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Landscape, sustainability and the socioeconomy in the coastal urdaibai biosphere reserve, Northern Spain

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Abstract

The main objective of this study is to analyze the sustainability of the landscapes in the Urdaibai Biosphere Reserve (UBR) through the relationship between the landscape units and the socio-economic activities. The UBR is located in the north of Spain, being an area of great ecological and landscape values in anurbanized environment. The landscape is composed by numerous and varied units composed by spontaneous communities and those that are dependent on human activities. The economic activity depends mainly on the industrial and service sectors. A Principal Component Analysis (PCA) was carried out using territorial and socioeconomic indicators for each municipality. The relationship between the landscape and the socio-economic activity was performed using the Pearson's multiple correlation test. Our results suggest that the sustainability of the cultural landscape units in the UBR is linked to the socioeconomic activities in the industrial and service sectors.

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Introduction

Biosphere reserves were created over 30 years ago under the United Nations Educational, Scientific and Cultural Organisation (UNESCO) Man and the Biosphere program (MAB). The concept of Biosphere Reserves (BR) is based on three functions, namely (1) conserving ecosystems and genetic resources, (2) supporting research, monitoring and education and (3) fostering sustainable development. With the Seville Strategy, released in 1995, the sustainable development gained a great importance into the three main goals of the BR. The Lima Action Plan 2016-2025 for Man and the Biosphere Reserves is the current strategic document for existing BR. The Lima Action Plan 2016-2025 is founded on the continuity of the Seville Strategy and the Statutory Framework of the World Network of Biosphere Reserves (WNBR) and based on the findings of the evaluation of the implementation of the Madrid Action Plan for Biosphere Reserves (UNESCO, 2016).

The increasing urban nature of humanity has profound environmental, economic, and social implications for the world's future (Wu 2010). Biosphere reserves are global mechanisms that enable local level experimentation with sustainable conservation, development and collaborative governance (Edge and McAllister, 2009).

Europe has a long history of landscape use by humans, ranging from prehistoric to present times (Vos and Meekes, 1999). The human intervention in the landscape begins in the Neolithic, when the need for the widest possible extension of arable land brought associated the recoil of forests to hillsides and valley bottoms (Pérez-Jordá and Stika, 2004). European landscapes have been shaped over the centuries by processes related to human land use, which are reflected in landscape patterns (Renetzeder *et al.*, 2010).In the case of the UBR, the presence of human settlements, such as the Santimamiñe cave, has been dated at least from the Magdalenian (15.000 years BP) (De Aranzadi *et al.,* 1935).

Land use can create diverse landscapes of outstanding aesthetic, economic and ecological value, but it may equally result in land degradation, soil loss and impoverished ecosystems (Haberl *et al.,* 2004).

Today, the rural exploitation unit in Urdaibai is the traditional Basque farm, which has subsisted to the present by a process of primogeniture. These farms are small-sized farms, most of them from 5 to 30 ha, subdivided into separate small parcels, giving to the landscape a typical image of a chessboard. The pluriactivity is also another main feature of this entity, being usually a mixture of livestock (normally of several species and aptitudes), agriculture, and even work in industry or services (Ruiz *et al.,* 1998).

Landscapes are places where people live and work, and where ecosystems reside and provide services to people (Wu, 2013). The landscape is the scenario that reflects the relationships between the society and the environment (Stock *et al.,* 2007). The spatial configuration of the landscape components is a key factor in this relationship (Liu and Opdam, 2014). In the landscape we can find the evidence of the adaptation of human groups to the surrounding environment or territory (Dibari, 2007).

The interrelations between land uses, landscape and the socioeconomypose a challenge for decision-makers, which require extensive research and a profound understanding of the potential impacts for the landscape decisions (Harmáčková and Vačkář, 2015).

Thus, the study of the territory offers the possibility to observe the effects of the human actions and their impact, as the technological capacity of the society which has transformed and humanized the landscape (Stock *et al.*, 2007). The landscape analysis provides the ability to show the effects of these actions and to explore the use humans has made of the territory and the dynamic character of the landscape (Dibari, 2007).

Perspectives for a sustainable future for European cultural landscapes are based, among others, on society's demand for multifunctionality and the inclination of farmers to meet this demand if it is economically sustainable (Vos and Meekes, 1999).

The present study was carried out to assess the sustainability of the landscapes in the Urdaibai Biosphere Reserve (UBR) because they provide not only a great diversity of natural environments and a valuable agricultural system, but also economic activities, such as tourism, based in the attractiveness of the landscapes and the nature. Up today, the UBR is one of the best preserved areas of the Basque territory (Basque Government, 2004).

In that sense the purpose of this study is also to analyse the relationship between the land uses of the territory and the socio-economic activities, using a set of socio-economic and territorial indicators (Sensu Schmitz *et al.,* 2003; Salinas and Mendieta, 2013a).

Material and methods

Area of study

The Urdaibai Biosphere Reserve is located in the Autonomous Community of the Basque Country, Spain. It has an area of 220 km², equivalent to the 10% of the territory of the province of Bizkaia. The UBR has 45.000 inhabitants and includes 22 municipalities being eleven of them fully within this territory (Fig. 1) (EUSTAT, 2011). The geographical boundaries of the UBR are defined by the Oka river basin. The UBR is marked by different altitudes describing a territory which does not exceed twelve kilometers wide and twenty kilometers long. It is an area of great ecological and landscape value in a relatively urbanized area and close to the metropolitan area of Bilbao, which has over one million inhabitants (Basque Government, 2010).

The vegetation coverage of the UBR area is composed by numerous and varied vegetation units which can be separated into two types: spontaneous communities (hardwood forests, scrub and heath land, aquatic vegetation and coastal sands) and those which are dependent on the human activities (conifer and *eucalyptus* plantations, pastures and crops). According to the forest inventory made by the Basque Government (2010) there are 625 vascular plants identified in the UBR (Basque Government, 2010).

There is also a vast zoological community, with an interesting avifauna linked to the wetlands (Basque Government, 2010). There are 318 vertebrate species identified for the UBR (245 birds, 41 mammals, 12 reptiles, 10 amphibians, and 10 freshwater fish) (Basque Government, 2010).

There is great diversity of natural environments and a valuable agricultural system in the UBR. The landscape is diverse and harmonious, having the presence of the traditional Basque farms, villages and towns of historical and economic significance (Basque Government, 2004).

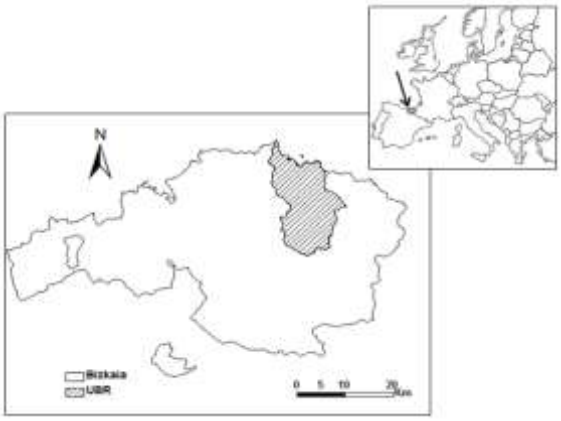

Fig. 1. Location of the UBR.

Study indicators

The analysis carried out in this work considered the relationship between the landscape and the socioeconomy trough methodological approaches based on socioeconomic and territorial variables. The selection of the territorial and the socioeconomic indicators was based on their descriptive and predictive ability, according to Smitz *et al.,* (2003), Renetzeder *et al.,* (2009) and Salinas and Mendieta (2013 a,b,c). The selection of the socio-economic variables was performed having as a reference the guidelines of the sustainable indicators by the United Nations (UN, 2007).

We considered the surface occupied by different uses of the land at the UBR as territorial indicators because they are directly related to human activities in the territory and can be used as indicators of naturalness an land use intensity (Schmitz *et al.*, 2003; Renetzeder *et al.*, 2009).

The indicators that do not depend on human activity, such as lithological, meteorological or geomorphological variables, were not directly considered in this study. The selected socioeconomic indicators are those related to the production structure of the territory, to human development and to infrastructure. The selection of the socio-economic variables was performed having as a reference the guidelines of the sustainable indicators by the United Nations (UN, 2007) (Table 1).

The information of the socio-economic aspects was collected from the Basque Institute of Statistics (EUSTAT). The data related to the territorial indicators was collected from Basque Government (2010).

Table 1. Socioeconomic and the territorial indicators considered for this study.

Socioeconomic indicators	Territorial indicators
Total population	Native forests (ha)
Employed people	Forest plantations (ha)
People employed in agricultura	Riverside areas (ha)
People employed in industry	Riverside woodlands (ha)
People employed in construction	Bush formations (ha)
People employed in services	Grasslands (ha)
No of banks	Mountain devoid of vegetation (ha)
No. of Industrial and power facilicies	Agricultural uses (ha)
No. of construction facilities	Artificial uses (ha)
No. of retail, transport and hotel-restaurant service facilities	Wetlands (ha)
No. of banking, insurance and service facilities	Water (ha)
No. of other service activity facilities	Pastures (ha)
No. of health service facilities	Bush-pasture formations (ha)
Total number of facilities	Other uses (industrial, ports, etc.) (ha)
Total number of Jobs	
Income per capita	

Data analysis

The information regarding the land uses and the socioe-conomic variables was collected for the municipalities inside the UBR. The data of the land uses of each municipality were standardized as a percentage relative to their total areas. The information regarding to the socioeconomic variables were standardized as a percentage for each municipality.

A Principal Component Analysis (PCA) was carried out using the territorial and the socioeconomic indicators for each municipality. The objective of the analysis of PCA was to order the municipalities in a plane. The spatial distribution of each municipality depend of the most representative spatial variables, those of greatest loading in the analysis. PCA is widely used for territorial and environmental analysis (Riitters *et al.*, 1995; Schmitz *et al.*, 2003; Plieninger *et al.*,2013; Salinas and Mendieta, 2013a). The interesting aspect of this analysis is that it reduces a complex number of variables to a smaller number of variables which are called principal components; therefore it simplifies the initial large amount of information.

The selection of the components of the PCA analysis was made so that the first component picked up the greatest proportion of the original variance. The second component collected the maximum variance not collected by the first, and so on (Salinas and Mendieta, 2013a). We selected the first two components because together they explained most of the total variance.

The relationship between the landscape and the socio-economic activity was performed using the Pearson's multiple correlation test. To statistically validate the coincidences detected with the spatial analysis, both the socio-economic data and the land use information, were subjected to the Pearsons multiple correlation, considering a confidence level of 95% for a significant correlation ($p \leq 0,05$). Thus, the significant values allowed the selection of the variables that directly describe or reflect the socioeconomic interaction linked to the land use in the municipalities in the UBR.

Results

The PCA applied to the indicators suggests that the two first components explained almost the 100% of the variance; Component 1 explained the 97 % and Component 2 explained the 2.3 %. The Fig. 2 shows the graphical representation of the studied municipalities in relation to the indicators values obtained in the PCA analysis for Components 1 and 2. The main result of this analysis is that the position of the municipalities is divided into three groups. Thus, the group a) assemblies the most urban municipalities and industrialized; b) groups the touristic municipalities and c) groups most rural municipalities.

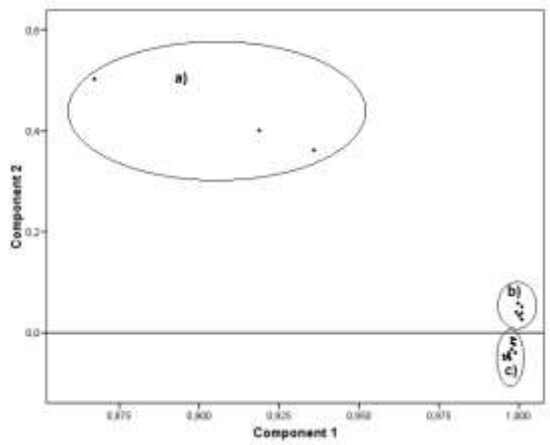

Fig. 2. Location of the municipalities of the UBR on a basis of two main components, according to their socio-economic and territorial indicators, where a) indicates the group urban/industrialized municipalities, b) indicates the group of touristic municipalities and c) represents most rural municipalities.

Land use distribution

The distribution of the land uses in the UBR provides an idea of the major landscape units. Most of the surface of the Reserve is occupied by forest plantations with a total of 11.540 ha, which represents almost 53% of the total area. In order of importance and in terms of land occupation, the second landscape unit is that formed by meadows with 4.116 ha, representing a 19% of the total area. The surface occupied by forestry plantations and grasslands, is 72% of the total area of Urdaibai, suggesting that human activity related to these landscapes determines the landscape of the UBR.

Analyzing the territory occupied by forest types, we have that the 52,5% of the vegetation cover is dominated by forest plantations, native forests, riparian forests and scrubs account for the 19% of the total area.

The other two landscape units in order of occupied surface that give the UBR a high degree of uniqueness correspond to the urban areas with 797 ha, 3.7% of the total area, and the wetlands with 445 ha was 2% of the total area. Artificial areas indicate the degree of human disturbance in the territory, while the wetland is a clear demonstration of the importance of the Reserve itself, due to the high biodiversity that it provides. Table 2 shows the distribution of land uses per unit surface and the Fig. 3 shows their spatial distribution.

Table 2. Land use distribution in the UBR (Basque Government 2010).

Land use	Surface	
	(ha)	(%)
Ntive forests	3.302	15,1
Forest plantations	11.540	52,9
Riparian forests	100	0,5
Scrub	744	3,4
Grasslands	84	0,4
Mountain areas devoid of vegetation	61	0,3
Crops	213	1,0
Urban areas	797	3,7
Wetlands	445	2,0
Water runoffs	1	0,0
Estuaries	107	0,5
Roads	85	0,4
Mining, tailings and sanitary landfills	22	0,1
Meadows	4.130	19
Grassland-scrub areas	191	0,9
Total	21.822	100

Analyzing the land uses according to the groups of municipalities, we see that the touristic municipalities have the highest diversity of the land uses, concentrating most of the wetlands and the native forests (see Fig. 4). In terms of the agricultural land use, its distribution is homogeneous for the three groups. The Urban/industrialized municipalities concentrate most of the urban areas, while Rural ones concentrates the minimum of this use of land.

According to the distribution of native forests, the rural municipalities concentrate a low percentage of this use of land, being the forest plantations the main landscape unit of the rural areas.

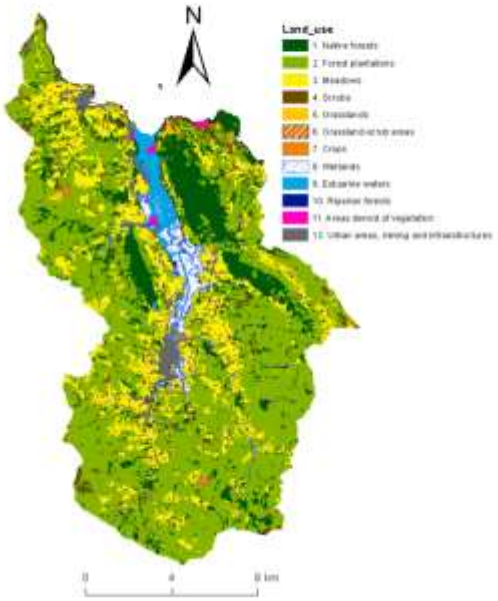

Fig. 3. Land uses in the Urdaibai Biosphere Reserve.

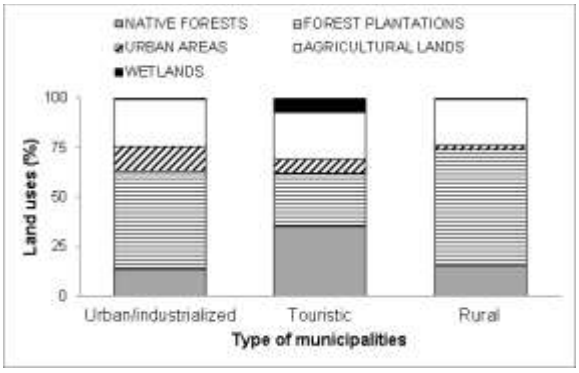

Fig. 4. Distribution of the main land uses in the UBR by type of municipality.

Socioeconomy

The territory of the Urdaibai Biosphere Reserve plays an important role in the social, economic and political organization of the Bizkaia province.

Currently, the UBR has a population of approximately 45.000 inhabitants, being 80% of them in the urban municipalities (EUSTAT, 2011). On one hand, the UBR maintains an economic activity based on the metal, maritime, fisheries and forestry sectors and on the other hand it is based on agricultural and livestock production. Together with these activities, the tourism is mainly focused on the beaches, the historic villas and the network of rural tourism accommodations and hotels scattered throughout the area.

As in the rest of the province of Bizkaia, the service sectors are the most important activity in the UBR. The percentage of people working on the services reaches the 55% of the working population. The UBR still maintains a population rate dedicated to the agriculture and livestock above the average of the province. The 7% of the working population in Urdaibai works in the primary sector (agriculture, livestock, forestry and fisheries) compare to the 2% that works in the rest of the Bizkaia province (EUSTAT, 2011).The industrial sector employs 29% of the working population in Urdaibai.

The Fig. 5 shows the labor occupation by the sector of activity for each group of municipalities. Analyzing the employed people by type of municipalities, we have that in the Urban/industrialized municipalities and in the Rural municipalities, the structure of the employed people is similar. On the other hand, the percentage of the population working in the services sector is higher in the touristic municipalities than in the other municipalities.

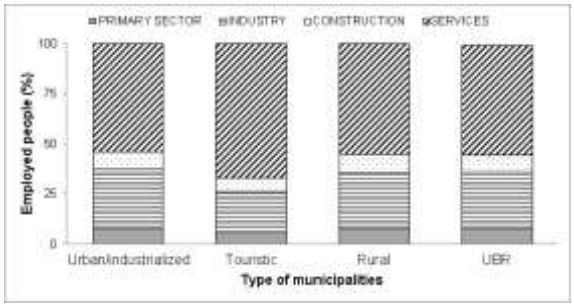

Fig. 5. Labor occupation by economic sector and by type of municipality in the UBR.

Landscape and socioeconomy

The landscape of UBR is dominated by coniferous forest plantations, the coast, the estuary and wetlands, also by the Cantabrian holm oak forests, the Atlantic mixed forest, the meadows, and the riparian forests and villages (rural and urban). Table 3 shows the cases where there have been significant correlations between socio-economic and territorial indicators.

Table 3. Significant correlations among the socioeconomic and territorial indicators.

Socioeconomic indicators	Territorial indicators						
	Forest plantations	Riparian forests	Scrub	Crops	Urban Areas	Pastures	Other uses (industrial, ports, etc.)
Total population					*		*
Employed people							
People employed in agriculture						*	
People employed in industry			*	*			
People employed in construction							
People employed in services	*	*					
No. of construction facilities							*
No. of retail, hotel trade facilities					*		*
No. of other service activity facilities					*		*
Total number of facilities					*		*
Total number of jobs					*		*

This test indicates interesting correlations between the land use, which ultimately determines the landscape, and the economic activities of the UBR. Thus, both values are significant for services and the urban areas, total population and use of urban soil.

In this case the results suggest that the urban development, associated with the land use, is the main determinant component of the landscape.

Our findings show statistically significant dependencies between the use of the urban soil and the occupation in services ($P \leq 0.05$), which is the predominant socioeconomic activity in the UBR.

Employment in services is a particularly important activity in the touristic municipalities. In these municipalities employment in services is around 70% (see Fig. 5), and there is a highly significant correlation ($P \leq 0,01$) between the riparian forests with the occupation in services.

The other big landscape units of the UBR are the native forests (oak and Atlantic mixed forests) and the extensive plantations of conifers and eucalyptus. (Figs 3 and 4).

Finally, the third major landscape unit consists of meadows and farmlands. The importance of this scenery is the cultural value linked to the traditional land uses. This relationship is manifested by the Pearson test result for the variables of meadow land use and agricultural land with employment in the primary sector, which showed a high significance ($P \leq 0.01$).

Discussion

Our methodological approach and its results suggest that understanding how humans use and develop the environment is much more complex than to define the territory, and that it is necessary to include the socioeconomic factor.

Sustaining ordinary traditional landscapes based upon rural economies such as agriculture, stock raising and forestry, demands an adapted policy and supporting actions (Antrop, 2006). Our results suggest that the economic activities associated to the urban areas, coastal accommodations and port and industrial facilities allow the maintenance of forestry and rural farming activities due to the labor force absorbed in the industrial and touristic municipalities of the reserve. In this context, the presented methodological approach has shown that the sustainability of the landscapes in the UBR are linked to the economic activities of the urban, industrial and touristic areas.

Our results suggest the fact that in the Urban/industrialized municipalities and in the rural municipalities, the structure of the employed people is similar, may be due because of the industrialized municipalities absorb the labor force of the rural areas. These results are in accordance with the findings described in other parts of the world, where the links between the rural-urban has propounds impacts in the landscape and rural socioeconomy (Salinas *et al.*, 2015).

The correlation between the riparian forests and the employment in services suggest that the good condition of the banks and wetlands at the mouth of the Oka river benefits not only biodiversity, but also enables the existence of numerous jobs related to the service sectors which also generates economic benefits to the UBR. Finally these economic benefits also result in the good condition of the banks and wetlands of the Oka River.

The cultural landscape of the Urdaibai Biosphere Reserve is linked to the socioeconomic structure of the territory. The landscape of the rural municipalities in the UBR are characterized more by the use of land devoted to forest plantations than the use of land dedicated to the agriculture. This is in contrast to the described by Knickel (2001) for central Europe's BR. This author described that the cultural landscapes of the region are the result of a long period of agriculture. The reason for this situation in the Basque country is because that during the first half of the twentieth century, much of the farmland in the region was planted with forest species, mainly *Pinus radiata* (Michel, 2006). There was also an abandonment of farming activities and a migration of the labor force to the industrial areas in the region (Collantes, 2009).

The strong urban growth experienced worldwide in recent decades, has profoundly changed the landscape, which have dramatically affected the ecological systems (Sukopp and Werner, 1983; McDonnell *et al.*, 1997; Breuste and Wohlleber, 1998; Baker *et al.,* 2001, Salinas and Mendieta, 2013d; Salinas *et al.*, 2015). In this respect, our findings suggest that the land use planning applied in the UBR in the last decades, enable the economic development of the UBR and the preservation of the landscape, the ecosystem services, the biodiversity and the traditional uses of the land. Thus, enabling the sustainable development of the UBR.

The effects of all the natural biotic and abiotic processes occurring in the environment and all the human interventions are reflected in the landscape. The human and natural impacts cause changes in the landscape which happen very quickly, and the natural environment does not have the time to adapt to these impacts; therefore, they cause significant impact on the landscape (Alados *et al.*, 2004). In that sense, the landscape structure of the UBR has not significantly changed in, at least, the last two decades.

In our analysis, we can distinguish two totally different development patterns between the municipalities of the Urdaibai Biosphere Reserve. On one hand, we found the urban municipalities which have a strong development in the industrial and service sectors and on the other hand, we found the rural municipalities which are characterized by a mainly agricultural economy.

The relationship between biodiversity and the distribution of ecosystem services varies depending on the characteristics of the territory, which generally cannot plan for all services based solely on the distribution of one ecosystem service (Chan *et al.,* 2006). In the Biosphere Reserve of Urdaibai there is a high overlap between areas of high biodiversity and areas with high value of ecosystem services (Onaindia *et al.,* 2010). This high spatial correlation allows biodiversity to be applied in this area as an indicator to regulate the cultural services. This indicator has important implications for the land management, because it involves the need for conservation of the most biodiverse areas for the preservation of the hydrological control, recreational use of land and for the accumulation of carbon in biomass and soil (Onandia *et al.,* 2010).

Conclusions

The cultural heritage of the UBR is closely connected to its natural heritage and one cannot exist without the other. The combined works of the nature and man configured the cultural landscape of the UBR. According to the definition given by Wiggering *et al.* (2006), the landscape of the UBR can be classified as multifunctional landscape, having as a result commodity and non-commodity outputs. These outputs are the key for the sustainability of the reserve because they allow the development of economic activities linked to the service and primary production sector in the UBR.

The urban/industrialized municipalities of the UBR plays an important role, absorbing a great part of the labor force of the rural municipalities. Thus, making possible the sustainability of the landscape in this great part of the reserve.

Most of the surface of the UBR, close to 90%, is important for the generation of various ecosystem services, such as the support of the biodiversity, the regulation of the hydrological cycle, the carbon storage and the cultural traditions (Onandia *et al.,* 2010). Our results suggest that the preservation of the landscapes of the UBR and the socioeconomic activities related to the tourism activities, are sustained one to each other.

With regard to forest plantations, it is important to note that in a global market scenario, with countries producing cellulose pulp and lumber at lower costs, it could be possible that in the future this activity will not be profitable and forest plantations could be abandoned or transformed to more profitable activities. If this situation occurs, the main landscape unit of the UBR will change. In this respect, involving local stakeholders would help to articulate future values in the local context of cultural factors, landscape and the environment (Liu and Opdam, 2014). In that sense, with the participation of the stakeholders, the enhancement of the biodiversity and cultural values associated with the tourism revenues could be reached through the appropriate land use changes. All of this guaranteed and reinforced the participatory assessment of the stakeholders.

References

Alados CL, Pueyo, Barrantes O, Escós J, Giner L, Robles AB. 2004. Variations in landscape patterns and vegetation cover between 1957 and 1994 in a semiarid Mediterranean ecosystem. Landscape ecology **19,** 543-559.

Antrop M. 2006. Sustainable landscapes: contradiction, fiction or utopia? Landscape and urban planning **75,** 187-197.

Baker LA, Hope D, Xu Y, Edmonds J, Lauver L. 2001. Nitrogen Balance for the Central Arizona-Phoenix (CAP) Ecosystem. Ecosystems **4,** 582-602.

Basque Government. 2004. El paisaje de Urdaibai. Materiales de Educación Ambiental. Eusko Jaurlaritza-Gobierno Vasco. Dpto. de Ordenación del Territorio y Mediaoambiente 103 pp.

Basque Government. 2010. Inventario forestal 2010: mapa forestal y datos de superficies por cuenca hidrográfica P. 32.

Breuste, J, Wohlleber S. 1998. Naturschutz und Landschaftspflege in urbanen Kulturlandschaften Leipzigs. In Zeitschrift für den Erdkundeunterricht **50,** 215-225.

Chan KM, Shaw MR, Cameron DR, Underwood EC, Daily GC. 2006. Conservation planning for ecosystem services. PLoS Biology **4,** 11-379.

Collantes JCA. 2009. Medio rural y abandono de la agricultura: desarrollo de un ejemplo, el caserío vasco. Lurralde: Investigación y espacio **32,** 395-404.

de Aranzadi T, de Barandiarán JM, Bengoa ED. 1935. Exploraciones de la Caverna de Santimamiñe (Basonde, Cortézubi). Grijelmo.

Di Bari JN. 2007. Evaluation of five landscape-level metrics for measuring the effects of urbanization on landscape structure: the case of Tucson, Arizona, USA. Landscape and Urban Planning **79,** 308-313.

Edge S, McAllister M. 2009. Place-based local governance and sustainable communities: lessons from Canadian biosphere reserves. Journal of Environmental Planning and Management **52,** 279-295.

EUSTAT. 2011. Población de 16 y más años ocupada de la C.A. de Euskadi por ámbitos territoriales según sectores económicos. Basque Institute of Statistics. Basque Government.

Haberl H, Wackernagel M, Wrbka T. 2004. Land use and sustainability indicators. An introduction. Land Use Policy **21,** 193-198.

Harmáčková ZV, Vačkář D. 2015. Modelling regulating ecosystem services trade-offs across landscape scenarios in Třeboňsko Wetlands Biosphere Reserve, Czech Republic. Ecological Modelling **295,** 207-215.

Knickel K. 2001. The marketing of Rhöngold milk. An example of the reconfiguration of natural relations with agricultural production and consumption. Journal of Environmental Policy and Planning **3,** 123-136.

Liu J, Opdam P. 2014. Valuing ecosystem services in community-based landscape planning: introducing a wellbeing-based approach. Landscape Ecology **29,** 1347-1360.

McDonnell MJ, Pickett ST, Groffman P, Bohlen P, Pouyat, RV, Zipperer A, Parmelee R, Carreiro MM, Medley K. 1997. Ecosystem processes along an urban-to-rural gradient. Urban Ecosystems **1,** 21-36.

Michel, M. 2006. El pino radiata en la historia forestal vasca. Sustrai: revista agropesquera **75,** 56-69.

Onaindia M, Peña L, Amezaga I, Rodríguez-Loinaz. 2010. Evaluación y localización de los servicios de los ecosistemas en la reserva de la biosfera de Urdaibai-País Vasco p. 56.

Perez-Jorda G, Stika HP. 2004. Early Neolithic Agriculture in the Iberian Peninsula. Journal of World Prehistory **18,** 4-12.

Plieninger T, Dijks S, Oteros-Rozas E, Bieling C. 2013. Assessing, mapping, and quantifying cultural ecosystem services at community level. Land Use Policy **33,** 118-129.

Renetzeder C, Schindler S, Peterseil J, Prinz MA, Mücher S, Wrbka T. 2010. Can we measure ecological sustainability? Landscape pattern as an indicator for naturalness and land use intensity at regional, national and European level. Ecological Indicators **10,** 39-48.

Riitters KH, O'neill RV, Hunsaker CT, Wickham JD, Yankee DH, Timmins SP, Jackson BLl. 1995. A factor analysis of landscape pattern and structure metrics. Landscape ecology **10,** 23-39.

Ruiz R, Mandaluniz N, Albizu I, Oregui LM. 1998. The environmental role of traditional farming systems in the Basque Country. Livestock Systems in Integrated Rural Development p. 101.

Salinas CX, Gironás J, Pinto M. 2015. Water security as a challenge for the sustainability of La Serena-Coquimbo conurbation in northern Chile: global perspectives and adaptation, Mitigation and Adaptation Strategies for Global Change Journal, DOI: 10.1007/s11027-015-9650-3 .

Salinas CX, Mendieta J. 2013a. Numerical model to assess the impact of the strategies to mitigate desertification. Mitigation and Adaptation Strategies for Global Change Journal **18,** 551-566.

Salinas CX, Mendieta J. 2013b. Effectiveness of the strategies to combat land degradation and drought", Mitigation and Adaptation Strategies for Global Change Journal **8,** 1269-1281.

Salinas CX, Mendieta J. 2013c. The cost of mitigation strategies for agricultural adaptation to global change, Mitigation and Adaptation Strategies for Global Change Journal **18,** 933-941.

Salinas CX, Mendieta J. 2013d. Mitigation and adaptation investments for desertification and climate change: an assessment of the socioeconomic return, Mitigation and Adaptation Strategies for Global Change Journal **18,** 659-672.

Schmitz MF, De Aranzabal I, Aguilera P, Rescia A, Pineda FD. 2003. Relationship between landscape typology and socioeconomic structure scenarios of change in Spanish cultural landscapes. Ecological Modeling **168,** 343-356.

Stock C, Bishop ID, Green R. 2007. Exploring landscape changes using an envisioning system in rural community workshops. Landscape and Urban Planning **79,** 229-239.

Sukopp, H, Werner O. 1983. Urban environments and vegetation. In: Zerbe, S, Maurer U, Schmitz S, Sukopp H. 2003. Biodiversity in Berlin and its potential for nature conservation. Landscape and Urban Planning **62,** 139-148.

UN (United Nations). 2007. Indicators of sustainable development: guidelines and methodologies. United Nations publications p. 94.

UNESCO (United Nation Educational Scientific and Cultural Organization). 2016. Lima Action Plan for UNESCO's Man and the Biosphere (MAB) Programme and its World Network of Biosphere Reserves (2016-2025). UNESCO Division of Ecological and Earth Sciences, Paris.

Vos W, Meekes H. 1999. Trends in European cultural landscape development: perspectives for a sustainable future. Landscape and urban planning **46,** 3-14.

WCED (World Commission on Environment and Development). 1987. Our Common Future. The World Commission on Environment and Development. Oxford University Press, Oxford, UK.

Wiggering H, Dalchow C, Glemnitz M, Helming K, Müller K, Schultz A, Stachou U, Zander P. 2006. Indicators for multifunctional land use- Linking socio-economic requirements with landscape potentials. Ecological indicators **6,** 238-249.

Wu J. 2010. Urban sustainability: an inevitable goal of landscape research. Landscape ecology **25,** 1-4.

Wu J. 2013. Landscape sustainability science: ecosystem services and human well-being in changing landscapes. Landscape Ecology **28,** 999-1023.