensive agrosystem (agroforestry mosaic) in plain or valley	0.55			0.5	0.5	**0.75**	0.49	0.52	0.56	0.52	0.54	**0.63**	0.53
Intensive agrosystem (agroforestry mosaic) in mountain	0.56		0.55	0.5	0.5	**0.75**	0.49		0.56			**0.63**	0.53
Extensive agrosystem in plain or valley	0.49	0.53		0.38	0.41	**0.60**		0.43	0.52	0.47		0.57	
Extensive agrosystem in mountain	0.46	0.53	0.52	0.38	0.36	**0.60**		0.34					
Vineyard in canyon	0.51		0.50			0.52							
Vineyard in plain or valley	0.46				0.44	0.52	0.44		0.42				
Urban in plain or valley	0.51			0.56	0.52	0.52	0.45	0.43	0.49	0.47	**0.60**		
Cultural heritage area in plain or valley	0.45			0.44	0.5	0.49	0.46	0.42	0.47	0.43	0.39		
Rurban in plain or valley	0.57	**0.73**		**0.64**	0.46	**0.60**	0.54	0.50	0.54	0.58	0.59		0.52
Rurban in mountain	**0.60**		**0.60**										
Mining in plain or valley	**0.69**				**0.67**		**0.76**	**0.62**		**0.64**		**0.74**	
Mining in mountain	**0.70**	**0.88**	**0.67**			0.49						**0.74**	
Coastal valley	0.41						0.39		0.43	0.20	0.49	0.45	0.50

* Highest scores in bold

The analysis of each landscape type and area reveals some exceptional values of the index of intervention. Landscape area 5 received very high scores for required intervention, which

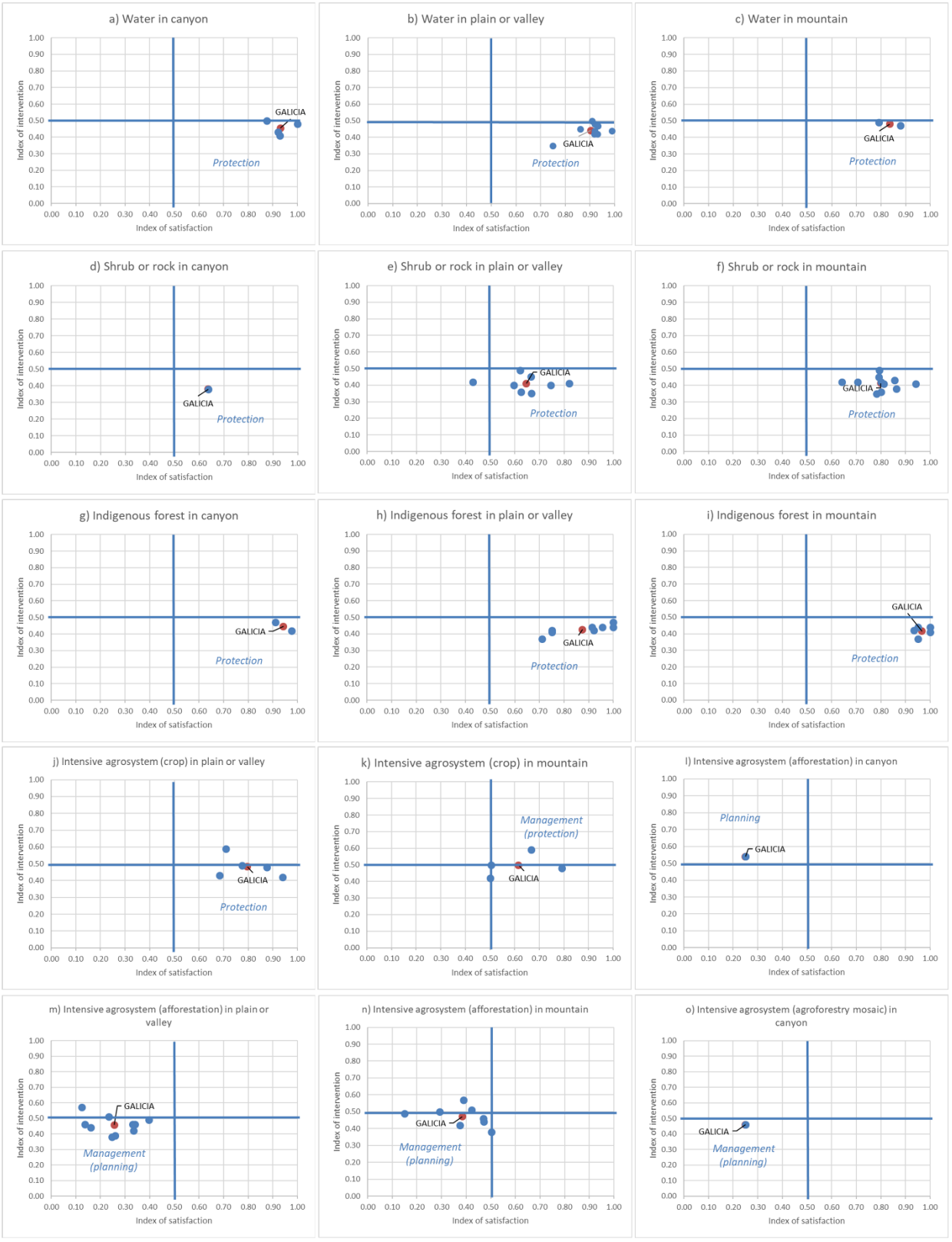
reached maximum values in the case of the landscapes of indigenous forest, extensive agrosystems and vineyards, even though these same landscape types are associated with a high degree of public satisfaction. River canyons obtained the highest index of intervention in area 10, where this landscape type is not frequent but corresponds to a natural park. This area also obtained the highest index of intervention recommended for urban land, which may be related to the intense development of the coastal zone. Finally, intervention was highly recommended for afforestation in area 4 and cultivated land in area 3, both of which are inner rural land areas where these landscape types are very important.

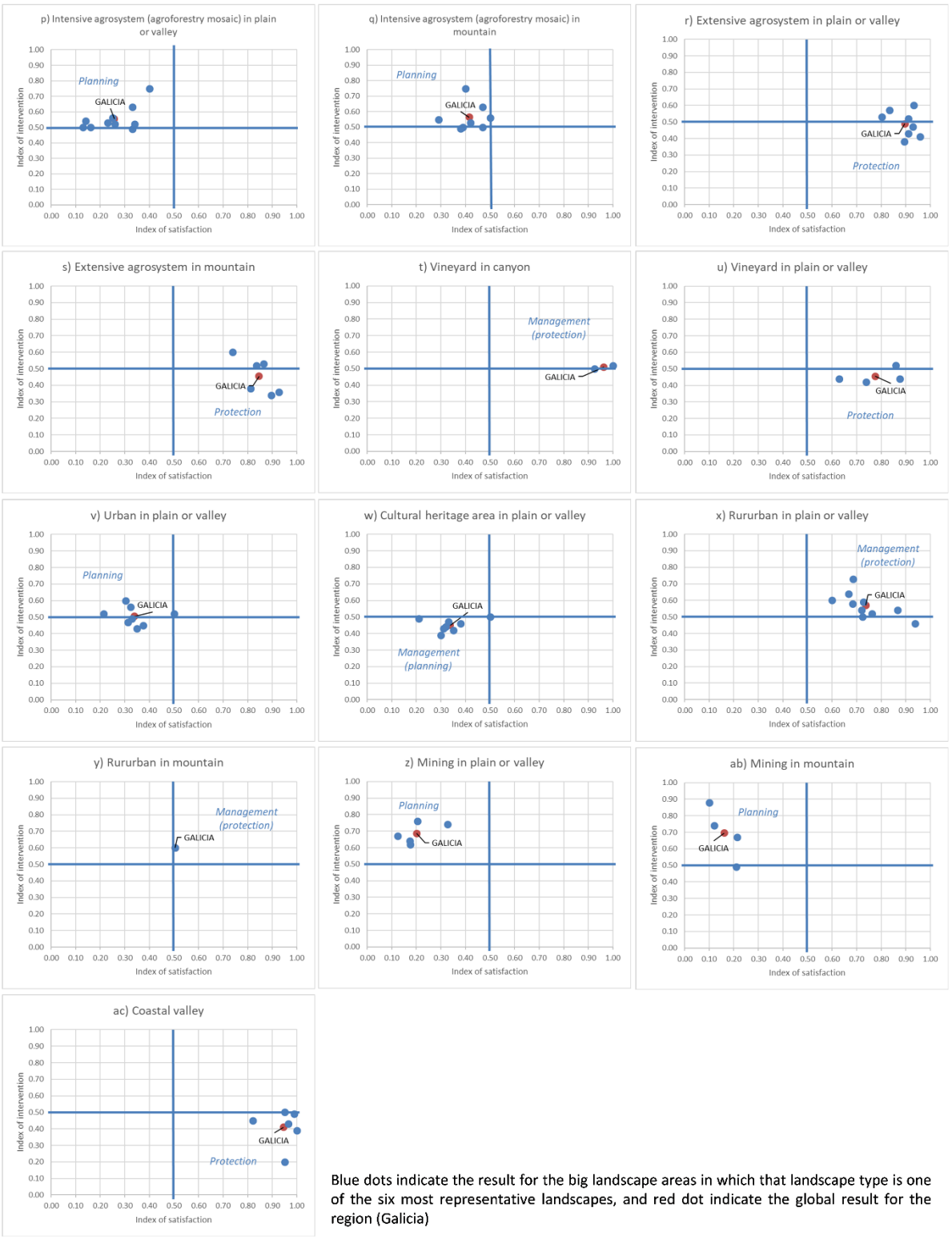
3.2.1.3 Landscape planning scenarios for landscape types

The most highly valued landscape types, specifically those that stand out by their natural values, i.e. coastal areas, water or indigenous forest landscapes, present a protection scenario (Fig. 6a-c, g-i, ac). The exception was vineyard, for which management scenario was recommended in canyon, whereas for vineyards plains or valleys, protection was indicated, except in area 5, where a management scenario is obtained (Fig. 6t-u). The other agricultural landscape types, cropland or extensive agrosystems, obtained a protection or management scenario depending on the landscape area (Fig. 6j-k, r-s). For the remaining highly valued landscape types, protection was recommended in the case of shrub landscapes (Fig. 6d-f) and management in the case of rurban landscapes (Fig. 6x-y). The latter landscape refers to the continuous fragmented mix of rural and urban features (Zaleskiene & Grazuleviciute-Vileniske, 2014).

For those landscape types awarded a low index of satisfaction, a planning or management (planning) scenario is always obtained, including mining and urban landscapes (Fig. 6v, z-ab).

Afforestation landscapes, corresponding to eucalyptus and pine plantations, are a special case in which the resulting scenario (Fig. 6l-n) is planning or management (planning).





Blue dots indicate the result for the big landscape areas in which that landscape type is one of the six most representative landscapes, and red dot indicate the global result for the region (Galicia)

Figure 6. Landscape planning scenarios for different landscape types

3.2.2 Assessment of landscape areas

For all of the landscape areas, except one, a global scenario of landscape management is obtained (Fig.7), due to the high degree of public satisfaction with the current landscape but also to consciousness-raising about the need for landscape planning and management (Table 4). The highest index of satisfaction corresponded to landscape area 5, in accordance with the exceptional landscape characteristics in this area (Fig. 8). Areas 1, 2 and 4 also scored above average because of their great natural values. The poorest valued landscape areas were areas 9, 10 and 11, which have large extensions of afforestation and extensive agrosystems, giving rise to landscapes characterized by low diversity and a shortage of more highly valued landscapes, with the exception of the coastal zone in area 10, characterised by a high degree of urban development that is also low valued.

Table 4. Global indices of satisfaction and intervention in Galicia and in the big landscape areas

Landscape area	Index of satisfaction	Index of intervention
1. Serras Orientais	**0.82***	0.55
2. Serras Surorientais	**0.80**	0.48
3. Chairas e Fosas Luguesas	0.75	0.55
4. Chairas, Serras e Fosas Ourensás	**0.82**	0.48
5. Ribeiras Encaixadas do Miño e do Sil	**0.85**	0.55
6. Costa Sur-Baixo Miño	0.71	0.50
7. Galicia Central	0.77	0.51
8. Rías Baixas	0.78	0.51
9. Chairas e Fosas Occidentais	*0.63*	0.51
10. Golfo Ártabro	*0.73*	0.56
11. Galicia Setentrional	*0.73*	0.52
12. A Mariña-Baixo Eo	0.76	0.56
Galicia	0.75	0.52

* Highest scores in bold, lowest in italics

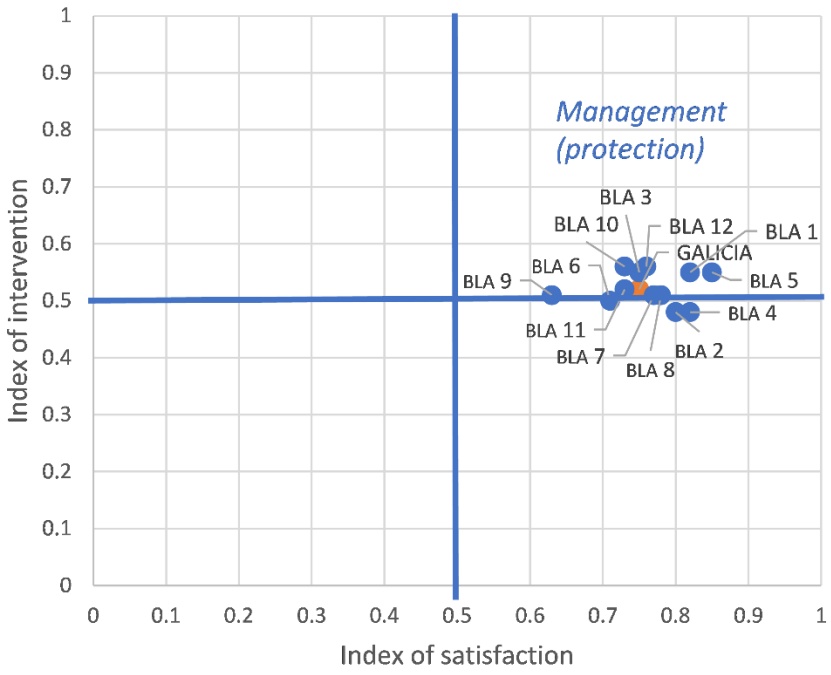


Figure 7. Landscape planning scenario in each landscape area and in Galicia

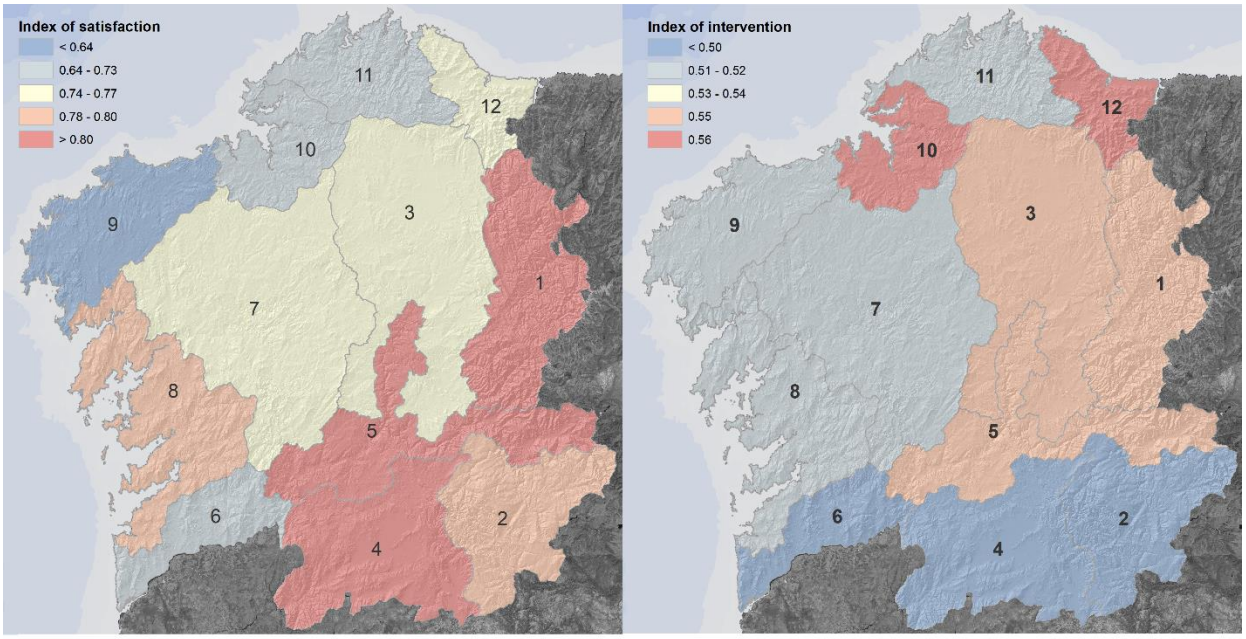


Figure 8. Maps of indices of satisfaction and intervention

3.3. Definition of landscape quality objectives

General LQO for each landscape area and specific LQO for each landscape type in each area were defined from the resulting participatory scenarios in order to accomplish the ELC's requirements. LQO were written by planners, establishing for each landscape type (land use and geomorphology) the general objective of the landscape planning scenario (protection, management or planning) and relating this objective to the specific characteristics of the landscape type. For example, for the landscape type of extensive agrosystem in mountain areas the following LQO were defined:

Protection; an extensive agrosystem in mountains with productive and aesthetic values that must be preserved, in which structural cultural elements -such as fences and hedges- should be kept and fauna and flora respected, thus preventing overuse of the land and forest fires.

Management; a harmonic combination of the extensive agrosystem landscape in mountains with shrub, rock and forest areas should be maintained, preventing the destruction of cultural heritage elements and the proliferation of shrub or residual forest generated by abandonment processes and ensuring an ecological cycle that provides natural grazing.

Planning; landscape of extensive agrosystem in mountains in which areas that undergo abandonment processes should be put into production or used to improve the hydrological cycle, where traditional fences and hedges should be restored and new, suitable fences constructed.

In total, 71 LQO were defined for the one to four landscape planning scenarios (protection, planning, management-protection and management-planning) obtained for 28 different landscape types (see Appendix A).

4. Discussion

The global results of the public assessment of landscape types show constant values of both indices of satisfaction and intervention throughout the different landscape areas, although some particularities were noted, mainly reflecting territorial characteristics or problems typical of a specific area. One example of these particularities is the high value ascribed to the shrub and rocky mountainous landscape in area 1, which includes protected natural spaces of great landscape value in which the mountainous landscape with shrub or brushwood predominates (Fig. 9). The general coherence and match between scores for each landscape type throughout the different areas validates the public participation process. This coherence proves that factors

influencing landscape preferences, such as familiarity with the landscape or social background (Dramstad et al., 2006; van Zanten et al., 2014), were considered in the public participation process.

Figure 9. Natural Park “O Invernadeiro” landscape area 1

In general, the landscape types with the highest indices of satisfaction are those with the best natural values, which is consistent with the results of multiple studies (e.g., Bulut & Yilmaz, 2008; Lindemann-Matthies et al., 2010; De Vries et al., 2013; Schirpke et al., 2013; Tieskens et al., 2018) . On the contrary, the lowest indices of satisfaction correspond to mining and afforested landscapes as shown in previous studies (Tahvanainen et al., 1996; Grêt-Regamey et al., 2007; Svobodova et al., 2012). Regarding afforested landscapes, low satisfaction is justified by the negative perception of low species-richness (Lindemann-Matthies et al., 2010) and homogeneous (Schirpke et al., 2013) landscapes. Differences on scores for afforested landscapes in plains or valleys and in mountain zones suggest the public aspiration to locate these landscapes in the areas traditionally allocated to this land use, which coincides with the results of Karjalainen & Komulainen (1998), who found that location was the most important factor affecting afforestation

preferences. However, there is not a clear relationship between the public perception of afforested landscapes and their frequency in the landscape area, whereas cultivated land is best valued in areas 4 and 7, where is one of the most extensive landscapes and the agricultural activity is more important in the area.

The relationship between the scores for satisfaction and intervention indices is direct and inverse only for the case of mining landscapes but not for the remaining types. This study's results show that some landscapes types with high indices of satisfaction present also a high demand of intervention. This is the case of ruruban landscape, which supposes a modification of the traditional settlement model that is well-valued by population (Bulut & Yilmaz, 2008). In the same way, other landscape types much appreciated by local people also show high demand of intervention, such as cultivated land in area 3, a river canyon in area 10 that preserves the best Atlantic forest of Galicia or indigenous forests and vineyards in area 5. People recognizes the need for intervention due to a requirement for active management of landscapes (e.g. vineyards cultivated in small steep terraces in area 5) or to certain aspects of landscapes that can be improved (e.g. the Atlantic forest of area 10 is threatened by the expansion of the afforestation with allochthonous species).

The combination of indices of satisfaction and intervention provided landscape scenarios according to the three strategies defined in the ELC: protection, management and planning. Most highly valued landscapes led to protection scenarios that reflect the public desire to maintain the current characteristics, with the exception of vineyards, for which management scenarios where obtained because of the requirement of an intensive management, specifically in area 5, where this need is particularly important because vineyard is carried out in narrow steeply sloping

terraces (van der Sluis et al., 2014). Protection or management scenarios are also obtained by agricultural landscapes, which are greatly appreciated by public, who also recognize the need for human intervention for their correct management. The scenarios for the remaining highly valued landscapes are protection (shrub) or management (rurban) according to the degree of intervention required for their adequate maintenance and evolution.

Planning or management (planning) scenarios are always allocated to low valued landscapes such as mining, confirming the positive influence of mining restoration (Svobodova et al., 2012), and urban lands. The management (planning) scenarios for afforested landscapes are a special case in which the high degree of public dissatisfaction with these landscape types (the second lowest valued type) contrasts with the low demand for intervention, which indicates different perceptions for this landscape, as reported by Anderson et al. (2013), probably due to the productive and economic value of this land use. However, this can also be interpreted as the public believing that intervention would not improve the perception of these landscapes, on the contrary to the results of Karjalainen & Komulainen (1998), who found that an appropriate location and shape of the afforestation can improve it.

The analysis of global results by landscape area reveals that, interestingly, the degree of satisfaction was not proportionally inversely related to the required degree of intervention, but even some of the areas with a high degree of satisfaction are also those that demand a higher degree of intervention. This may be because, among other factors, the economic activities (tourism, viticulture, etc.) in these areas are closely related to landscape.

In this way, the landscape scenarios were defined directly from the public assessments and the LQO were written to reflect the resulting scenarios as precisely as possible, so that the

ELC's requirement about defining LQO after public consultation is accomplished in a transparent and justified way. A systematic methodology is proposed, in which the relationship between public opinion and LQO is clear and evident, and contributes to bridging the gap between the public participation processes and the final definition of LQO (Prieur & Durousseau, 2006). The translation of public opinion into landscape planning scenarios by using quantitative indices offers a more objective technique than the direct interpretation of stakeholders' opinions (Van Eetvelde & Antrop, 2011) or of the results of personal interviews or questionnaires (Burgui et al., 2017; Sevenant & Antrop, 2010). The proposed methodology takes advantage of quantification and objectivity provided by landscape indices, which are similar to those previously used in many studies (Dramstad et al., 2006; Walz et al., 2007; Sowinska-Swierkosz & Chmielewski, 2016), to go a step further in systematizing the definition of landscape scenarios (Loupa Ramos, 2010). However, the stage of definition of LQO from the resulting landscape scenarios still involves subjective decisions by planners, who must write the final wording of LQO. Despite this, the planners' decisions must always be subject to the global objective of protection, management or planning identified by population. The scenarios obtained in the case study are coherent and consistent with previous studies about landscape preferences, which proves the methodological consistency.

5. Conclusions

This paper reports a proposed new methodology that enables compliance with the ELC's statement that the LQO must reflect the "aspirations of the public" in a transparent and justified manner, by objectively analysing the information provided by the public and using it to develop landscape planning scenarios and to identify the desired LQO. The development of landscape

scenarios from quantitative indices calculated from public opinion allowed citizens themselves to design the desired scenarios. In this approach, more information than in the assessment of predefined scenarios is obtained because the process is open and participants are not conditioned by a series of predefined options, and the desired landscape is designed using their own specific decisions and choices. This methodology made possible the use of the scenarios approach in the case study because the enormous landscape diversity of the region prevented *a priori* design of all possible landscape scenarios. In addition, use of this methodology to develop the Landscape Guidelines for Galicia enabled more detailed investigation of the public perception of each landscape type and of the preferred measures for landscape improvement via protection, management or planning.

The outcomes show that it is possible to systematically analyse public opinion about landscape, even though the data are derived from different social research techniques. In addition, the proposed methodology is completely applicable in any place because it does not require data or technics specific for a region. The use of the PPGIS facilitated the capture of a large amount of information about public opinion and preferences, provided in a readily analysable format, which made systematic and objective data analysis easier.

The most evident conclusion of the analysis of results is that the values of the indices of satisfaction and intervention are very similar for the 12 landscape areas, despite being derived from different workshops that took place in distinct locations and dates, and attended by very diverse people and associations. This validates both the public participation process and the method used to analyse the information gathered in this process, as well as the results obtained.

In addition, the resulting landscape planning scenarios are generally consistent with the characteristics of each landscape type, the previous studies on landscape preferences and the technical criteria for landscape management. One example of this is that the most frequent result for agricultural landscapes is a management scenario, which coincides with the numerous manuals of good practices in agricultural management and is consistent with the fact that agriculture requires active human intervention. The special case of afforestation landscapes stands out because of the contrast between the high degree of public dissatisfaction and the low will of intervention, probably derived from the assumption of their economic value and the supposition that an improvement of these landscape types that keeps the productive value is not possible. In this case the public assessment differs from previous studies that propose a suitable management to improve perception of afforestation landscape, showing an evidence of the need for education in this field.

When interpreting the results of the indices, a need for detailed analysis of the reasons underlying the public assessments was detected. Thus, future studies will address the extent of the PPGIS functions in order to collect information about the citizen's motives for positively or negatively assessing different landscape types. This will support interpretation of the results, e.g. allowing identification of the reasons for the management (planning) scenarios, as those obtained for afforestation landscapes.

Funding

This work was supported by an agreement between the Institute of Land Studies of the Regional Ministry of Environment and Planning of Galicia (Spain) and the University of Santiago de Compostela

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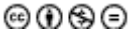

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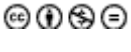
Appendix A. Landscape Quality Objectives (LQO)

LQO Code	Landscape type		Scenario***	Landscape quality objective (LQO)
	Land use*	Geomorphology**		
1A_3_1	1	A	3	Sheets of water in canyons, riverside forests and their environment must be preserved and constitute natural corridors that support the ecological and landscape connectivity among different areas. These landscapes must be areas with protected ecological and aesthetic values compatible with productive activities, sports and recreation through the establishment of measures that consider specific topographical conditions of canyons
1A_3_2	1	A	3	Rivers and lakes have a great value derived from their singular, aesthetic and natural characteristics, which must be protected by measures and actions subject to sustainability criteria
1B_3_1	1	B	3	Rivers and lakes in plain or valleys and their riverside forests must be protected because of their ecological value and landscape interest. Rivers must be respected, thus keeping their path and the cultural heritage associated to rivers
1B_3_2	1	B	3	Rivers and lakes that run through urban areas must be considered as relevant landscape elements in urban planning by establishing transition areas in order to soften the impact of the city and to allow a higher visibility between the water landscape and the urban public spaces
1C_3_1	1	C	3	Rivers and lakes in mountains, as well their environment, must be protected because of their ecological value and landscape interest. Rivers and their associated cultural heritage must be kept in good condition and without impacts
1C_3_2	1	C	3	The environment of sheets of water in mountains must be conserved because of their ecological value and landscape interest and maintain the topographical characteristics of mountain areas, avoiding erosion processes and respecting riverside forests
2A_3_1	2	A	3	Shrub, rock and peatland in canyons must contribute to keep the geomorphology, the vegetal composition and the soil of the area, thus preserving the characteristic image of canyons from aggressive intervention
2B_3_1	2	B	3	Shrub, rock and peatland must be preserved by means of an agricultural activity that maintain live and resilient spaces, thus protecting them from abandonment processes and invading species proliferation. Productive and ecologically viable criteria must be considered for contributing to a landscape with natural quality
2B_4_1	2	B	4	Shrub, rock and peatland in plains or valleys located on spaces between croplands and indigenous forests should be transition areas that ensure the landscape and ecological connectivity. Thus, these landscapes should be managed with sustainability criteria that avoid their degradation

2C_3_1	2	C	3	Shrub, rock and peatland in mountains should be ecologically structured, resilient and without erosive processes. These landscapes must preserve the typical morphology and vegetation, without invading and allochthonous species. The ecological function of these natural spaces must be compatible with productive uses and resistant to the main threats (abandonment, fires, erosion and invading species)
2C_3_2	2	C	3	The appropriate integration between shrubland or peatland and other land uses aimed at forest, energy or agricultural production must be ensured
3A_3_1	3	A	3	Indigenous forest in canyons must preserve their natural richness and indigenous species must dominate, thus maintaining biodiversity and ecological connectivity through the canyon, as well as the morphological characteristics of the canyon. These issues must be compatible with sustainable productive activities typical of these spaces in order to maintain the ecological, aesthetic and productive values
3B_3_1	3	B	3	Indigenous forests should preserve native fauna and flora, dealing with the expansion of allochthonous species. The correct integration between these natural spaces and agricultural, livestock and forest land uses must be ensured
3B_3_2	3	B	3	Indigenous forests in plains or valleys must be part of ecological corridors and maintain landscape connectivity and structure. Indigenous forest in riversides must be integrated with meadows and pastures typical of valleys and contribute to avoid erosive processes of rivers
3C_3_1	3	C	3	Indigenous forests in mountains must preserve a high ecological diversity by means of the conservation and/or expansion of the area occupied by native species, in a compatible way with sustainable and complementary productive activities
4B_1_1	4	B	1	The productive model of croplands in plains or valleys should be managed with sustainability criteria in order to make landscape and natural values compatible with land uses typical of valleys. An effective management must combine the achievement of economic benefits with a varied and heterogenous landscape matrix. The agricultural landscape should be managed to obtain different values from agricultural activity
4B_1_2	4	B	1	The agricultural landscapes should be managed in a comprehensive way by including the diverse elements that shape them: cadastral structure, traditional fences and hedges, traditional agricultural infrastructures (irrigation systems, roads, …), traditional agricultural buildings, etc.
4B_3_1	4	B	3	Cropland must be preserved, dealing with abandonment processes and maintaining the natural, cultural and aesthetic values of traditional agricultural landscapes (crop systems, traditional agricultural infrastructures, etc.) in a compatible way with a sustainable and economically profitable model. A sustainable model must make productive crops, meadows and pastures compatible with the preservation of native vegetation in parcel edges and of a diverse agroforestry mosaic. The

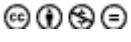


				protection of the agricultural landscape must be aimed at improving the quality of life of rural population
4B_3_2	4	B	3	Cropland must preserve the landscape quality and harmony in both the landscape inner structure and the relationship with the surrounding land uses, especially with forests, extensive agriculture and rural settlements typical of plains and valleys
4B_3_3	4	B	3	Cropland must preserve the different elements that shape it and provide diverse natural, aesthetic and cultural values. These elements comprise cadastral structure, traditional fences and hedges, traditional irrigation systems, traditional agricultural buildings, traditional road networks and other elements linked to agricultural practices
4C_1_1	4	C	1	Cropland in mountains should be managed according to the geomorphological and topographical conditions in order to respect soil and water characteristics of the environment and to avoid erosive processes. The sustainable management should allow the economic return and the preservation of the typical character of these landscapes and of their traditional elements, such as the cadastral structure or the traditional fences
4C_3_1	4	C	3	Cropland in mountains must keep the structural heterogeneity of landscape and the integration of crops with surrounding extensive agrosystems or forests. The geomorphological and topographical conditions must be preserved in order to make mountain crops compatible with the preservation of soil and water characteristics and to avoid erosive processes
4C_3_2	4	C	3	Cropland in mountains must preserve the historical structure of landscape, by keeping the traditional relationship between rural settlements and rural land, avoiding large extensions of cropland or of other land uses
5A_2_1	5	A	2	Agroforestry mosaic in canyons should be planned in order to structure internally the different forest and agricultural uses by considering the adaptation of land uses to topographical conditions, the expansion of areas occupied by indigenous species and the restoration of spaces affected by erosive processes, fires or other environmental impacts
5B_1_1	5	B	1	Agroforestry mosaic in plains or valleys should be managed in order to achieve forestry and agricultural farms sustainable and efficient. These farms should maintain the aesthetic and textural diversity and preserve traditional fences and hedges, as well as indigenous forest species that provide the agrosystem with ecological values

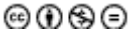
5B_2_1	5	B	2	Agroforestry mosaic in plains or valleys should be planned according to a sustainable productive model, which properly integrates agricultural uses and afforestation by considering land suitability for each land use. Agroforestry mosaic should be both internally structured and integrated with the surrounding land uses in order to achieve landscape harmony and to avoid sharp contrasts among land uses or large extensions of one specific land use
5B_2_2	5	B	2	Agroforestry mosaic in plains or valleys should be planned for restoring aesthetic and textural diversity and ecological values, as well as for ensuring harmonic transitions among land uses. Planning of agroforestry mosaic should recover and consolidate native vegetation in parcel edges that provides ecological and textural diversity
5B_4_1	5	B	4	Agroforestry mosaic in plains or valleys should be managed in order to achieve forestry and agricultural farms sustainable and efficient. These farms should recover the aesthetic and textural diversity and preserve traditional fences and hedges, as well as indigenous forest species that provide the agrosystem with ecological values
5C_2_1	5	C	2	The combination of agricultural and forest land uses typical of agroforestry mosaic in mountains should be planned according to the soil and topographical conditions of mountains by considering the slope in different zones. Agroforestry mosaic should recover the typical inner structure and the natural and aesthetic values simultaneously with the maintenance of the productive capability
5C_4_1	5	C	4	Agroforestry mosaic in mountains should be managed to locate each land use in the most suitable areas by considering suitability criteria and ensuring a high-quality agricultural landscape. Management should integrate harmoniously different land uses, fauna and flora, as well as maintain traditional structuring elements
6A_2_1	6	A	2	Afforestation in canyons should be planned in order to recover native vegetation by seeking the increase in the area occupied by indigenous forest species, which replace invading or allochthonous species to increase landscape and environmental resilience. Forest plantations should be adapted to the topographical conditions and allow the recovering of areas affected by erosive processes, fires or other environmental impacts
6A_4_1	6	A	4	Afforestation in canyons should be managed to improve ecological diversity and landscape quality, by considering geomorphology and avoiding erosive processes and habitat fragmentation
6B_1_1	6	B	1	Afforestation in plains or valleys should be managed to ensure efficient and sustainable forest production by considering landscape criteria such as mixture of species, incorporation of indigenous species, plantations of different age, land use diversity, integration of afforestation edges, etc.

6B_2_1	6	B	2	Afforestation in plains or valleys should be planned according to forest planning regulations and plans, thus being located on the most suitable areas in a compatible way with other land uses, using a variety of forest species and planning appropriate forest tracks
6B_4_1	6	B	4	Afforestation in plains or valleys should be managed to make profitable forest production compatible with a high-quality forest landscape (mixture of species, plantations of different age, integration of afforestation edges, etc.) and to adapt plantations to the topographical conditions. The management of forest spaces by means of proper forest planning should ensure a sustainable exploitation that recover the diversity of land uses and landscape values
6C_2_1	6	C	2	Afforestation in mountains should be planned to achieve high biodiversity and to adapt plantations to the topographical conditions of mountainous areas, thus avoiding erosive processes and preserving soil, ecologic and productive functions. Planning should recover tree diversity and shape and textural irregularity, which provide landscape heterogeneity
6C_3_1	6	C	3	Afforestation in mountains must be protected to keep a productive and sustainable forest land use, which allows the integration of other natural or agricultural land uses and prevent from threats (fires, erosion, invading species, …) by suitable silvicultural measures and forest plans
6C_4_1	6	C	4	Afforestation in mountains should be managed to provide a mixture of different forest areas which improve textural and ecological diversity, by means of proper forest plans that consider landscape criteria. Afforestation planning should consider altitude, native species, multifunctionality and creation of mixed forests with accompanying forest species
7B_1_1	7	B	1	Extensive agrosystems in plains or valleys should be managed in a sustainable way in order to keep a varied and heterogeneous landscape matrix with the typical textural diversity of agricultural landscapes. Extensive agricultural areas should be maintained in use, dealing with abandonment or afforestation processes, respecting the hydrological system and being properly integrated with surrounding land uses
7B_1_2	7	B	1	Extensive agrosystems in plains or valleys should be managed using a sustainable model that ensures preservation of indigenous forests. In new meadows or pastures, new hedges, tree alignments or other traditional agricultural fences should be created in order to structure large livestock areas
7B_3_1	7	B	3	Extensive agrosystems in plains or valleys must preserve their high ecological and landscape values and form the basis of a varied and heterogeneous landscape matrix, which is characterized by textural diversity and does not have large monoculture areas. Extensive agricultural areas must be maintained in use, dealing with abandonment and afforestation processes, respecting the hydrological system and being properly integrated with surrounding land uses

7B_3_2	7	B	3	Extensive agrosystems in plains or valleys must preserve the current sustainable model and ensures preservation of indigenous forests. In meadows and pastures, hedges, tree alignments or other traditional agricultural fences must be preserved and created in order to structure large livestock areas
7C_1_1	7	C	1	A harmonic combination of the extensive agrosystem landscape in mountains with shrub, rock and forest areas should be maintained, preventing the destruction of cultural heritage elements and the proliferation of shrub or residual forest generated by abandonment processes and ensuring an ecological cycle that provides natural grazing
7C_2_1	7	C	2	Landscape of extensive agrosystem in mountains in which areas that undergo abandonment processes should be put into production or used to improve the hydrological cycle, where traditional fences and hedges should be restored and new, suitable fences constructed
7C_3_1	7	C	3	Extensive agrosystems in mountains that must be preserved, in which structural cultural elements -such as fences and hedges- should be kept and fauna and flora respected, thus preventing overuse of the land and forest fires
7C_3_2	7	C	3	Natural meadows and pastures must keep a harmoniously integration with shrubland, rock or forest areas and avoid abandonment processes. Hydrological system of these areas must be specially preserved because of its ecological and productive value
7C_3_3	7	C	3	Extensive agroystems in mountains must preserve parcel edges appropriate for the environment by a suitable maintenance of traditional fences, hedges, tree alignments or other fences properly integrated in the landscape
8A_1_1	8	A	1	Vineyards in canyons should be efficiently managed in order to make productive values compatible with natural, aesthetic and cultural values typical of traditional elements such as agricultural buildings, infrastructures and practices
8A_3_1	8	A	3	Vineyards in canyons must preserve traditional infrastructures such as agricultural terraces typical of these landscapes. The cadastral structure adapted to canyon slopes must be respected, avoiding topographical modifications that may generate erosive processes or large uniform parcels that impact on aesthetic values of vineyards
8A_3_2	8	A	3	In vineyards, traditional crop systems must be given priority, thus respecting natural values that are characteristic of canyons.
8A_3_3	8	A	3	Vineyards in canyons must ensure a high quality image of viticulture in these areas according to the diverse characteristics of the different protected geographical indications
8B_1_1	8	B	1	Vineyards in plains or valleys should be efficiently managed in order to integrate environmental, cultural and productive values, as well as traditions and cultural practices
8B_3_1	8	B	3	In vineyards in plains or valleys, historic character and traditional building elements must be preserved, and recovery of abandoned plantations must be given priority over new plantations



9B_2_1	9	B	2	Urban areas in plains or valleys should be planned in order to promote urban compactness, diversity of compatible land uses and landscapes values such as the cultural heritage. New buildings should be integrated into the specific characteristics of each urban settlement and suitable transition areas between urban and agricultural and natural areas should be planned
9B_2_2	9	B	2	Urban areas in plains or valleys should be planned in order to be located in the most suitable areas and allow an adequate growth. Urban development should imply actions for landscape integration and improvement
9B_3_1	9	B	3	Urban areas in plains or valleys must be properly maintained using landscape improvement criteria
9B_4_1	9	B	4	Urban areas in plains or valleys should be managed by land use plans aimed at increasing urban compactness and diversity of compatible land uses, as well as to integrate new buildings with the specific characteristics of the urban settlement
9B_4_2	9	B	4	Urban areas in plains or valleys should be managed in order to ensure an adequate growth and the use of landscape improvement criteria
10B_3_1	10	B	3	Cultural heritage areas must preserve their structure and original elements. Traditional buildings must be rehabilitated and must contribute to create public spaces with public life, high landscape quality and mixture of uses
10B_4_1	10	B	4	Cultural heritage areas should be managed in order to improve their structure and original elements, and give priority to the rehabilitation of existing buildings over new buildings. These areas should contribute to create public spaces with public life, high landscape quality and mixture of uses
11B_1_1	11	B	1	Rurban areas in plains or valleys should be managed in order to integrate buildings in the landscape, to preserve the existing land structure and to define functionalities of each zone, thus contributing to appropriately planned landscapes of population settlements and rural spaces
11B_1_2	11	B	1	Traditional rural settlements should be managed according to their specific growth requirements in order to achieve compact settlements with buildings integrated in the landscape and adapted to the topography and the road network
11B_3_2	11	B	3	Traditional rural settlements must preserve their traditional characteristics and a proper integration in the surrounding environment. Traditional buildings must be preserved and used by keeping their original materials, volume and shape
11C_1_1	11	C	1	Urban areas in mountains should be managed to integrate the built space with the rural surroundings. The required urban developments should preserve the traditional, cultural and aesthetic values by adapting volumes, shapes, heights, materials and typologies to the morphological and topographical characteristics of the area. Transition areas between urban and rural spaces should be well defined and functionalities of each zone must be clear



11C_3_1	11	C	3	Traditional rural settlements in mountains must be preserved in good conditions, especially traditional architecture and built elements. Morphology of settlements must be respected and topographical conditions must be considered
12B_2_1	12	B	2	Mining areas in plains or valleys should be planned in order to reduce their visual impact and consider their cumulative effect in the landscape
12B_2_2	12	B	2	Mining areas in plains or valleys should be planned to be integrated in the surrounding landscape. Mines should be restored simultaneously with their exploitation and afterwards, using native vegetation whenever possible
12C_2_1	12	C	2	Mining areas in mountains should be planned in order to minimise their visual impact and consider their cumulative effect in the landscape
12C_2_2	12	C	2	Mining areas in mountains should be planned to be integrated in the surrounding landscape. Mines should be restored simultaneously with their exploitation and afterwards. In mountainous areas special attention must be paid to landscape integration of mines, respecting original landscape whenever possible and creating new high quality landscapes after the exploitation
13_3_1	13	3	3	Coastal landscape must preserve their natural and ecological (both biotic and abiotic), thus natural processes of sand systems, dunes and cliffs (and associated habitats) must be respected. Natural, aesthetic and cultural values of coast must be compatible with residential or productive functions by following sustainability criteria
13_3_2	13	3	3	Landscape quality of coastal landscape must be conserved by properly planning buildings or infrastructures, thus minimising the impact of constructions and integrating them in the environment

* Land use: 1 water; 2 shrub, rock or peatland; 3 indigenous forest; 4 intensive agrosystem (cropland); 5 intensive agrosystem (agroforestry mosaic); 6 intensive agrosystem (afforestation); 7 extensive agrosystem; 8 vineyard; 9 urban; 10 cultural heritage area; 11 rurban; 12 mining; 13 coastal

** Geomorphology: A canyon; B plain or valley; C mountain

*** Scenario: 1 management (protection); 2 planning; 3 protection; 4 management (planning)