Universidad del País Vasco / Euskal Herriko Unibertsitatea

eman ta zabal zazu

Ecosystem services assessment in Urdaibai Biosphere Reserve social-ecological system:

Insights into management strategies

Ekosistemen zerbitzuen ebaluazioa Urdaibaiko Biosfera Erreserbako sistema sozial-ekologikoan:

Kudeaketa estrategietarako ezaguerak

International PhD dissertation

Nekane Castillo Eguskitza

Supervisors:

Miren Onaindia Olalde
Alejandro J. Rescia Perazzo

2018

Watercolour cover: Maite Muro

Layout and watercolour paintings: Nekane Castillo Eguskitza

This research has been funded by the Science Policy Directorate of the Department of Education, Language Policy and Culture of the Basque Government, with a pre-doctoral training grant for the years 2015-2018.

Acknowledgments

Dicen que las palabras bonitas puede que no sean sinceras, mientras que las palabras sinceras no son bonitas… Son muchas las formas, y aunque las palabras no sean lo mío, no hace falta que diga quiénes sois aquellas personas importantes a las que agradezco y agradeceré siempre su apoyo. ¡Eskerrik asko familia y kuadrilla y demás!

Pero, sería de muy mal gusto no agradecer en esta breve etapa (o larga, depende cómo se mire) a varias personas sin las cuales no hubiera sido lo mismo. Por ello, no puede faltar un espacio en el que expresar mi agradecimiento a tod@s ellos:

Lehendabizi, beti nire buruan zaudelako, zu gogoratu nahi zaitut, amoma. Gurekin gerra ematen ez egon arren, oso pozik egongo zinela badakit. Zure indarra eta aurrera egiteko zure gogoagatik, ez zaitut inoiz ahaztuko.

Noski, Miren Onaindia, tesi honen zuzendaria, eta Alejandro Rescia, zuzendarikidea, eskertu beharrean nago nigan izandako konfiantzagatik eta etengabeko laguntzagatik. Mila esker Miren abentura txiki honetan nirekin nahasteagatik elkar ezagutzen ez bagenuen ere. Lehenengo egunean, nire asmoak kontatzeko aurkeztu natzaizuenean, dudarik gabe animatu eta babestu ninduzun eta. Zure bizitzeko moduagatik, zure betiereko irribarreagatik. Alejandro, muchas gracias porque, como bien sabes, si no llega a ser porque nos cruzamos en la Complutense, esto no habría salido adelante. Por tu paciencia y confianza, de nuevo, gracias.

Eskerrik beroenak Garapen Iraunkorra eta Ingurumen Hezkuntzari buruzko UPV/EHUko UNESCO Katedrari, eta nola ez, denbora guzti honetan nirekin egondako lankideei. Mila esker Jasone, Bea, Ibone eta Lorena zuen laguntza guztiagatik, ospakizunetarako zuen zaletasunagatik eta umore onagatik. Igone, zure prestutasunagatik eta elkarrekin pasatako momentu onengatik, eskerrik asko. Gloria, Izaskun, Leire, berdina diñotsuet. Tampoco podía faltar mi gran compañero Edu, el hombre de historias infinitas. Una no se aburre contigo. María, por tu motivación y buen rollo, por ese humor característico tuyo y gran apoyo.

No puedo olvidarme de ti, Berta, que me acogiste y me hiciste sentir como en casa. Por esas excursiones por el campo, alguna que otra *Dunkel*, por tu positividad y energía contagiosa. Por lo aprendido. Sólo tengo buenas palabras y agradecimientos.

Fernanda, the best flatmate I could ever have had. *Vielen Dank* for your friendliness, for making me love Lüneburg and its people, for those vegan barbeques and baths in the river. Paola, porque aunque breve, fue intenso y siempre sacaste un rato para reírnos. ¡Tenemos una visita pendiente! Jorge, siempre amable y dispuesto, alerta con tu vista de águila. Filipa, friend of trips and adventures. Esteban, Maria, for showing me the most hidden corners. Lara, Antje, for those afternoons trying to be a tightrope walker and those volleyball matches. To all of you, and some more, thank you very much! When I realized I had to come back home!

Claramente, debo agradecer también a David por introducirme en las técnicas de valoración económica y por su inestimable ayuda con los análisis y paciencia conmigo. Asimismo, no puedo más que dar las gracias a Marifé por aportar su experiencia, colaboración y hacerme bajar a la tierra.

Azkenik, tesi honen oinarri direlako eta haien laguntza barik hau guztia ez zatekeelako posible izango, esker onenak ikerketa honetan parte hartu duten eragile guztiei, bai inkestak gogo onez erantzuteagatik bai haien denbora eta ezagutza elkarbanatzeagatik. Batzuetan nekeza izan arren, ederto baten pasa dudalako eta oso ondo hartu nauzuelako beti.

Mila esker danori!

¡Muchísimas gracias a tod@s!

Thank you so much to everyone!

Summary

Human well-being is based on ecosystems and their sustained delivery of ecosystem services, and at the same time, human actions and policy decisions influence ecosystems through different (direct or indirect) drivers of change. Ecosystem services degradation associated to an increasing biodiversity loss is threatening human well-being and it is being necessary to re-orient our policy interventions to a sustainable management of nature. Sustainability Science frames the study of social-ecological systems where society and nature interact, by integrating the concept of ecosystem services in management. Thus, ecosystem services and their valuation have become a mainstream for decision-making and promotion of conservation. In particular, the economic valuation of ecosystem services has been highly backed by scientist and political forums as a tool for communicating and making visible the monetary value of nature and, even, the economic benefits of conservation.

This work highlights the need to incorporate the ecosystem services framework in management strategies to better understand nature's value to society and better inform policy making. The main goal of this PhD thesis is to contribute to the knowledge in support of decision making for sustainability in the social-ecological system of the Urdaibai Biosphere Reserve by assessing and valuing ecosystem services. By addressing this goal, we sought to answer the following research questions:

1) Which is the relationship between conservation and socioeconomic and cultural development in the Urdaibai Biosphere Reserve?
2) What has been the economic impact of land use changes occurred in the Urdaibai Biosphere Reserve during the last 44-year period? Does the zoning of the biosphere reserve adjust to the biophysical and monetary values of ecosystem services?
3) Would the inhabitants of the Urdaibai Biosphere Reserve contribute to another management strategy? Which are the social preferences towards different scenarios of land uses and related ecosystem services?
4) Do the different components of ecosystem services provide consistent information? How can we identify mismatches in ecosystem services assessment? And does the information vary across the different units with similar socio-economic characteristics and land uses within the Urdaibai Biosphere Reserve?

To this end, we applied a multidisciplinary valuation approach, from the biophysical to the monetary and socio-cultural dimension, especially focused on the monetary dimension of ecosystem services. More specifically we performed 1) statistical data compilation in order to compare landscape and socioeconomic and cultural evolution of the protected area with a non-protected area; 2) monetary value transfer of ecosystem services for each land use category over time and biophysical-monetary correspondence analysis; 3) choice experiments (n=266 face-to-face questionnaires) to estimate local population's willingness to pay; and 4) ecosystem services mapping and face-to-face questionnaires to local and tourist population (n=416), including contingent valuation monetary approaches and non-monetary approaches for ranking service interests. The data analysis consists mainly of multivariate ordination techniques and econometric models.

The result section is split into four empirical and independent chapters. *Chapter 4.1* (**Paper I**) puts us in context and explores whether the designation of the biosphere reserve fulfills its sustainability goal and enhances the quality of life of the local population. Then, being ecosystem services recognised as the new paradigm for sustainable decision making, we focus on their valuation. First, in *Chapter 4.2* (**Paper II**), we analyse the main land use changes occurred in the study area in the last 44 years and estimate their economic impact by transferring existing benefit measures from studies already completed throughout the world. Next, we try to link the biophysical and monetary dimension of the ecosystem services so as to building conservation decision making. But since the socioeconomic and cultural characteristics are surely different in our study area and in order to fill this knowledge gap, in *Chapter 4.3* (**Paper III**) we carry out a choice experiment to study local population's preferences and their willingness to pay towards different management alternatives and related ecosystem services. Eventually, assuming the multidimensionality of ecosystem services, in *Chapter 4.4* (**Paper IV**) we propose a methodological approach to examine mismatches when analysing the different components (supply, demand and interest components) of ecosystem services in four different units socioeconomically and environmentally similar of the Urdaibai Biosphere Reserve.

Our results show that the designation of the biosphere reserve does not influence the local population negatively but seems to safeguard its conservation, while enhancing socioeconomic and cultural development. The land uses changes occurred during the last 44-year period have not had such a big impact on the economic valuation of ES, but clearly have homogenised the territory with a subsequent loss of multifunctionality. However, the highest coupling between biophysical and economic valuations in the core area of the biosphere reserve suggests that its establishment has contributed to its conservation goal. Besides, local population is willing to financially support a new management plan, where the improvement of the quality of water bodies is primary concern followed by the increase of native forest surface area, organic farming and biodiversity protection. Lastly, our findings suggest that the different ecosystem services components provide divergent but complementary information on their value, strengthening arguments of former calls to integrate the biophysical, monetary and socio-cultural values addressed by the supply, demand and interest components of ecosystem services, respectively.

In sum, this thesis moves towards the comprehension of the ecosystem services framework so as to uncover the links between ecosystems and human well-being. It involves environmental and socioeconomic and cultural information, together with an active role of stakeholders. Therefore, the information provided may be useful to take agreed decisions at local level and ease potential conflict resolutions and management for sustainability.

CONTENTS

LIST OF FIGURES

List of tables

Abbreviations and Acronyms

AIC	Akaike's Information Criterion
ANOVA	Analysis of variance
BIC	Bayesian Information Criterion
BT	Benefit transfer
CBD	Convention of Biological Diversity
CICES	Common International Classification of Ecosystem Services
CS	Coefficient of sensitivity
CV	Contingent Valuation
DCE	Discrete Choice Experiment
ES	Ecosystem services
ESTIMAP	Ecosystem services Mapping
ESV	Monetary value of ecosystem services
EUNIS	European Nature Information System
GIS	Geographical Information System
GDP	Gross Domestic Product
GPUM	Governance Plan for Use and Management
InVEST	Integrated Valuation of Ecosystem Services and Tradeoffs
IPBES	Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem
LS	Land stewardship
MA	Millennium Ecosystem Assessment
MANOVA	Multivariate analysis of variance
MNL	Multinomial Logit
MXL	Multinomial Mixed Logit
NGO	Non-Governmental Organisation
OLS	Ordinary Least-Squares
PA	Protected area
PCA	Principal component analysis
PES	Payment for ecosystem services
RUSLE	Revised Universal Soil Loss Equation
SDGs	Sustainable Development Goals
SES	Social-ecological systems
SEU	Socioeconomic units
SIMPA	Simulation Precipitation-Contribution
TEEB	The Economics of Ecosystems and Biodiversity
UBR	Urdaibai Biosphere Reserve
UN	United Nations
VC	Valuation coefficients
WTP	Willingness to pay
WTT	Willingness to give up time

Chapter 1
Introduction

"Me lo contaron y lo olvidé. Lo vi y lo entendí. Lo hice y lo aprendí."

Confucio

"Cuando era niño, mi abuela me contó la fábula de los ciegos y el elefante.
Estaban los tres ciegos ante el elefante. Uno de ellos le palpo el rabo y dijo:- es una cuerda.
Otro ciego acarició una pata del elefante y opinó:- es una columna.
Y el tercer ciego apoyó la mano en el cuerpo y dijo: -es una pared.
Así estamos: ciegos de nosotros, ciegos del mundo.
Desde que nacemos, nos entrenan para no ver más que pedacitos. La cultura dominante,
cultura del desvinculo, rompe la historia pasada como rompe la realidad presente;
y prohíbe armar el rompecabezas."

Eduardo Galeano
Los ciegos y el elefante

1. INTRODUCTION

It is well-known that human relationship to nature has changed and that disconnection from nature is growing. Over the last 60 years, ecosystems of the Earth have been altered more quickly and extensively than in any other period of time in history (MA, 2005). These global environmental changes influenced by human activities and great drivers of change of land uses and biogeochemical cycles, climate change or expansion of invasive species, have altered the functioning of the Ecosphere (Rockström et al., 2009; Steffen et al., 2015). The scientific community, assuming this functional change at a global scale, has proposed recognizing that we are in a new geological time period, called Anthropocene. This new geologic age is human influenced and modeled intentionally in order to satisfy our needs (Crutzen 2002).

However, we are integral part of ecosystems and even the encyclical *Laudato* si' states, in its own words, that "nature cannot be regarded as something separate from ourselves or as a mere setting in which we live. We are part of nature, included in it and thus in constant interaction with it" (Pope Francis, 2015). So, as Folke et al. (2011) suggested, development and progress must be reconnected with the capacity of ecosystems to be sustainable.

1.1. ECOSYSTEM SERVICES AND HUMAN WELL-BEING

The main challenges for humanity are to protect, manage and restore nature in such a way that human well-being can be sustained, in balance with nature (van Oudenhoven et al., 2018). Sustainability involves understanding and protecting the interdependent relationships among environmental, economic and social factors. At present, the most accepted concept that integrates the biophysical, monetary and socio-cultural dimensions of ecosystems is the framework of ecosystem services (ES) (Haines-Young & Potschin, 2010; Martín-López et al., 2014).

Defined as the contributions ecosystems provide to humans (Pascual et al., 2017), ES are usually classified in three categories (CICES, 2018) (Fig. 1): 1) provisioning services, including all nutritional, non-nutritional material and energetic outputs from living systems as well as abiotic outputs; 2) regulating and maintenance services (hereinafter regulating services) that cover all indirect contributions obtained from the functioning of ecosystems; and 3) cultural services or non-material outputs of ecosystems (biotic and abiotic) that affect physical and mental states of people.

Fig. 1. Categories of ecosystem services and some examples (Basque Government, 2014).

They contribute to the comprehension of the relationship between ecosystems and human well-being, defining this last as a state that includes the basic material needs for a good life, freedom and choice, health, good social relations and personal security (MA, 2005). In other words, ES are embedded in the ecosystems, and at the same time, humans are intertwined with ecosystems and the services they provide, which ultimately underpins our future by providing basic resources like food and water, through to influencing the spiritual, aesthetic, and cultural dimensions of our embeddedness in nature (Folke et al., 2016). ES are the foundation upon which society and economy rest, and central idea in the UN Sustainable Development Goals (SDGs) of the 2030 Agenda for Sustainable Development.

The SDGs, launched in 2016, consist of 17 goals and 169 targets, aimed at ending poverty and hunger, protecting the planet for degradation, and ensuring prosperity for all by 2030 (Sustainable Development Knowledge Platform; https://sustainabledevelopment.un.org/sdgs) (Fig. 2). Links between ES and achieving SDGs are clear: as said before, ecosystems provide ES like food production, fuel and shelter, which contribute to the eradication of poverty (SDG 1) and hunger (SDG 2), and constitute the basis for new economic scenarios (SDG 8). The degradation of ecosystems is directly related to a higher burden of disease (SDG 3), which can also affect children's education (SDG 4) and widen gender inequality (SDG 5) since they may be forced to work at home or simply collect water or food. Besides, it leads to a limited safe water access (SDG 6), as well as a reduction of raw materials, necessary for some renewable energy (SDG 7) or a resilient green infrastructure (SDG 9), which are also key to move towards more sustainable cities (SDG 11) and consumption models (SDG 12). Nature protection and the sustainable supply and equitable access to these ES, prevent social conflicts and reduce inequalities within and among countries (SDG 10), while promoting peaceful and inclusive societies (SDG 16). Urgent actions are needed to combat climate change and its impact (SDG 13), to conserve life below water (SDG 14) and protect and restore life on land (SDG 15). All this, requires strengthening global partnerships and the collaboration of so many sectors of society (SDG 17).

Fig. 2. Sustainable Development Goals and their links: from bottom, biophysical, social and economic spheres. Source: Stockholm Resilience Centre; https://sustainabledevelopment.un.org/sdgs

1.1.1. Valuation of ecosystem services for sustainable decision-making

Decision making implies making choices and therefore, valuations. Valuation of nature comes with the idea of assigning importance (Boeraeve et al., 2015) and helps to decision makers to assess trade-offs between alternative ecosystem management regimes and social actions that alter ecosystems and ES (MA, 2005).

Trade-offs appear when management choices entail the optimization of a single or few ES prompting the reduction or deterioration of other services (Rodríguez et al., 2006). So, ecosystem management intended to maximize the supply of some ES, usually provisioning services, to fulfil the consumption demands of a growing population, often results in the decline of the delivery of other ES (Bennett et al., 2009). According to the Millennium Ecosystem Assessment (2005) more than the half of the ES are being degraded or used unsustainably. In response, governments worldwide have committed to international agreements to stop biodiversity loss, directly linked to ES (Balvanera et al., 2006; Harrison et al., 2014), and different international initiatives have been developed so as to make the concept of ES operational and linked with decision-making, such as The Economics of Ecosystems and Biodiversity (TEEB) and the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES).

The TEEB initiative was adopted to try to solve the failure to meet the 2010 Biodiversity Target, which not only did not reduce biodiversity decline, but it also increased (Butchart et al., 2010). This fact encouraged efforts to develop new strategies with greater impact on decision making and economic arguments arose as a tool with which to push environmental problems up on political agenda. Previously, in 2006, the Stern report on the Economics of Climate Change (Stern, 2007) laid on the table the need to take decisive political actions to mitigate the effects of climate change, if 20% of global Gross Domestic Product (GDP) was not being collapsed. Then, in the wake of this report, the TEEB highlighted the economic costs of not acting on biodiversity loss (TEEB, 2010). In a European context too, the Conference of the Parties agreed by 2020 to incorporate biodiversity values into development planning processes and national accounting (Aichi Target 2).

More recently, in 2012, IPBES was established to strengthen knowledge foundations for better policy through science, for the conservation and sustainable use of biodiversity, long-term human well-being and sustainable development (IPBES, 2018). Both the IPBES and even the more economically focused TEEB acknowledge value pluralism as fundamental to achieving societal goals for sustainability and recognise multiple human motivations to guide their decisions (TEEB, 2010; Pascual et al., 2017).

To this extent, many scholars have endorsed value pluralism in ES research calling for the integration of the multiple value dimensions of ES (Gómez-Baggethun & de Groot, 2010; Díaz et al., 2015; Jacobs et al., 2016), which following earlier typologies in the ecological economics literature on ES, can be group into three value dimensions: biophysical, monetary and socio-cultural (de Groot et al., 2010; Castro et al., 2014; Martín-López et al., 2014).

Biophysical value is measured with biophysical indicators or proxies and encompasses the health state of an ecosystem, which in its turn, depend on the management interventions developed by stakeholders (Geijzendorffer et al., 2015). Monetary value translates ES into money terms by estimating the actual allocation of human resources to get, use or enjoy a particular service (Geijzendorffer et al., 2015) or the willingness to obtain a service (Wolff et al., 2015; Wei et al., 2017). Finally, socio-cultural value is related to the importance given to the ES by stakeholders in a particular area for their well-being (Geijzendorffer et al., 2015). All of them represent different components and as Martín-López et al. (2014) suggested, the methods used to elicit value actually shape and define the values being elicited. Thus, it is fundamental to understand the biophysical, monetary and socio-cultural values of ES to enhance the ability of decision makers to sustainably manage the territory and provide multiple ES.

Especially since the publication of Costanza et al. (1997) and the Millennium Ecosystem Assessment (MA, 2005), interest in ES assessment has invoked considerably. Yet, in spite of the academic progress, the ES framework faces several challenges arising from the inconsistency among scientist to develop a comprehensive assessment framework that integrates the plurality of values of ES. As a result, there are so many ES frameworks, including the Millennium Ecosystem Assessment (MA, 2005), the cascade model (Haines-Young & Potschin, 2010), the Economics of Ecosystems and Biodiversity (TEEB, 2010), ES capacity, pressure, demand, and flow framework (Villamagna et al., 2013) or supply-and-demand framework (Geijzendorffer et al., 2015). Here, we base on the supply-demand framework developed by Geijzendorffer et al. (2015) since it includes the societal dimension by distinguishing the different interlinked components of supply to demand, i.e. supply, demand and interest components. These components of the supply-demand framework of the ES are implicitly included in the criteria of value pluralism as they address the biophysical, monetary and socio-cultural values (Martín-López et al., 2014; Geijzendorffer et al., 2015) (Fig. 3).

Altogether, the valuation of ES can improve our knowledge to manage ecosystems and social systems in an appropriate way to enhance human well-being and solve potential conflicts. In this context, where there might be a problem that needs to be solved, ES are the basis of nature-based solutions, now increasingly being used to reframe policy debates on biodiversity conservation, climate change adaptation and mitigation strategies or the sustainable development (Potschin et al., 2016).

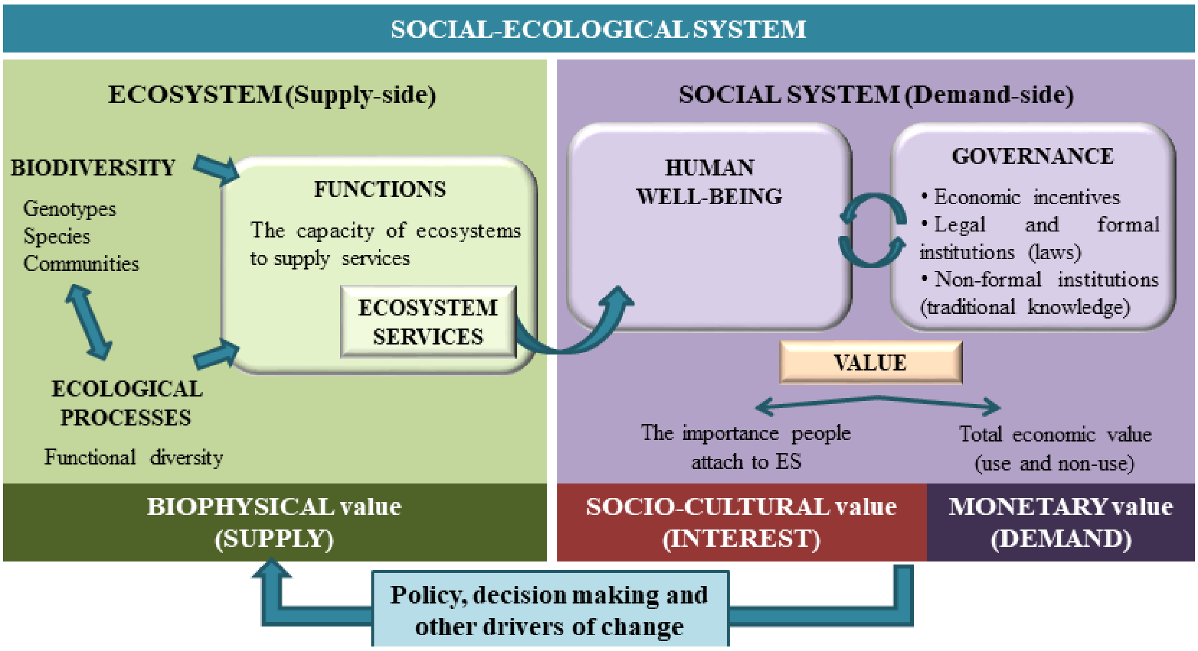


Fig. 3. Methodological framework for an integrated assessment of ecosystem services based on the performance of their delivery (biophysical value - supply) and importance (socio-cultural value - interest) and total economic value (monetary value - demand) given by users (the sizes of the different values are fixed on purpose). Governance, as regulatory mechanism, operates at the interface between ecosystems and social systems in three levels, including economic incentives, legal and formal institutions, and non-formal institutions. Adapted from Martín-López et al. (2014) and Gómez-Baggethun et al. (2013).

1.2. Biosphere Reserves: connecting nature and society

Conservation planning of protected areas has frequently focused only on the biophysical components; however, as Petrosillo et al. (2015) state, there are neither social systems without nature nor ecosystems without people. As living laboratories for sustainable development, biosphere reserves constitute suitable conservation figures for testing interdisciplinary approaches to comprehend the interactions between nature and society. Recognized by UNESCO's Man and Biosphere Program, these areas aim to reconcile nature conservation with its sustainable use and increase human well-being, by involving the local communities in management (UNESCO, 2018). They are recognized as models contributing to the implementation of the SDGs by covering the three dimensions of sustainable development: economic growth, social inclusion and environmental protection (UNESCO, 2018).

In order to promote a social-ecological resilience, biosphere reserves are zoned in three different interrelated areas (Fig. 4): a core area or strictly protected ecosystem; a buffer zone surrounding the core areas where human activity is limited to sound ecological practices that can reinforce scientific research, monitoring, training and education; and a transition zone where the greatest activity is allowed, fostering economic and human development that is socio-culturally and ecologically sustainable.

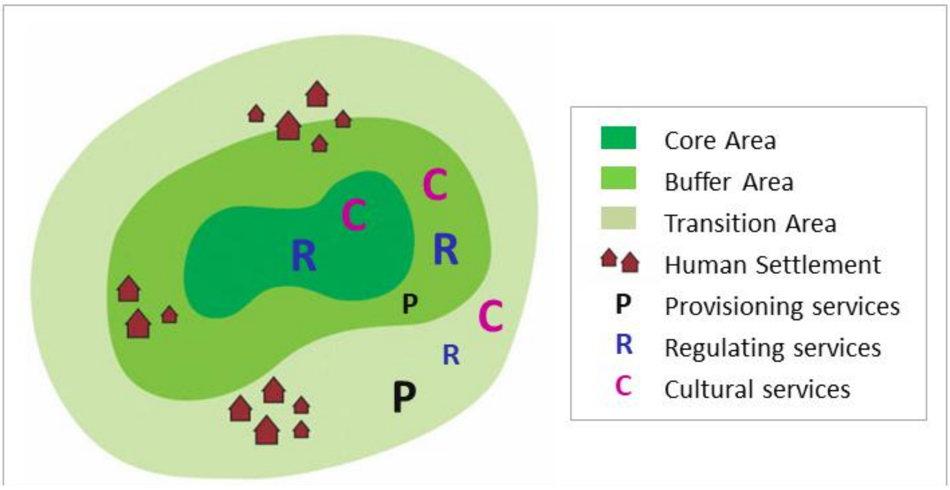


Fig. 4. Zoning of biosphere reserves and ecosystem services associated with each zone (the bigger the symbol, the higher the supply of ecosystem services).

Biosphere reserves are conceived as examples of sustainable social-ecological systems (SES), i.e. complex adaptive systems result of the interrelationship between ecosystems and human activities shaped over time (Liu et al., 2007). A systemic worldview, co-development of knowledge, stakeholder engagement, monitoring systems, and education and training are key concepts of SES (Virapongse et al., 2016), so are they for environmental management of biosphere reserves.

1.3. HYPOTHESIS AND OBJECTIVES

1.3.1. Initial hypothesis

Protected areas, in their broad sense of safeguarding biodiversity and its associated ES, have been historically perceived as a major limitation and restriction to local population development (Pullin et al., 2013; Palomo et al., 2014). They are often imposed on the rural areas and many activities or exploitation of natural resources are usually prohibited, excluding people from nature. Contrary to this, biosphere reserves attempt to make society part of the management of the territory so that potential conflicts can be prevented and sustainable development supported.

Therefore, being conservation and human well-being the primary goal of biosphere reserves, evaluating their effectiveness may be useful for future land management. However, considering the land use changes occurred in the last decades and in order to promote awareness rising for conservation, economic valuation of ES is suggested as an understandable language by everybody. It could provide guidelines for decision making by visualising the overall importance of ES for human societies and their preferences for different scenarios. Still, monetary value dimension only represents one component of ES. Thus, since we recognise the plurality of values of ES, one of the main challenges to be addressed is the development of an approach that integrates the multidimensional value of ES.

Ultimately, by dealing with these points, we sought to answer the following research questions:

1) Which is the relationship between conservation and socioeconomic and cultural development in the Urdaibai Biosphere Reserve (UBR)?
2) What has been the economic impact of land use changes occurred in the UBR during the last 44-year period? Does the zoning of the biosphere reserve adjust to the biophysical and monetary values of ecosystem services?
3) Would the inhabitants of the UBR contribute economically to its enhancement? Which are the social preferences towards different scenarios of land uses and related ES?
4) Do the different components of ES provide consistent information? How can we identify mismatches in ES assessment? And does the information vary across the different units with similar socio-economic characteristics and land uses within the UBR?

1.3.2. General and specific objectives

The main goal of this PhD thesis is to contribute to the knowledge in support of decision making for sustainability in the SES of the UBR by assessing and valuing ES.

Specifically, we:

1) Analyse the effectiveness of the UBR protection status and its sustainable development.
2) Estimate the economic consequences of management decisions before and after the designation of the biosphere reserve through literature review, and analyse the interdependence between biophysical and monetary values of ES across the different zones in the UBR.
3) Use monetary techniques that comprises different ES to study local population's preferences and their willingness to pay (WTP) towards different land uses and related ES.
4) Assess biophysical, monetary and socio-cultural values of ES in different socio-economic units of the UBR and explore mismatches among the supply, demand and interest component of ES to identify potential conflicts.

1.4. STRUCTURE OF THE DISSERTATION

This PhD thesis consists of four interrelated, but independent, publications (*Chapters 4.1, 4.2, 4.3* and *4.4*). These main chapters are preceded by this general introduction (*Chapter 1*), description of the study area (*Chapter 2*) and the methodological approach (*Chapter 3*) and are followed by a general discussion (*Chapter 5*) and main conclusions (*Chapter 6*). Figure 5 shows the outline of the four results chapters and their relationship.

Chapter 4.1 (**Paper I.** *Urdaibai Biosphere Reserve (Biscay, Spain): Conservation against development?*) puts us in context and explores whether the designation of the UBR fulfills its sustainability goal and enhances the quality of life of the local population. To this end, we evaluate the evolution of land use variables and socioeconomic and cultural variables in two areas inside and outside the biosphere reserve since the approval of the Governance Plan for Use and Management (GPUM). Then, being ES recognised as the new paradigm for sustainable decision making, we focus on their valuation. First, in *Chapter 4.2* (**Paper II.** *Linking biophysical and economic valuations of ecosystem services for a social–ecological approach to conservation planning: Application in a Biosphere Reserve (Biscay, Spain)*), we analyse the main land use changes occurred in the study area in the last 44 years and estimate their economic impact by transferring existing benefit measures from studies already completed throughout the world. Next, we examine the correspondence between biophysical and economic valuations of ES in the delimited sectors by the biosphere reserve zoning so as to building conservation decision making. But since the socioeconomic and cultural characteristics are surely different in our study area and in order to fill this knowledge gap, in *Chapter 4.3* (**Paper III.** *Economic valuation of ecosystem services: an application to Biosphere Reserve management*) we carried out a discrete choice experiment (DCE) to study local population's preferences and their WTP towards different management alternatives and related ES, including increase in organic farming, higher biodiversity protection, improvement of quality of water bodies, increase in native forest and improvement of paths and recreational areas. Eventually, assuming the multidimensionality of ES, in *Chapter 4.4* (**Paper IV.** *A comprehensive assessment of ecosystem services: integrating supply, demand and interest in the Urdaibai Biosphere Reserve*) we propose a methodological approach to examine mismatches, i.e. differences in quality or quantity, when analysing the supply, demand and interest components of ES in four different units with similar socio-economic characteristics and land uses of the UBR. That way, potential conflicts among the biophysical, monetary and socio-cultural value dimensions of ES were explored.

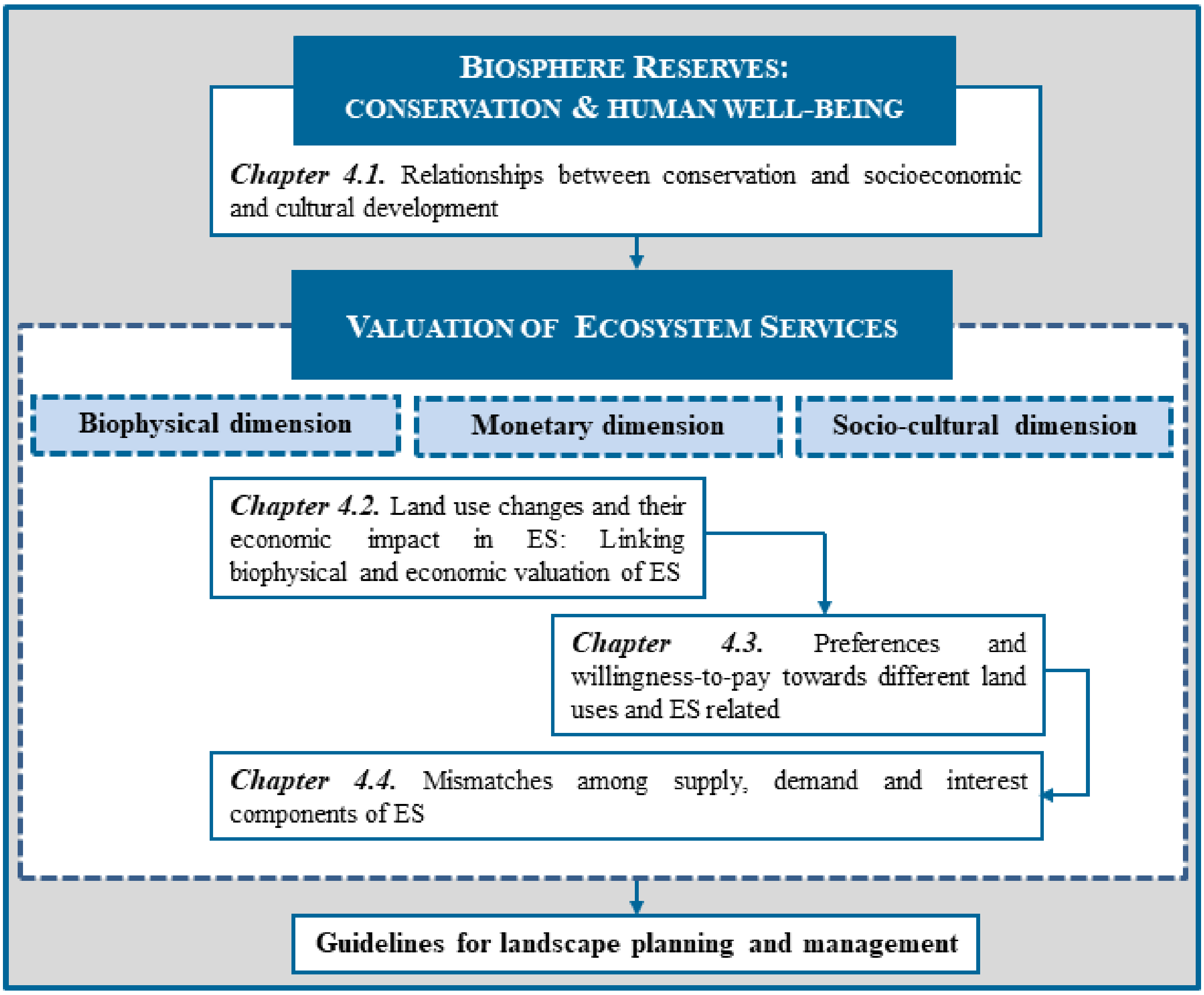


Fig. 5. Structure of the results of the PhD dissertation and their relationships (ES=Ecosystem Services).

REFERENCES

Balvanera, P., Pfisterer, A.B., Buchmann, N., He, J.-S., Nakashizuka, T., Raffaelli, D., Schmid, B., 2006. Quantifying the evidence for biodiversity effects on ecosystem functioning and services. Ecol. Lett. 9, 1146-1156.

Basque Government, 2014. Department of Environment and Regional Planning. Ihitza 44 Driving the 21 school schedule. Ecosystems are our Natural Capital.

Bennett, E.M., Peterson, G.D., Gordon, L.J., 2009. Understanding relationships among multiple ecosystem services. Ecol. Lett. 12, 1394-1404.

Boeraeve, F., Dendoncker, N., Jacobs, S., Gómez-Baggethun, E., Dufrêne, M., 2015. How (not) to perform ecosystem service valuations: pricing gorillas in the mist. Biodivers. Conserv. 24 (1), 187 - 197.

Butchart, S.H.M., Walpole, M., Collen, B., et al., 2010. Global biodiversity: Indicators of recent declines. Science 328, 1164-1168.

Castro, A.J., Verburg, P.H., Martín-López, B., García-Llorente, M., Cabello, J., Vaughn, C.C., López, E., 2014. Ecosystem service trade-offs from supply to social demand: a landscape-scale spatial analysis. Landsc. Urban Plan. 132, 102-110.

CICES. Common International Classification of Ecosystem Services., 2018. Available: www.cices.eu

Crutzen, P.J., 2002. Geology of mankind: The Anthropocene. Nature, 415:23.

De Groot, R.S., Alkemade, R., Braat, L. Hein, L., Willemen, L., 2010. Challenges in integrating the concept of ecosystem services and values in landscape planning, management and decision making. Ecol. Complex. 7(3), 260-272.

Díaz, S., Fargione, J., Chapin, F.S., Tilman, D., 2006. Biodiversity Loss Threatens Human Well-Being. PLoS Biol 4(8): e277.

Díaz, S., Demissew, S., Joly, C., Lonsdale, W.M., Larigauderie, A., 2015. A Rosetta Stone for nature's benefits to people. PLoS Biol. 13(1), e1002040.

Dominati, E., Patterson, M., Mackay, A., 2010. A framework for classifying and quantifying the natural capital and ecosystem services of soils. Ecol. Econ. 69(9), 1858-1868.

Folke, C., Jansson, Å., Rockström, J., Olsson, P., Carpenter, S. R., Chapin III, F. S., et al., 2011. Reconnecting to the Biosphere. Ambio, 40:719.

Folke, C., Biggs, R., Norström, A., Reyers, B., Rockström, J., 2016. Social-ecological resilience and biosphere-based sustainability science. Ecol. Soc. 21(3):41.

Geijzendorffer, I.R., Martín-López, B., Roche, P.K., 2015. Improving the identification of mismatches in ecosystem services assessments. Ecol. Indic. 52, 320-331.

Gómez-Baggethun, E., de Groot, R., 2010. Natural capital and ecosystem services: The ecological foundation of human society. In: Hester, R.E & Harrison, R.M (eds) Ecosystem Services: Issues in Environmental Science and Technology. Cambridge: Royal Society of Chemistry, 118–145.

Gómez-Baggethun, E., Kelemen, E., Martín-López, B., Palomo, I., Montes, C., 2013. Scale Misfit in Ecosystem Service Governance as a Source of Environmental Conflict. Society & Natural Resources: An International Journal 26(10), 1202-1216.

Gómez-Baggethun, E., Martín-López, B., 2015. Ecological Economics perspectives on ecosystem services valuation. In: Martínez-Alier, J. & Muradian, R. (eds.). Handbook on Ecological Economics. Edward Elgar, pp. 260-282.

Haines-Young, R., Potschin, M., 2010. The links between biodiversity, ecosystem services and human well-being. Ch. 6. In: Raffaelli, D. & Frid, C. (Eds.), Ecosystem Ecology: A New Synthesis. BES Ecological Reviews Series, CUP, Cambridge.

Harrison, P.A., Berry, P.M., Simpson, G., Haslett, J.R., Blicharska, M., Bucur, M., et al., 2014. Linkages between biodiversity attributes and ecosystem services: A systematic review. Ecosyst. Serv. 9, 191-203.

IPBES, 2018. Intergovernmental Platform for Biodiversity and Ecosystem Services. [online] Available at: www.ipbes.net/ [Accessed 2018].

Jacobs, S., Dendoncker, N., Martín-López, B., Barton, D.N., Gómez-Baggethun, E., Boeraeve, F., et al., 2016. A new valuation school: Integrating diverse values of nature in resource and land use decisions. Ecosyst. Serv. 22(B), 213-220.

Liu, J., Dietz, T., Carpenter, S.R., Folke, C., Alberti, M., Redman, C.L., et al., 2007. Coupled Human and Natural Systems. Ambio, 36(8), 639-649.

MA, 2005. Ecosystems and Human Well-being: Synthesis. Island Press, Washington, DC.

Martín-López, B., Gómez-Baggethun, E., García-Llorente, M., Montes, C., 2014. Trade-offs across value-domains in ecosystem services assessment. Ecol. Indic. 37, 220-228.

Palomo, I., Montes, C., Martín-López, B., González, J.A., García-Llorente, M., Alcorlo, P., García Mora, M.R., 2014. Incorporating the Social–Ecological Approach in Protected Areas in the Anthropocene. BioScience 64(3), 181-191.

Pascual, U., Balvanera, P., Díaz, S., Pataki, G., Roth, E., Stenseke, M., et al., 2017. Valuing nature's contributions to people: the IPBES approach. Curr. Opin. Environ. Sustainability 26, 7-16.

Petrosillo, I., Aretano, R., Zurlini, G., 2015. Socioecological systems. In: Reference Module in Earth Systems and Environmental Sciences, ed. S.A. Elias, pp. 1–7. Amsterdam, The Netherlands: Elsevier.

Pope Francis, 2015. Laudato Si': On Care for Our Common Home.

Potschin, M., Kretsch, C., Haines-Young, R., Furman, E., Berry, P., Baró, F., 2016.

Nature-based solutions. In: Potschin, M. and K. Jax (eds): OpenNESS Ecosystem Services Reference Book. EC FP7 Grant Agreement no. 308428. Available via: www.openness-project.eu/library/reference-book

Pullin, A.S., Bangpan, M., Dalrymple, S., Dickson, K., Haddaway, N.R., Healey, J.R., et al., 2013. Human well-being impacts of terrestrial protected areas. Environ. Evid. 2:19.

Rockström, J., Steffen, W., Noone, K., Persson, Å., Chapin III, F. S., Lambin, E., et al., 2009. Planetary boundaries: exploring the safe operating space for humanity. Ecol. Soc. 14(2):32.

Rodríguez, J.P., Beard, T.D., Bennett, E.M., Cumming, G.S., Cork, S., Agard, J., Dobson, A.P., Peterson, G.D., 2006. Trade-offs across space, time, and ecosystem services. Ecol. Soc. 11(1): 28.

Steffen, W., Richardson, K., Rockström, J., Cornell, S.E., Fetzer, I., Bennett, E.M., et al., 2015. Planetary boundaries: Guiding human development on a changing planet. Science, 347:6223.

Stern, N., 2007. The Economics of Climate Change: The Stern Review. Cambridge University Press, Cambridge.

TEEB, 2010. The Economics of Ecosystems and Biodiversity Ecological and Economic Foundations. Edited by Pushpam Kumar. Earthscan, London and Washington.

UNESCO, 2018. [online] Available at: www.unesco.org/ [Accessed 2018].

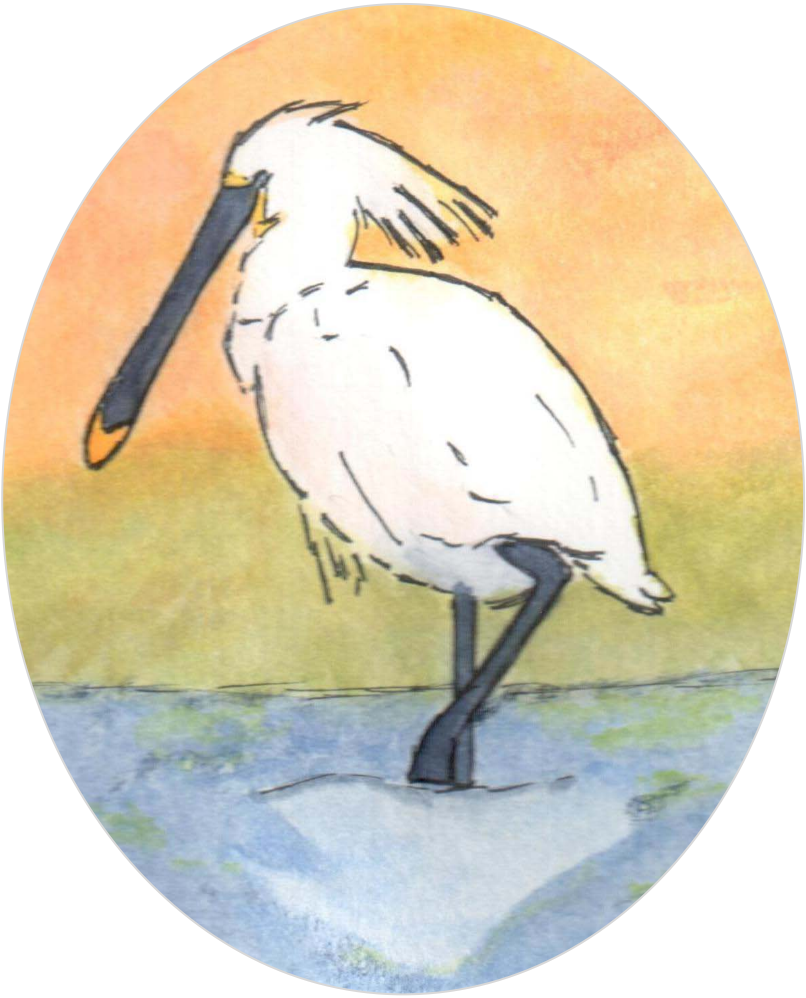
van Oudenhoven, A.P.E., Martín-López, B., Schröter, M., de Groot, R., 2018. Advancing science on the multiple connections between biodiversity, ecosystems and people, International Journal of Biodiversity Science, Ecosystem Services & Management, 14:1, 127-131.

Virapongse, A., Brooks, S., Covelli Metcalf, E., Zedalis, M., Gosz, J., Kliskey, A., Alessa, L., 2016. A social-ecological systems approach for environmental management. J. Environ. Manage. 178, 83-91.

Wei, H., Fan, W., Wang, X., Lu, N., Dong, X., Zhao, Y., Ya, X., Zhao, Y., 2017. Integrating supply and social demand in ecosystem services assessment: A review. Ecosyst. Serv. 25, 15-27.

Wolff, S., Schulp, C., Verburg, P.H., 2015. Mapping ecosystem services demand: a review of current research and future perspectives. Ecol. Indic. 55, 159-171.

Chapter 2
Study area



Urdaibai responds to the Basque toponym of:
“Urde” = wild boar and “Ibai” = river, so that it could be understood as “river of wild boars” or "basurdeen ibaia" in Basque.

Hegoak ebaki banizkio
nerea izango zen,
ez zuen alde egingo.
Bainan, honela
ez zen gehiago txoria izango
eta nik... txoria nuen maite

Mikel Laboa
Txoria Txori

If I had cut its wings
it would have been mine
it would never have flown away.
But this way
it would no longer have been a bird
And I…I loved that bird

Mikel Laboa
The Bird Which Is a Bird
(Hymn to freedom)

2. STUDY AREA

This study is performed in the UBR in Northern Spain (the Basque Country, Biscay) (43º 19’ N, 2º 40’ W) (Fig. 1). It covers an area of *ca.* 220 km^2 with 22 municipalities and around 45,000 inhabitants.

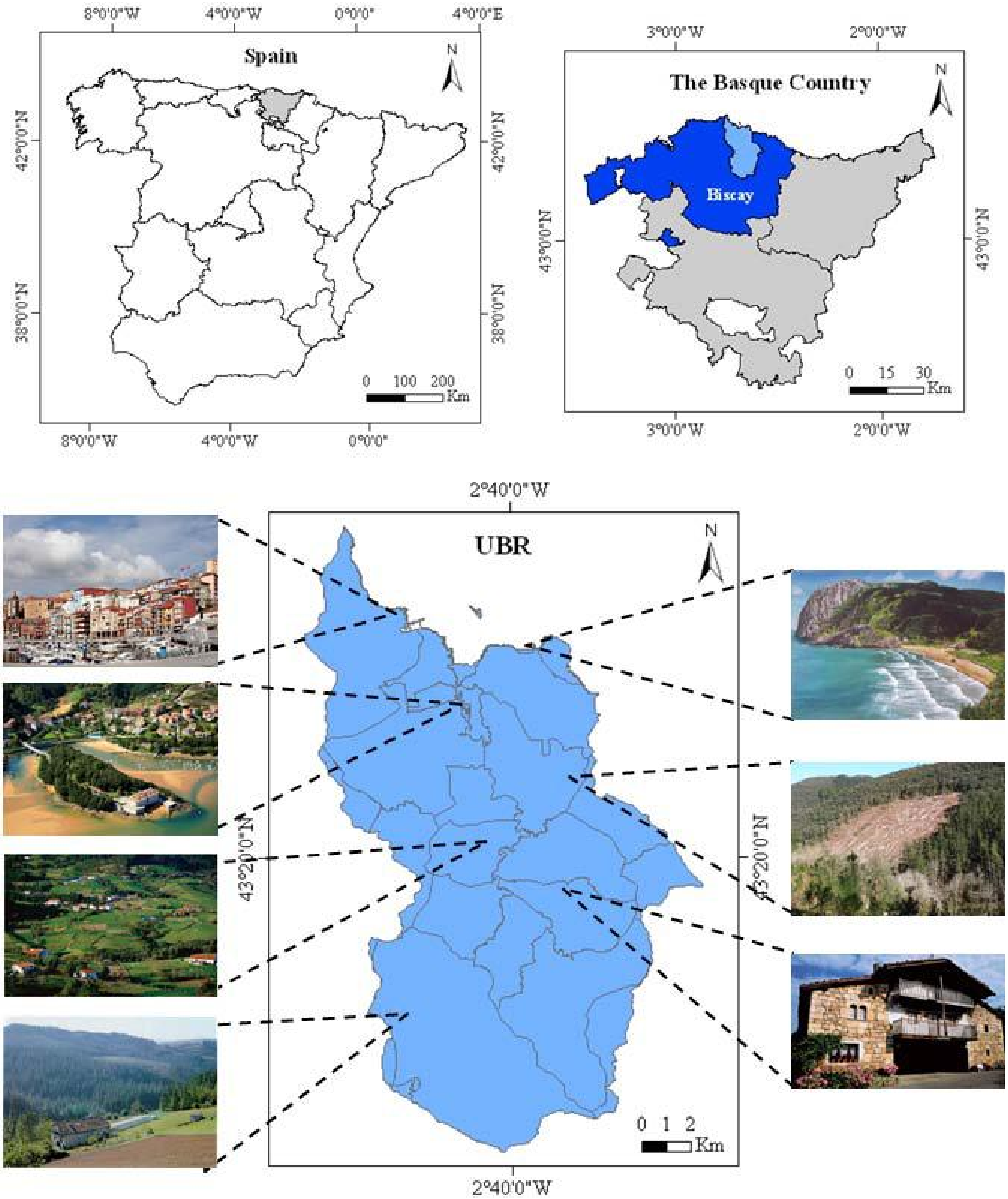


Fig. 1. Location of the study area and some detailed views of different sites.

Two areas can be clearly distinguished in the UBR: an urban area (municipalities of Bermeo and Gernika-Lumo), which gathers most of the industrial activity and services and about 75% of its inhabitants; and a rural area, with a very low population density, mainly dedicated to forestry and agriculture and livestock sector, as well as summer tourism in the coast. Altogether, according to the most current data, 69% of the employed population works in the tertiary sector, 27% in industry (including construction) and 3% in the primary sector (EUSTAT, 2016). The tertiary sector covers 61% of the total GDP, industry 26% and the primary sector 13% (EUSTAT, 2013). Comparing to Biscay or the Basque Country, where the primary sector does not exceed 1% of the GDP, the primary sector in the UBR is quite relevant; but the number of arable hectares and livestock farms have been gradually reduced and fishing industry, the most important in the primary sector, is also shifting to lower economic value species like mackerel and bonito.

Urdaibai was declared a biosphere reserve by UNESCO in 1984 because of its high naturalistic and cultural value, and later, in 1993 it was also added to the list of Ramsar Wetlands and the network of the European Union Natura 2000. Its territory is composed of a mosaic of diverse natural and cultural systems, highlighting the marshlands, the coastline and the Cantabrian holm oak forests. These systems form a heterogeneous and complex landscape (Rescia et al., 1994) presenting a high diversity of habitats, which has determined the existence of a variety of wildlife species, but especially its relevance for migratory birds stands out. In total, more than 700 species of fauna and 800 species of flora are counted. On top of that, the UBR also has an interesting geodiversity which goes from the Triassic (251 million years ago) to the Quaternary (2.6 million years ago) until current periods.

Like other biosphere reserves, the central functions of the UBR include conservation, sustainable development and logistical support for research, training and communication. These three functions are implemented through the GPUM, approved in 1993 (Basque Government, 2004) and now being reviewed, which articulates the guidelines for management and conservation. It involves the classical zonation of a biosphere reserve: a) a core area of strictly protected ecosystems (coastal ecosystems, marshlands, Cantabrian holm oak and archaeological sites); b) a buffer zone which contains areas of coastal protection and the oak and river network and develops activities compatible with conservation purposes; and c) a transition zone that consist of forest areas, rural villages and scattered hamlets and promotes sustainable activities.

Yet, its designation as protected area is not free of conflicts since it constitutes a complex social-ecological system in which contrary interest coexists between conservation and economic development (Onaindia et al., 2013a). As happened in Biscay, the landscape of the UBR, shaped by agriculture and livestock in the past, has been highly transformed due to the industrialization and its associated rural abandonment. In fact, in the mid-20th century, to counteract native forest deforestation and rural crisis, exotic plantations were promoted by the administration (Madariaga et al., 2011); so nowadays, more than the half of the territory is dominated by *Pinus radiata* and *Eucaliptus* sp. monocultures, and only 17% and 3% are native forests and croplands, respectively. This increase of fast-turnover exotic plantations and their aggressive forms of management has led to a series of environmental problems, such as loss of species diversity, aesthetic and cultural values, soil erosion or worsening of water quality and quantity (Onaindia et al., 2013b; Rodriguez-Loinaz et al., 2013). Besides, industrial activities throughout the last century, harbor activities and inefficient sewage disposal have impacted even more the quality of water bodies in the UBR, resulting in bad global state of transitional waters (AZTI-Tecnalia, 2016) and bad chemical state of the aquifer of Gernika (Agencia Vasca del Agua, 2016). Hence, strategic planning is needed to support decision making for sustainability and create sustainable landscapes.

REFERENCES

Agencia Vasca del Agua, 2016. Red de seguimiento del estado de las aguas subterráneas. Informe 2015. [Spanish]

AZTI-Tecnalia, 2016. Red de seguimiento del estado ecológico de las aguas de transición y costeras de la Comunidad Autónoma del País Vasco. Informe de resultados. Campaña 2015. [Spanish]

Basque Government, 2004. Governance Plan for Use and Management of Urdaibai Biosphere Reserve. Refunded text. Department of Land Management and Environment, Vitoria-Gasteiz. [Spanish]

EUSTAT., 2013. Basque Institute of Statistics. Gross value added (GVA) of the Basque Country by territorial scope, according to sectors of activity. Current prices (%). 2012. [Online]. Available: www.eustat.es

EUSTAT., 2016. Basque Institute of Statistics. Employed population aged 16 and over of the Basque Country by provinces according to economic sector. [Online]. Available: www.eustat.es

Madariaga, I., Arana, X., Casado-Arzuaga, I., Palacios-Agúndez, I., 2011. Servicios de los ecosistemas del paisaje cultural de Bizkaia. Perspectiva histórica de la actividad forestal y minera. Revista Forum de Sostenibilidad 4:33-46.

Onaindia, M., Ballesteros, F., Alonso, G., Monge-Ganuzas, M., Peña, L., 2013a. Participatory process to prioritize actions for a sustainable management in a biosphere reserve. Environ. Sci. Policy 33, 283-294.

Onaindia, M., Fernández de Manuel, B., Madariaga, I., Rodríguez-Loinaz, G., 2013b. Co-benefits and trade-offs between biodiversity, carbon storage and water flow regulation. For. Ecol. Manage. 289, 1-9.

Rescia, A.J., Schmitz, M.F., Martín de Agar, P., de Pablo, C.L., Atauri, J.A., Pineda, F.D., 1994. Influence of landscape complexity and land management on woody plant diversity in Northern Spain. J. Veg. Sci. 5, 505-516.

Rodríguez-Loinaz, G., Amezaga, I., Onaindia, M., 2013. Use of native species to improve carbon sequestration and contribute towards solving the environmental problems of the timberlands in Biscay, northern Spain. J. Environ. Manage. 120, 18-26.

Chapter 3
Methodology

"We cannot manage what we do not measure"

Pavan Sukhdev

"To measure the unmeasurable is absurd and constitutes but an elaborate method of moving from preconceived notions to foregone conclusions. The logical absurdity, however, is not the greatest fault of the undertaking: what is worse, and destructive of civilization, is the pretence that everything has a price or, in other words, that money is the highest of all values"

E.F. Schumacher
Small is beautiful: A study of economics as if people mattered

3. METHODOLOGY

This methodology chapter aims to present an overall joint view of the different method used along the thesis (Figure 1). Further explanation on each of the applied methodologies is included in detail in the associated chapters.

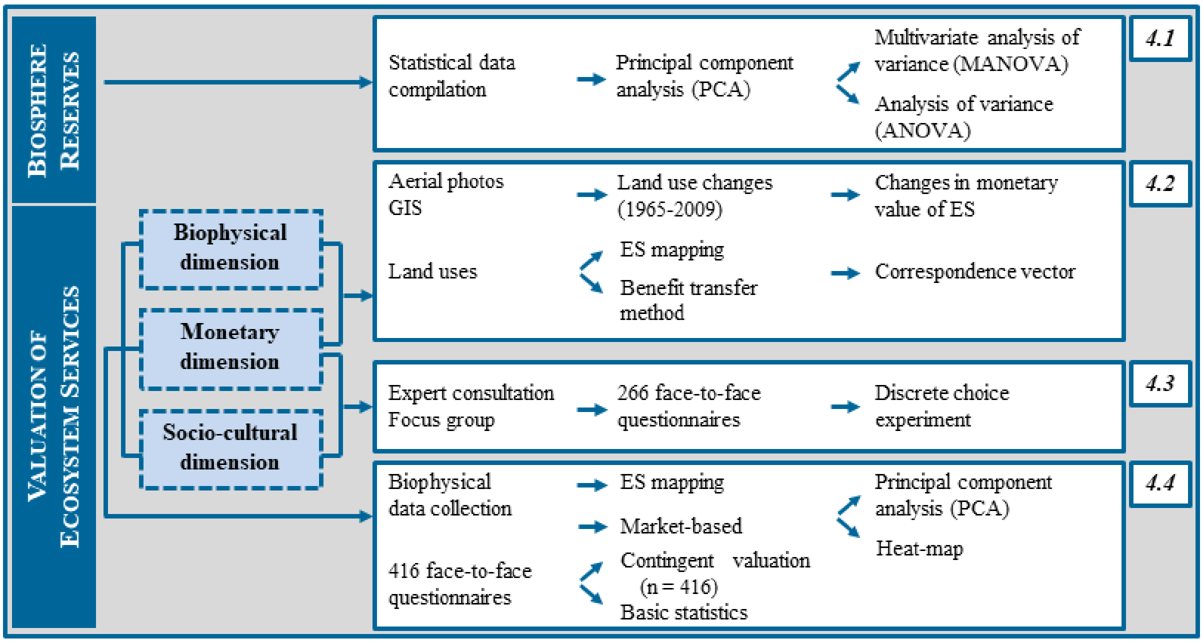


Fig. 1. General methods used for each result chapter and their different value dimensions.

On the one hand, we performed statistical data compilation of environmental, socioeconomic and cultural variables, as well as aerial photo interpretation to quantify the landscape evolution of the study area. On the other hand, we evaluate the three dimensions of the ES, from the biophysical to the monetary and socio-cultural dimension. However, it is important to highlight that we mainly focused on the monetary dimension. Indeed, biophysical dimension of ES has been previously evaluated in the area through biophysical maps (Onaindia et al., 2013a; Peña et al., 2015) and different participatory processes have been also carried out dealing with socio-cultural dimension (Onaindia et al., 2013b; Garmendia & Gamboa, 2012). Thus, we applied biophysical, monetary and non-monetary approaches, paying particular attention to monetary techniques.

Many are the methods for measuring biophysical, monetary and socio-cultural value dimensions. Specifically, we assessed these different values as following:

Biophysical value: Supply component

We analysed the supply of different ES, including provisioning (food from agriculture, food from livestock, fishing, timber, fresh water), regulating (carbon storage, erosion control, water regulation and purification, pollination, habitat for species) and cultural services (tourism and recreation, aesthetic enjoyment) *(Chapters 4.1* and *4.4).* We selected these ES because of their relevance for conservation planning and the socioeconomic development of the area and the availability of the data. As mentioned above, most of the biophysical valuation of ES has already been assessed, so we based on this data and the review of indicators and methods used to value ES.

Monetary value: Demand component

By using different monetary techniques, we estimated the monetary value of a variety of ES and management scenarios. Firstly, we applied the benefit transfer (BT) method *(Chapter 4.1)*. This method enables the derivation of monetary values of ES based on data previously used to value similar goods or services in a similar context (Liu et al., 2010). Then, direct market valuation and stated preference approaches were used to estimate the monetary value of provisioning services and regulating and cultural services, respectively *(Chapters 4.3* and *4.4)*.

State preference approaches simulate a hypothetical market for ES by means of surveys (Pascual et al., 2010). There are two main types of stated preference techniques: contingent valuation and discrete choice experiment. Contingent valuation obtains the monetary value of ES according to respondents' WTP for the protection of nature (Mitchell & Carson, 1989). With regard to discrete choice experiments, individuals are faced with two or more policy scenarios with shared attributes of the services to be valued, but with different levels of attribute (one of the attributes being the money people would have to pay for the service). Thus, when individuals make their choice, they trade-off between the levels of the attributes and the associated costs describing the different policies (Bernués et al., 2014). Both methods are based on the concept of utility change, so that the change in human well-being due to an increase or decrease in the quantity or quality of a service can be measured in monetary units.

In *Chapter 4.3* we conducted a total of 266 direct face-to-face questionnaires (Supplementary material Questionnaire A) aimed at the local population and analysed their preferences towards different management scenarios by using a Mixed Logit model. Besides, in *Chapter 4.4* we carried out 416 direct face-to-face questionnaires (Supplementary material Questionnaire B) aimed at the local population and users of the biosphere reserve and analysed the monetary value attributed to different ES by using a Tobit regression model.

Socio-cultural value: Interest component

Following the same 416 direct face-to-face questionnaires used to estimate the monetary value of ES (Supplementary material Questionnaire B), in *Chapter 4.4* we also analysed the socio-cultural importance of ES. To start with, we ensured that respondents understood the meaning of the different ES studied by given a short explanation of each service and then, we asked them to rank the five most important ES for their well-being. This interest component tends to be longer wish-lists of services without prioritization as suggested by Geijzendorffer et al. (2015).

REFERENCES

Bernués, A., Rodríguez-Ortega, T., Ripoll-Bosch, R., Alfnes, F., 2014. Socio-Cultural and Economic Valuation of Ecosystem Services Provided by Mediterranean Mountain Agroecosystems. PLoS ONE 9(7): e102479.

Garmendia, E., Gamboa, G., 2012. Weighting social preferences in participatory multi-criteria evaluations: A case study on sustainable natural resource management. Ecol. Econ. 84, 110-120.

Geijzendorffer, I.R., Martín-López, B., Roche, P.K., 2015. Improving the identification of mismatches in ecosystem services assessments. Ecol. Indic. 52, 320-331.

Liu, S., Costanza, R., Troy, A., D'Aagostino, J.D., Mates, W., 2010. Valuing New Jersey's ecosystem services and natural capital: A spatially explicit benefit transfer approach. Environ. Manage. 45, 1271-1285.

Mitchell, R.C., Carson, R.T., 1989. Using surveys to value public goods. The Contingent Valuation Method. Resources for the Future, Washington, DC.

Onaindia, M., Fernández de Manuel, B., Madariaga, I., Rodríguez-Loinaz, G., 2013a. Co-benefits and trade-offs between biodiversity, carbon storage and water flow regulation. For. Ecol. Manage. 289, 1-9.

Onaindia, M., Ballesteros, F., Alonso, G., Monge-Ganuzas, M., Peña, L., 2013b. Participatory process to prioritize actions for a sustainable management in a biosphere reserve. Environ. Sci. Policy 33, 283-294.

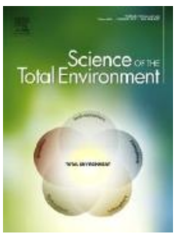
Pascual, U., Muradian, R., Brander, L., Gómez-Baggethun, E., Martín-López, B., Verma, M., et al., 2010. The Economics of Valuing Ecosystem Services and Biodiversity. In: Kumar, P. (Ed.), The Economics of Ecosystems and Biodiversity Ecological and Economic Foundations, Earthscan, London, pp. 183-256.

Peña, L., Casado-Arzuaga, I., Onaindia, M., 2015. Mapping recreation supply and demand using an ecological and a social evaluation approach. Ecosyst. Serv. 13, 108-118.

Chapter 4

Results

Chapter 4.1



This chapter corresponds to the article:

Castillo-Eguskitza, N., Rescia, A.J., Onaindia, M., 2017. Urdaibai Biosphere Reserve (Biscay, Spain): Conservation against development? *Science of the Total Environment* 592, 124-133. doi: 10.1016/j.scitotenv.2017.03.076

Urdaibai Biosphere Reserve (Biscay, Spain): Conservation against Development?

Nekane Castillo-Eguskitza, Alejandro J. Rescia, Miren Onaindia

Abstract

The protected area approach has extended from conserving biodiversity to improving human well-being. However, the relationship between conservation and socioeconomic and cultural development continues to be controversial. This paper combines land use variables with socioeconomic and cultural variables through multivariate ordination analysis and evaluates their evolution in two areas inside and outside a biosphere reserve since the approval of the Governance Plan for Use and Management in the Reserve. The results indicate a similar tendency in the two areas, from the abandonment of traditional rural activities and decline in pine plantations to naturalness, urban sprawl and the growth of the tertiary economic sector, welfare indicators and sustainability index. However, it can be broadly observed that the region included inside the protected area presents better conservation features (native forest and marshland) and rural systems (forestry and primary economic sector) than the region outside the protected area while maintaining similar socioeconomic and cultural conditions. We suggest that the designation of the biosphere reserve does not influence the local population negatively but does safeguard its conservation, which could have enhanced socioeconomic and cultural development. Thus, even though certain changes must be made to replace the conifer plantations and encourage agricultural activities, the designation of the protected area fulfills its sustainability goal and enhances the local population’s quality of life.

Keywords:

Biosphere reserve management; land use changes; conservation; local development; social-ecological system

1. Introduction

Ecosystems support all humans' activities and lives, and the ecosystem goods and services they offer are vital to human well-being and economic and social development (MA, 2005). Protected Areas (PAs) have become a key instrument for conserving biodiversity. To date, more than 15% of the world's land and 3% of the oceans are covered by PAs (IUCN, 2016). The primary aim of Pas is to protect particular species or habitats from the pressure of people. PAs are widely recognized to deliver (global) environmental benefits, such as carbon sequestration, biodiversity, and water regulation (Palomo et al., 2011; Castro et al., 2015), but they are also criticised for not being effectively managed to achieve their basic conservation objectives (Watson et al., 2014) and for having negative impacts on local populations (Oldekop et al., 2015). Furthermore, their surrounding lands may become degraded or intensified more than usually (DeFries et al., 2007; Martín-López et al., 2011), which increases the conservation and social conflicts inside and outside the PAs.

One of the most debated issues in conservation policy is the socioeconomic impact of PAs, either positive or negative, on neighbouring and local communities. Indeed, the relation between development and biodiversity is very complex. Some studies highlight that biodiversity protection and conservation contribute to one of the most important United Nations Millennium Development Goals, which is poverty reduction (Andam et al., 2010; Ferraro and Hanauer, 2013; Hanauer, and Canavire-Bacarreza, 2015). In contrast, others claim that PAs amplify local poverty or that there is no clear effect (West et al., 2006; Upton et al., 2008; Brockington and Wilkie, 2015). Surprisingly, areas of high poverty and high biodiversity overlap globally (Fisher and Christopher, 2007), and it is widely acknowledged that biodiversity loss and poverty are linked problems (Adams et al., 2014). Biodiversity underpins the ecosystem services upon which society depends. Poor people especially often depend directly on such services on a daily basis for subsistence or income. Consequently, they live in a vicious cycle where the more biodiversity is degraded, the more the poor are affected.

Arguments against PAs hold that local population development is restricted due to limitations on some activities or the exploitation of natural resources (Pullin et al., 2013), evictions and land appropriation (Brockington and Igoe, 2006), and crop damage and livestock depredation (Mackenzie, 2012). However, these negative effects are balanced by others, such as the promotion of tourism (Sims, 2010), the improvement of infrastructures and facilities (Ferraro and Hanauer, 2013), an increase of local funding pathways, business and home values (Heagney et al., 2015), research and environmental education, and especially, the preservation and enhancement of the environment in general and in terms of ecosystem services in particular (Balmford et al., 2002; Eastwood et al., 2016). These final aspects do not have direct market price, so the economic value of these areas would be even higher.

Sustainable development has been a political catchphrase for almost 30 years; however, we are still far from reaching global sustainability (Helne and Hirvilammi, 2015; Rodríguez-Rosa et al., 2016). In light of this situation and considering the ongoing increase in the number of protected areas, the politics for implementing sustainable development much be based on studies of the biophysical, social and economic systems at appropriate scales (Le Blanc, 2015). Suitable environmental management requires the consideration of local people's needs. Certainly, as Oldekop et al. (2015) suggested, conservation targets are more likely to be achieved when PAs encourage socioeconomic benefits through sustainability instead of imposing strict protection. That is precisely what a biosphere reserve seeks. Biosphere reserves focus on the involvement of the local communities in management with the aim of reconciling nature conservation and sustainable development (UNESCO, 2016). They represent a model for reinforcing a sense of place or a principle of solidarity between humans and nature (Bouamrane et al., 2016). Their integration in a network with common governance and management could contribute effectively to the solution of the global problems of species loss, the over-exploitation of resources and adaptation to climate change for the goal of global social-ecological sustainability (Lopoukhine et al., 2012). Many cultural landscapes and social-ecological systems closely linked to rural activities, protected or not, have been seriously impacted as a consequence of environmental and socioeconomic changes, such asagrarian intensification or land abandonment (Rescia et al., 2010; Schmitz et al., 2012), directly affecting the socioeconomic and cultural context of territories.

Therefore, assessing the land uses and socioeconomic and cultural changes may explain the influence of protected areas in the maintenance of landscape structures and communities and local economies. However, most of the studies, some of which are mentioned above, have been applied to developing countries. By contrast, this paper examines the land uses and socioeconomic and cultural changes in two developed, contiguous and environmentally similar areas, one included in a protected area and the other one in a non-protected area; and evaluates their evolution to determine the effect of the designation of the protection figure and whether it has contributed to its principal objectives.

2. Materials and methods

2.1. Study areas

Designated as a biosphere reserve in 1984 because of its high naturalistic and cultural value, the Urdaibai Biosphere Reserve (Biscay, Northern of Spain) was also added to the list of Ramsar Wetlands in 1993 and the network of the European Union Natura 2000. It constitutes a rural social-ecological system, being the "caserío", a historic Basque Country farm, a socioeconomic organizing unit of an agro-silvo-pastoral mosaic landscape. This reserve's origin resides in the seventies as a consequence of the social mobilization against the implementation of a megaproject called "Special Plan for the Integrated Use of the estuary of Gernika-Mundaka", which, ultimately, intended to dry the marsh and transform the estuary into an area of large infrastructure and residential services (Arana, 1997).

The reserve’s primary functions include the conservation of naturalistic values (ecological variety and complexity), sustainable socioeconomic development of the territory, and logistical support (research, training, and dissemination and interpretation of the area). To this end, among others, a Governance Plan for Use and Management (GPUM) was approved in 1993 (Basque Government, 2004) and reviewed this year, which articulates the guidelines for management and conservation to reconcile the conservation of natural resources with their sustainable use. It involves the classical zonation of a biosphere reserve corresponding to a core area of strictly protected ecosystems (coastal ecosystems, marshlands and green-oak forests), a buffer zone where human activity is limited, and a transition zone extended to the outside area where greater activity is allowed. Moreover, a Plan for the Harmonisation and Development of Socio-economic Activities (Basque Government, 1999), which was recently evaluated, and the Plan for the Interpretation, Research, Training and Education for the Sustainable Development of the Urdaibai Biosphere Reserve 2015-2025 (Basque Government, 2015) were also adopted.

The Urdaibai Biosphere Reserve (UBR) covers 22 municipalities totally or partially. Due to its complicated administrative division and considering that the study is based on the municipal level, the region of Busturialdea (Biscay) was taken as a reference (Fig. 1). The region of Busturialdea has an area of approximately 27,000 hectares covering 20 municipalities, all of them included in the UBR except one (Fig. 1). It represents a complex social-ecological system where contrary interests coexist. As a result, its management can turn very conflictive and controversial (Onaindia et al., 2013a). Specifically, the almost complete predominance of *Pinus radiata* and *Eucalyptus* sp. monoculture plantations and their unsustainable management has brought about erosion, worsening water quality and a decline of fresh water supplies, and the loss of aesthetic values, among others (Onaindia et al., 2013b; Rodríguez-Loinaz et al., 2013).

In addition, the non-protected region of Uribe Kosta (Biscay) was selected for the purpose of comparison. This region is next to the region of Busturialdea and has similar characteristic in the sense that it has an important rural past from its Basque cultural heritage, a smaller but valuable (ecologically, social-culturally and economically) estuary and a similar population, although Uribe Kosta is smaller in size. This region has an area of approximately 21,000 hectares covering 15 municipalities (Fig. 1).

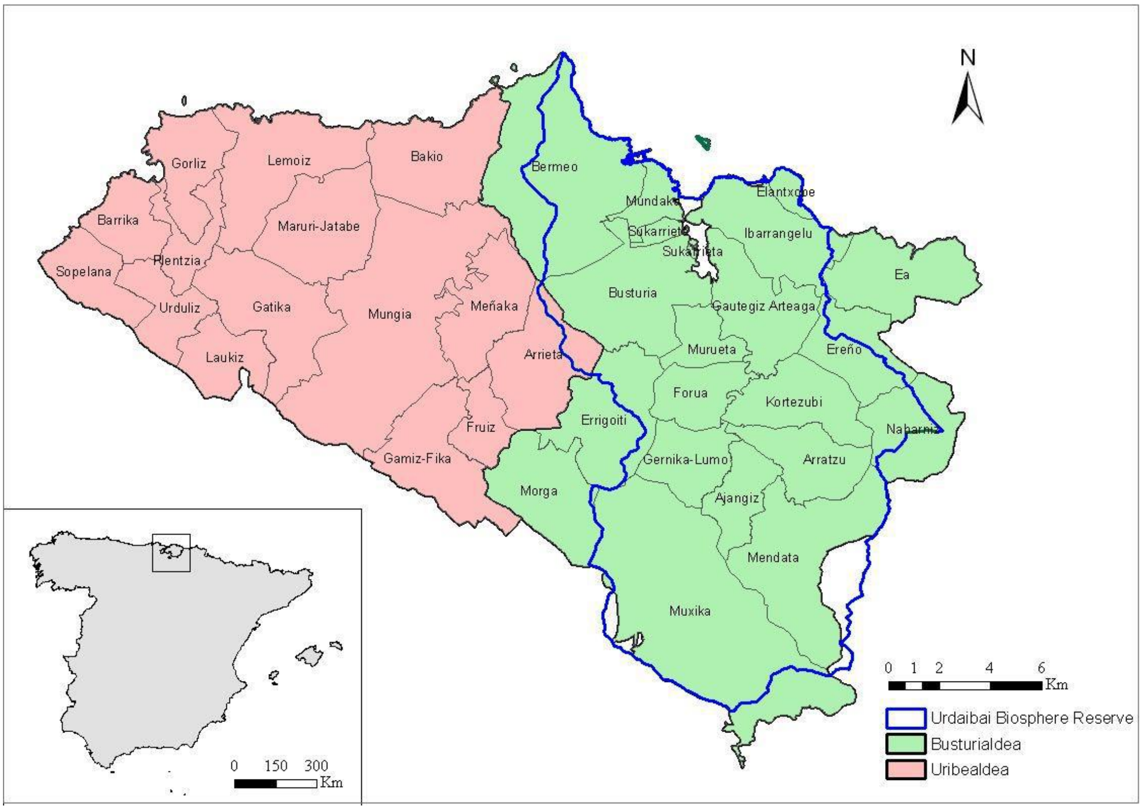


Fig. 1. Study areas. In green colour the region of Busturialdea, included in the protected area of the UBR, and in pink colour the non-protected region of Uribe Kosta.

2.2. Landscape and socioeconomic and cultural evolution

Land use and socioeconomic and cultural changes were analysed at the municipal level (App. A) for two time periods. Data for land use and socioeconomic variables vary from 1991 to 1997 and from 2008 to 2015 (for simplicity hereinafter, past and present, respectively). Although the protected area was designated in 1984, it was only feasible to go backwards until 1991 (1989 given the case) because of the lack of information about socioeconomic variables before that date. However, because the GPUM (Basque Government, 2004) was not approved until 1993 and thus land uses and activities started to be regulated that year, we consider that the used data are good indicators of the earlier and later landscape and socioeconomic situation of the protected territory, and consequently, of the impact of the biosphere reserve designation. However, regarding the cultural variables, there was no information preceding 1997; therefore, the two periods studied were established as before the year 2008 and from 2008 to 2015.

Information referring to land uses was obtained from forest inventories (Basque Government, 1996 and 2011), habitat EUNIS (European Nature Information System), a map (Basque Government, 2014) and aerial photographs (Basque Government, 2014). Based on the available data, 10 landscape variables were selected (App. B), and the frequency and diversity of uses (H’) were measured according to the Shannon-Wiener index (Shannon and Weaver, 1949).

$$H' = -\sum p_i \log_2 p_i \quad (1)$$

where p_i is the proportion of land use *i* relative to the total number of land uses presented in each municipality. Low values of diversity mean that there are few land uses and/or low evenness (for instance, when one land use is predominant), whereas high values indicate that there are more land uses and they are distributed in an equal proportion in the territory.

For the socioeconomic and cultural analysis, 14 and 4 descriptive variables of the municipalities were selected, respectively (App. B). The information was obtained from the Basque Institute of Statistics (EUSTAT, 2015) and Udalmap Municipal information system (Udalmap, 2016) by calculating the means of each period of time.

To compare the landscape and socioeconomic and cultural evolution for each municipality and period of time, Principal Components Analyses (PCAs), multivariate ordination analyses, were performed, with previous standardization and log (x+1) transformation of data to fulfil the requirements of normality and homoscedasticity. This technique reduces the dimensionality of the municipalities and projects them in two planes according to the importance of the variables used. Hence, it is possible to obtain the tendency of change of each municipality and region in space and time. Furthermore, to compare the displacement vectors of each region, which indicate the direction and magnitude of change, multivariate analysis of variance (MANOVA) was used. Finally, an analysis of variance (ANOVA) was applied to those key descriptive variables conforming to the PCAs to contrast the interaction of the evolution between time and region for each landscape and socioeconomic variable. All statistical analyses were performed in R (R Core Team, 2014).

3. Results

3.1. Landscape structure and evolution

The PCA analysis (Fig. 2, Table 1) enabled us to compare the landscape dynamic of the municipalities of both regions since the approval of the GPUM. The landscape structure change tendency on the first axis is determined mainly by urban zones on the positive side but also some natural land uses, such as scrublands, pastures and coastal beach and dunes, and eucalyptus plantations, whereas the negative side is exclusively defined by conifer plantations. Therefore, the first axis can be interpreted as a pine forestry trend, noting that pine plantations are away from urban areas and other land uses situated in lower zones. In turn, factor loadings of the second axis show a variation from cultivated lands and meadows to broadleaves; thus, it can be understood as a naturalisation/wilderness axis. The mean trajectories of change of the municipalities of Busturialdea and Uribe Kosta show a similar gradient of variation (the mean modules and angels are 0.443, 48.04º and 0.578, 57.10º, in Busturialdea and Uribe Kosta, respectively; $F=1.47$, $p=0.246$). Nevertheless, it can be observed that generally, the region of Busturialdea presents more pine lands (forestry) and natural characteristics (broadleaves) than the region of Uribe Kosta, which appears to have more urbanised and less natural land uses (Fig. 2).

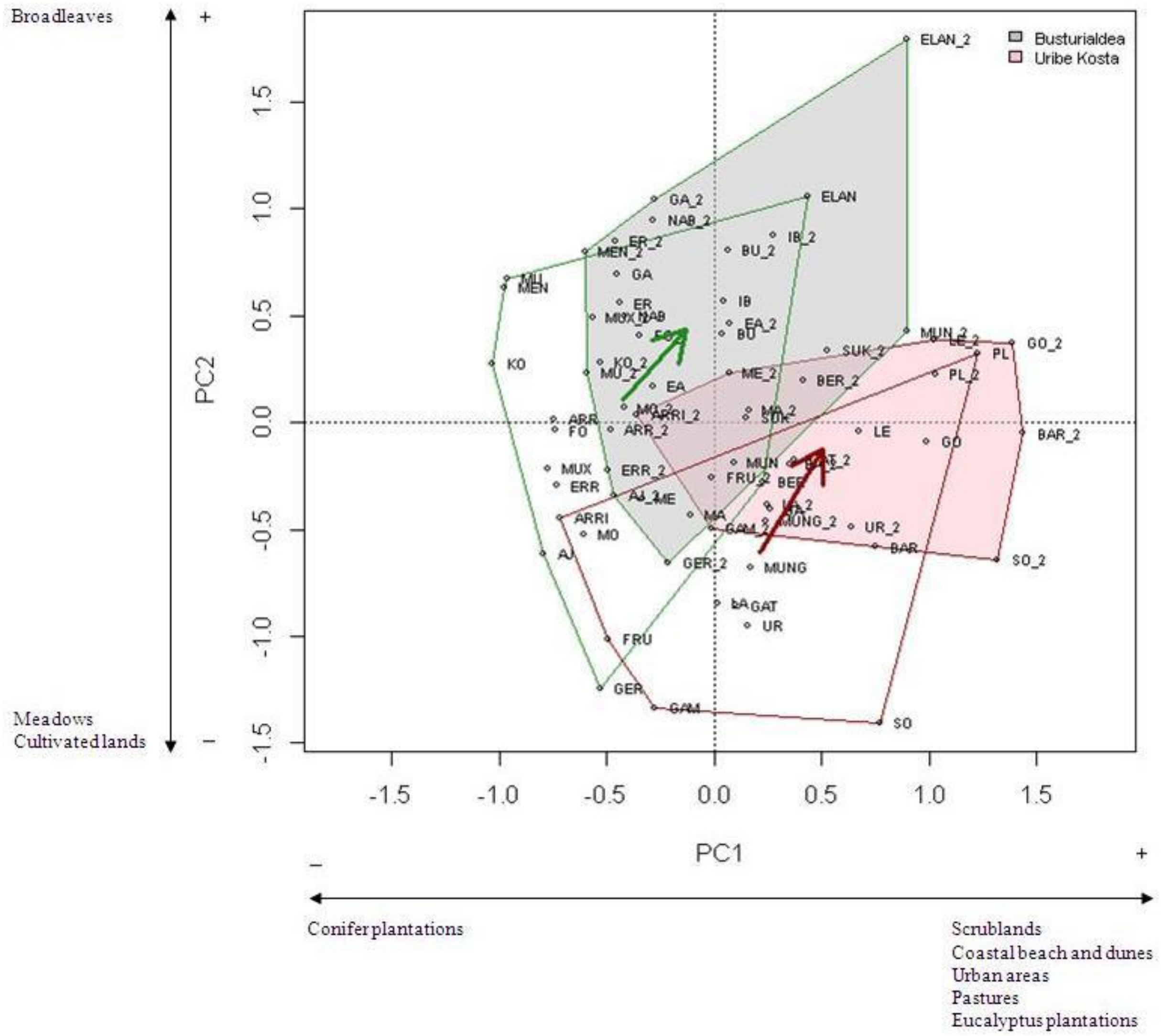


Fig. 2. PCA analysis. Coordinates of municipalities of Busturialdea (polygons with green colour border) and Uribe Kosta (polygons with maroon colour border) and the mean trajectories of change, represented by an arrow, from the past to the present (past and present are symbolised by uncoloured and coloured polygons, respectively). The principal landscape descriptive variables are at the end of the axes. See the codes of municipalities in App. A.

Table 1. Factor loadings of the landscape variables and their contribution (%) (in bold, variables identified as key descriptors).

Land uses	Axis 1 (32.81%)		Axis 2 (21.98%)	
	F1	Contribution	F2	Contribution
Conifer plantations	**-0.852**	22.142	0.193	1.698
Eucalyptus plantations	**0.612**	11.406	-0.095	0.407
Broadleaves	0.184	1.034	**0.729**	24.196
Scrublands	**0.779**	18.495	-0.269	3.287
Pastures	**0.635**	12.304	0.253	2.912
Meadows	-0.032	0.031	**-0.832**	31.501
Cultivated lands	-0.330	3.313	**-0.649**	19.185
Urban areas	**0.713**	15.485	-0.415	7.827
Coastal beach and dunes	**0.720**	15.789	0.263	3.140
Marshlands	0.008	0.002	0.359	5.849

According to the Shannon-Wiener diversity index, most of the municipalities in both areas have increased their land use diversity, except for Busturia and Gautegiz Arteaga in Busturialdea, and Gorliz, Laukiz, Mungia and Plentzia in Uribe Kosta (App. C). However, it must be considered carefully because the principal reason of this rise in the diversity index could be the decrease in the area occupied by predominant land uses over time, i.e. conifer plantations in Busturialdea and meadows in Uribe Kosta (Fig. 3), leading to a more equitable distribution of land uses. Currently, both regions have decreased their conifer plantation' area, while increasing the area of eucalyptus plantations and broadleaf native forests. In addition, urban areas have also experienced an important increase, especially pronounced in Uribe Kosta, where the change in urban areas is duplicating that happening in Busturialdea (Fig. 3).

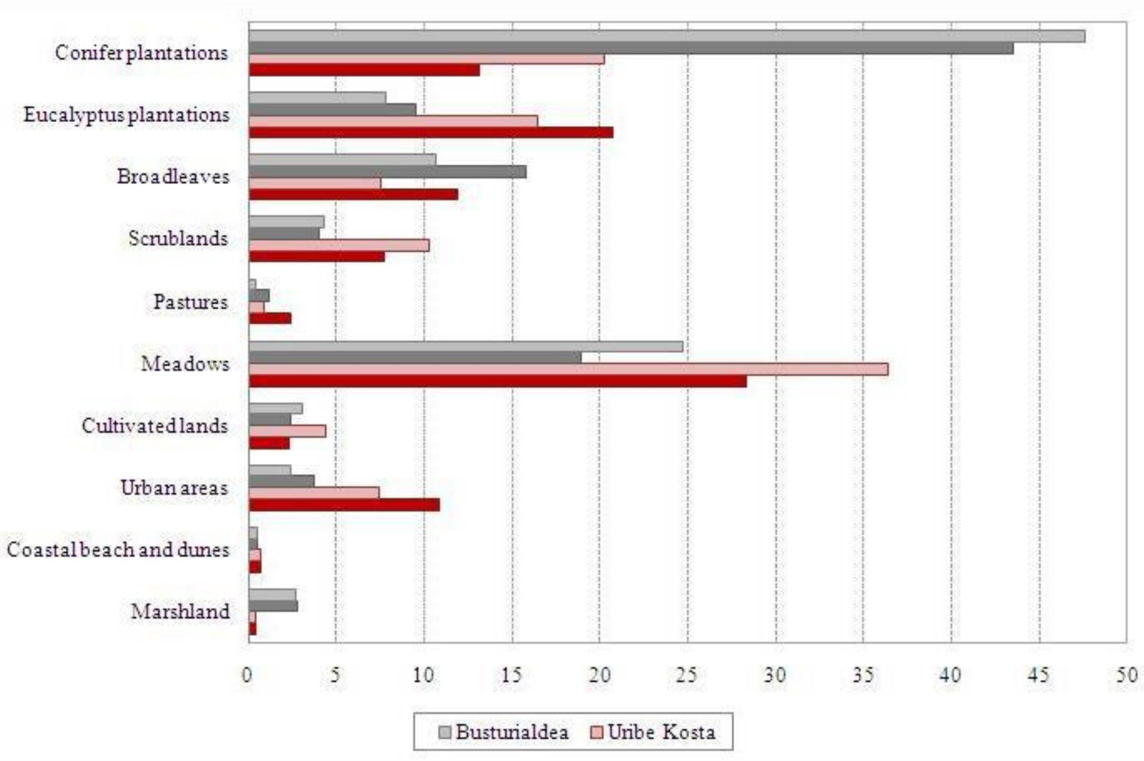


Fig. 3. Total area (%) of the land uses of Busturialdea and Uribe Kosta from the past to the present (higher colour intensities refers to the area of land uses in the present).

The ANOVA analysis shows a significant interaction of the evolution between time and region for conifer plantations and scrublands (Table 2). Both regions present a decrease in conifer plantations, but it is more noticeable in Uribe Kosta, which has apparently changed its market to eucalyptus plantations, with lower periods of logging. Similarly, contrary to the tendency of the Basque Country but mildly in line with Biscay, both areas have diminished their area of scrublands, especially Uribe Kosta (App. D).

Table 2. Analysis of variance (ANOVA) for landscape changes over time from one region to the other region.

	Sum. sq.	F value[a]
Conifer plantations	0.372	27.969**
Eucalyptus plantations	0.001	0.012
Broadleaves	0.010	0.212
Scrublands	0.766	7.420**
Pastures	0.159	0.768
Meadows	0.005	1.203
Cultivated lands	0.508	2.407
Urban areas	0.006	0.171
Coastal beach and dunes	0.000	0.262

[a] Statistical significance at the **=0.01 level.

3.2. Socioeconomic and cultural evolution

Figure 4 shows the socioeconomic and cultural evolution of municipalities in Busturialdea and Uribe Kosta since the designation of the GPUM. Considering the factor loadings (Table 3), the variables that contribute most in the first axis are related to human welfare (total personal income, GDP, population with higher education and employment), employment in the tertiary sector, the number of inhabitants and the sustainability index on the positive side and to the rural economy and employment in the primary sector, Basque culture and population >65 years on the negative side. Likewise, the principal change in the secondary axis comes from variables related to the secondary sector towards a tertiary sector and second homes. Both regions present almost the same socioeconomic and cultural changes, as indicated by the main trajectories of change (the mean modules and angles are 0.907, 26.05º and 0.799, 25.45º in Busturialdea and Uribe Kosta, respectively; $F=0.613$, $p=0.548$). However, it can be broadly observed that at present the region of Busturialdea is slightly more heterogeneous than Uribe Kosta, with municipalities like Ajangiz totally characterised by the secondary sector and more vacation municipalities, such as Ibarrangelu (Fig. 4).

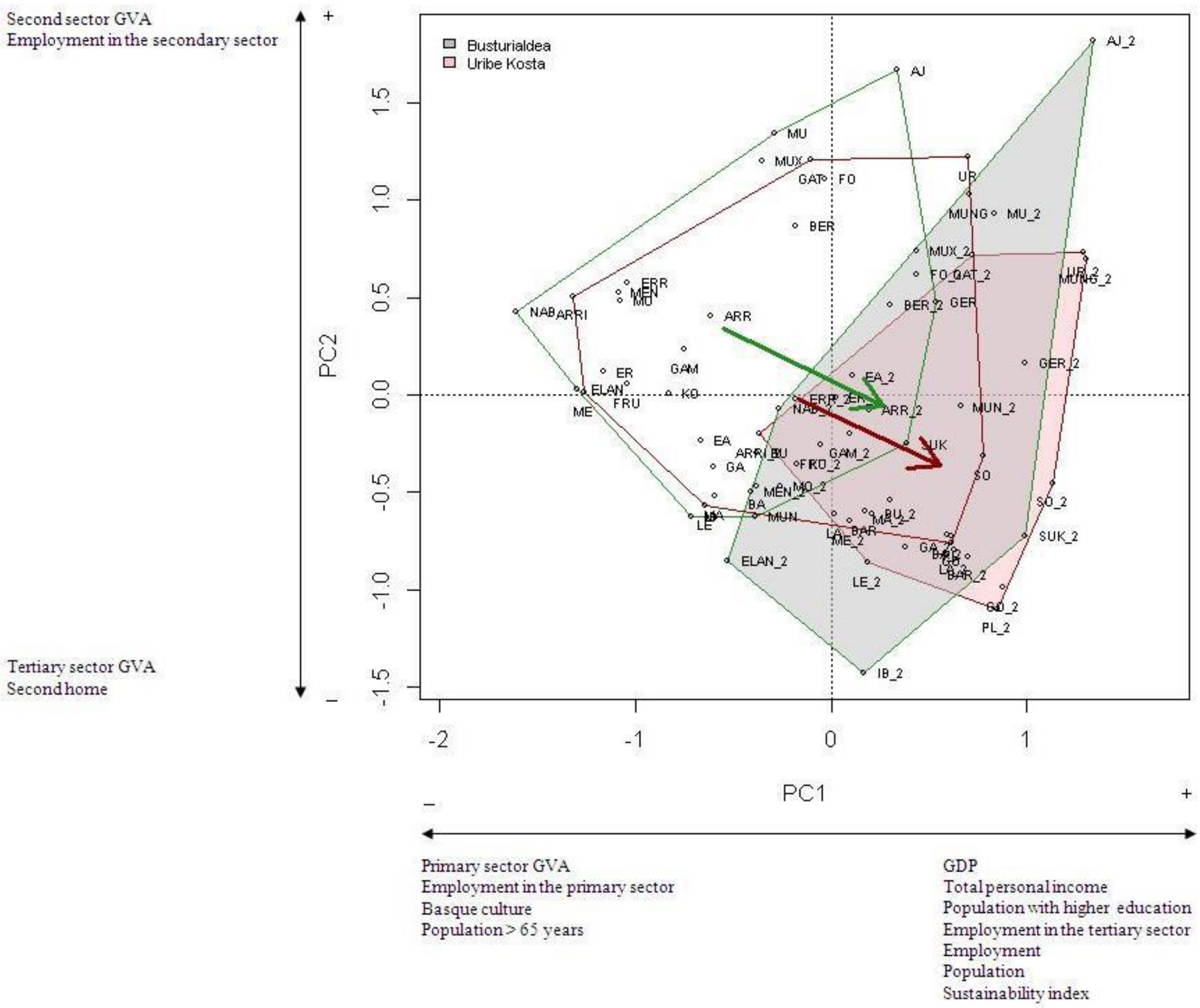


Fig. 4. PCA analysis. Coordinates of municipalities of Busturialdea (polygons with green border) and Uribe Kosta (polygons with maroon border) and mean trajectories of change, represented by an arrow, from the past to the present (past and present are symbolised by uncoloured and coloured polygons, respectively). The principal socioeconomic and cultural descriptive variables are at the end of the axes. See the codes of municipalities and socioeconomic and cultural descriptive variables in App. A and B.

Table 3. Factor loadings of the socioeconomic and cultural variables of municipalities and their contribution (%) (in bold, variables identified as key descriptors).

	Axis 1 (30.54%)		Axis 2 (21.16%)	
	F1	Contribution	F2	Contribution
Total population	**0.575**	6.016	0.003	0.000
Population >65 years	**-0.649**	7.655	-0.028	0.020
Second home	-0.048	0.041	**-0.509**	6.812
Population with higher education	**0.689**	8.646	-0.477	5.963
Employment in the 1st sector	**-0.845**	12.980	0.328	2.824
Employment in the 2nd sector	0.394	2.820	**0.810**	17.238
Employment in the 3rd sector	**0.627**	7.156	-0.100	0.260
Employment	**0.621**	7.008	0.575	8.683
Unemployment rate	0.179	0.581	-0.048	0.060
Total personal income	**0.668**	8.111	-0.341	3.053
GDP	**0.748**	10.172	0.358	3.358
1st sector GVA	**-0.871**	13.813	0.013	0.004
2nd sector GVA	0.142	0.367	**0.866**	19.679
3rd sector GVA	0.013	0.003	**-0.882**	20.406
Basque culture	**-0.656**	7.824	0.376	3.706
Social cohesion index	-0.294	1.573	0.301	2.383
Good relations index	-0.151	0.415	-0.428	4.805
Sustainability index	**0.515**	4.817	0.168	0.743

The ANOVA results reveal a significant effect of the interaction between time and region for total population and employment in the 1st sector (Table 4). In accordance with Biscay and the Basque Country, the total population has gone up in both regions, but especially in Uribe Kosta, where the total population has almost doubled and exceeded Busturialdea's. Similarly, and following the tendency of Biscay and the Basque Country, the employment in the first sector has decreased drastically in both regions, with Busturialdea, where the primary sector used to have a great weight, being the most strongly affected region. However, the employment rate continues to be higher than in Uribe Kosta and considerably higher than in Biscay and the Basque Country (App. D).

Table 4. Analysis of variance (ANOVA) for socioeconomic and cultural changes over time from one region to the other region.

	Sum. sq.	F value[a]
Total population	0.463	54.076***
Population >65 years	0.003	0.157
Second home	0.741	2.671
Population with higher education	0.041	1.680
Employment in the 1st sector	0.546	4.301*
Employment in the 2nd sector	0.397	1.336
Employment in the 3rd sector	0.098	1.274
Employment	0.069	1.172
Total personal income	0.000	0.029
GDP	0.018	0.405
1st sector GVA	0.079	0.607
2nd sector GVA	0.004	0.017
3rd sector GVA	0.003	0.110
Basque culture	0.004	0.572
Sustainability index	0.004	0.800

[a] Statistical significance at the *=0.05 and ***=0.001 level.

4. Discussion

Important landscape, socioeconomic and cultural changes have endured in both study areas, but their trajectory of change over time has followed a very similar tendency. Nonetheless, the results suggest a more rural, natural (native vegetation conserved) and heterogeneous character of the region of Busturialdea, included in the protected area, and a more urban, less natural and homogeneous one of the region of Uribe Kosta, outside the protected area. Actually, Busturialdea seems to be characterized by its rural life, understood not only as the exploitation of the land (conifer plantations mostly) but also as the protection and conservation of broadleaf native forests. Consequently, as our findings suggest, a wider range of economic sectors is possible in this region, including timber production and other rural and industrial activities, as well as a (rural) tourism linked to the conservation area (protected landscape quality).

4.1 Evolution of the landscape in protected and non-protected areas

Although land use change trajectories are almost the same in the two areas, their magnitude of change has been quite different. Natural ecosystems like broadleaf native forests have increased their area, but marshlands (core area of the UBR) have been recovered only in the protected area, being lost in the non-protected one. This evolution on natural ecosystems is seemingly due to the status of conservation in the biosphere reserve. In fact, there have been developed different conservation measures for core zones through the GPUM, focused mainly on wilderness and involving conservation and the active and passive restoration of ecosystems in the protected area (Basque Government, 2004).

Likewise, coniferous plantations, currently occupying a large extent in the protected area, have decreased in both areas, but contrary to what could be expected, the magnitude of decrease has been lower in the protected area. Moreover, both protected and non-protected areas have increased their expansion of eucalyptus plantations, especially the non-protected area, probably as a consequence of global timber markets. In the Basque Country, and the province of Biscay mostly, pine and eucalyptus plantations have been highly financially supported and among forest managers, “a pine and eucalyptus culture” has developed thanks to their relatively easy management, high productivity and favourable market demand (Rodríguez-Loinaz et. al., 2013). Certainly, the forestry sector continues to receive subsidies (Rodríguez-Loinaz et al., 2013; County Council of Biscay, 2015) in spite of the recognised environmental impacts caused by the unsustainable management of these forest plantations (Atauri et al., 2004; Rescia et al., 2010). Although the situation nowadays is improving, the pine timber sector is involved in a deep crisis, and timber prices fell by 80% in the 8 years after 2003 (EUSTAT, 2013), which could be one of the reasons for the growing popularity of eucalyptus plantations. This situation should be taken into account to promote a more sustainable forest management in the Basque Country in general and especially in the UBR, where the fact that the 92% of the territory is privately owned complicates its management even more.

The spreading of anthropic forest plantations has been historically linked to rural landscape abandonment. From the 1960s, as an effect of the process of industrialization in Spain, the abandonment of rural space began, creating not only the displacement of the population towards the urban areas but also the interruption of agrarian activities. In Northern Spain, in areas where an agro-silvo-pastoral culture prevailed, this phenomenon was particularly intense (Iriarte-Goñi, 2013). To recover the production of abandoned agricultural and grazing lands and to mitigate the human exodus, regional governments promoted forestry, particularly fast-growing plantations such as *Pinus* and *Eucalyptus sp.* (Groome 1990). Thus, a decrease in croplands is also a trend in both areas, as well as in the whole region of Biscay, even if the decrease has been less in the protected area.

All in all, we can say that the management of the UBR has been quite successful in conserving and regenerating natural core areas, whereas rural activities that have contributed to its maintenance and socioeconomic throughout the twentieth century have been relegated to second place. Therefore, it is necessary to take more measures to encourage agriculture and rural development, as in some other protected areas in Spain (Martín-López et al., 2011; Schmitz et al., 2012; Palomo et al., 2014). Besides, rural landscapes are considered very valuable, mostly due to their cultural heritage, and maximising multifunctional landscapes by enhancing local food production and reinforcing food security can also contribute to decreasing the local ecological footprint (Palacios-Agundez et al., 2015).

However, it should be pointed out that despite the decrease in cultivated lands, the Gross Value Added (GVA) of the primary sector, in contrast to the non-protected area, has increased in the protected area, which may be due to the measures taken to encourage agriculture

(Basque Government, 2009) and/or be the consequence of a specialization of the sector and technology improvement. Indeed, the region of Busturialdea has a quality label known as "*Beans and piper of Gernika*", which together with the “*txakoli*” (a white wine), makes the region a benchmark of quality of agricultural products. These products have their own certificate of origin and therefore, are legally protected. Moreover, we cannot forget the importance of the fishing sector in the area, although the decline in almost a third of offshore inshore fishing in the last 10 years in such municipalities as Bermeo is notably disquieting (EUSTAT, 2015).

Regarding changes in urbanised land areas, it must be emphasised that urban zones have increased in both areas, and almost doubled their extent in the protected area, which is not in keeping with the local population’s perception. The approval of the GPUM in 1993 has created a limitation of certain activities, and as an earlier report states, inhabitants of the UBR considered themselves damaged, understanding the designation of the biosphere reserve as a restriction of their economic and cultural (in terms of recreation) development. Most of the complaints refer to limitations in the exploitation of natural resources and homebuilding, principally around the rural-coastal zone (Basque Government, 2005). Residential growth has mainly been located in the areas classified by the GPUM as a *Population Centre* but also in those lands called *Areas of Agricultural Interest and Common Rustic Lands*, where residential uses linked to agricultural activity are allowed (Basque Government, 2004). Nonetheless, far from promoting rural purposes, it has led to the construction of dwellings with non-real farms, which over time tend to disappear (Abelairas-Etxebarria and Astorkiza, 2012). What is more, the high prices of land caused by urban pressure (Abelairas-Etxebarria and Astorkiza, 2012) have created difficulties in accessing land, preventing people from working the land. Thus, in part, it could be accepted that the designation of the status of a biosphere reserve has limited urban growth, or in other words, made it much lower than in the non-protected area, but at the same time, it has also had a negative impact in the promotion of agriculture due to the difficulties accessing land.

In addition, we must note that both regions have incremented landscape diversity due to the decrease in predominant land uses (conifer plantations and meadows, respectively). However, this result should be considered prudently because only one diversity index has been used and other indices, such as the structural heterogeneity of the landscape and spatial complexity or functionality are necessary to better understand the landscape changes of the territories (see e.g. Rescia et al., 2010); besides, it should be kept in mind if e.g. urbanisation is a desired condition.

4.2 *Balancing conservation and socioeconomic and cultural development*

The changes in socioeconomic and cultural indicators over time have also followed a similar tendency in both study areas probably due to the general socioeconomic and cultural conditions in the region. However, for some of the indicators the magnitude of change has been different.

Significant differences have been observed in relation to employment in the primary sector. In fact, although the population working in the primary sector has fallen more in the protected area, it is much higher than in the non-protected area. Likewise, contrary to what has happened in the non-protected area, the production of the primary sector has increased in the protected area and is much higher. Employment in the industrial sector has been maintained, and the tertiary sector exceeds that of the non-protected area. Thus, in accordance with other studies (Ferraro et al., 2011; Canavire-Bacarreza and Hanauer, 2013; Bonet-García et al., 2015), the designation of the figure protection cannot be considered as a limitation to economic development. Certainly, the amount of employment with respect to the active people in the protected area has increased notably while decreasing in the non-protected area. Moreover, other indicators, such as land prices (Abelairas-Etxebarria and Astorkiza, 2012), tourism (tourist offices, personal communications, 2015), research and environmental education, and special funds (Technical Service of the UBR, personal communication, 2015) have raised more in the UBR than in other regions in Biscay.

Besides, previous studies on the UBR suggested that biodiversity and ecosystem services are positively correlated (Onaindia et al., 2013b), which in turn, results in economic benefits (European Union, 2013; Costanza et al., 2014a). Hence, the economic and cultural growth of the protected area could also be associated with the conservation of biodiversity and landscape beauty, mainstays for (eco)tourism and recreation, which are indeed the main economic motor and attraction in the region. Therefore, the conservation of biological and cultural diversities seems imperative for sustainable development (Rajeswar, 2001); that is, considering that development entails a change to a more favourable situation and that economic and cultural growth in the area may depend on its biodiversity, if the territory is to remain in the future, it must be diverse and for that, biological and cultural diversities must be conserved. Several authors (Brebbia & Pineda, 2004; Schmitz et al. 2007) have demonstrated that one of the greatest attractions for rural tourism is a landscape mosaic based upon traditional uses and provided some examples of tourism as a sustainable economic alternative.

In this sense, the regions appear alike in terms of sustainability and other cultural variables related to social cohesion, good relations and Basque identity. Nonetheless, the higher good relations index in Busturialdea reinforces the importance of tourism and recreation in the region, resulting from its biodiversity and landscape beauty. Likewise, the decrease of Basque people in Busturialdea could be a consequence of this social cohesion and good relations, whereas the considerably higher proportion of Basque people could be due to rural living and the high importance of the primary sector, connected at the same time with the larger population >65 years.

It could also be expected that the designation of the UBR has affected the municipalities included inside it to different degrees and in different ways. With the approval of the GPUM, the territory was zoned depending on its environmental importance and socioeconomic interests. Thus, it was likely that the GDP, traditionally used as a measure of economic performance and well-being, would be unequally distributed. Nevertheless, although some considerable differences are observed from one municipality to other, it seems that they are not related to the regulation of the activities. Roughly, the number of people with higher education and total personal income in all municipalities of each region are practically the same, and the GDP, with some exceptions, is very similar because each municipality bases its economy on different sectors, such as tourism and industrial activity. If we compare the GDP of the protected area and the non-protected area, it can be observed that it is much higher in the first one, but lower than in Biscay and the Basque Country. In any case, these results are not unambiguous. Recently, the adequacy and misuse of GDP as an economic development index, and even more, as a wellbeing index has been contested (Stiglitz et al., 2010; Costanza et al., 2014b). GDP mainly measures market production, so nonmarket good and services and the depletion of natural resources are excluded. More relevant indicators of social welfare, with additional information are being demanded, and different alternatives have been measured (Kubiszewski et al., 2013; Li and Fang, 2014; Giannetti et al., 2015), including ecosystem services in GDP accounting. The challenge is to change from growth to a sustainable development indicator. Indeed, human welfare is closely related to the environment; thus, valuing ecosystem services and incorporating these values in decision-making are fundamental for ensuring sustainable conservation policies. A more integrative indicator including cultural aspects (health, education, and recreation) would contribute to achieving the set of Sustainable Development Goals proposed by the United Nations in 2014 as the new global reference goals for the international development community until 2030 (Le Blanc, 2015).

To enhance the management effectiveness of the protected area, greater effort in the protection of the rural activity, a hallmark of the territory, is necessary, as is allocating funding aimed at conifer plantations to broadleaves species. Replacing forest plantations with native broadleaves was suggested, at least in areas with slopes higher than 60% or with an erosion risk (Rodríguez-Loinaz et al., 2013). All this could help to stimulate economic growth as a result of an increase in the tourism sector, linked to the higher supply of ecosystem services (Onaindia et al., 2013b; Palacios-Agundez, 2013; Rodríguez-Loinaz et al., 2013), at the same time that other economic and cultural benefits are also obtained from the market and non-market services that cultivated lands’ and natural forests’ provide (De Groot et al., 2012; Costanza et al., 2014a). However, to achieve these objectives, and considering that most of the territory in the UBR is private, it is necessary to involve the affected local populations, adopting participatory and active conservation policy decisions and integrating the PAs and the priorities of the local population and the socioeconomic and cultural context. Management expenses, conservation and protection costs, must be regarded as an investment that ensures direct economic profits and benefits in term of avoided costs because they prevent environmental damage and loss of biodiversity.

At this point, we should ask ourselves what would have happened if the UBR had not been designated. Surely, the region of Busturialdea would have followed a developmental trend with the previously mentioned megaproject as a dominant paradigm; consequently, important environmental and socioeconomic changes would have occurred. However, as this study suggests, the socioeconomic and cultural development of the protected area has been similar to that of the non-protected area, so in terms of conservation, the project could be hardly argued.

5. Conclusions

Our results suggest that the designation of a biosphere reserve does not influence the local population negatively but does safeguard nature conservation, which could have enhanced socioeconomic development. The most important success of the designation of the UBR is that it prevented the construction of urban megaprojects that would have dramatically impacted the current natural core areas. The conservation of natural ecosystems and the status of the biosphere reserve have given local communities the opportunity to maintain social welfare and to develop an economy based fundamentally on the tertiary sector but also on the primary sector and local industry.

Among the most relevant future challenges are the urgency of taking measures to achieve sustainable forest management and the need to promote further development of local food production. Thus, more effort seems to be necessary to promote more sustainable forest management and support traditional rural activities, which in decline.

In addition, because biosphere reserves have the vocation to be pilot sites towards sustainability and pioneers in the implementation of actions towards sustainable land management, suitable measures suggested for biosphere reserves should also be recommended for the sustainable management of the entire region.

References

Abelairas-Etxebarria, P., Astorkiza, I., 2012. Farmland prices and land-use changes in periurban protected natural areas. Land Use Policy 29, 674-683.

Adams, W.M., Aveling, R., Brockington, D., Dickson, B., Elliott, J., Hutton, J., et al., 2004. Biodiversity conservation and the eradication of poverty. Science 306, 1146-1149.

Andam, K.S., Ferraro, P.J. Sims, K.R.E., Healy, A., Holland, M.B., 2010. Protected areas reduced poverty in Costa Rica and Thailand. PNAS 107(22), 9996-10001.

Arana, X., 1997. The management of tourism in the Urdaibai Biosphere Reserve. pp. 141-149. In: Towards a sustainable tourism in the UBR. 1997. Department of Land Management, Housing and Environment. Basque Government.

Atauri, J.A., de Pablo, C., de Agar, P., Schmitz, M.F., Pineda, F.D., 2004. Effects of management on understory diversity in the forest ecosystems of northern Spain. Environmental Management 34, 819-828.

Balmford, A., Bruner, A., Cooper, P., Costanza, R., Farber, S., Green, R.E., et al., 2002. Economic reasons for conserving wild nature. Science 297, 950-953.

Basque Government, 1996. Forest Inventory 1996. Department of Economic Development and Competitiveness. [Spanish]

Basque Government, 1999. Plan for the Harmonisation and Development of Socio-economic Activities. Local Agenda 21 of the Biosphere Reserve of Urdaibai. Department of Land Management, Housing and Environment, Vitoria-Gasteiz. [Spanish]

Basque Government, 2004. Governance Plan for Use and Management of Urdaibai Biosphere Reserve. Refunded text. Department of Land Management and Environment, Vitoria-Gasteiz. [In Spanish]

Basque Government, 2005. State of opinion of the population living in the Urdaibai estuary. Department of Environment and Land Management.[Spanish]

Basque Government, 2011. Forest Inventory 2011. Department of Economic Development and Competitiveness. [Spanish]

Basque Government, 2014. geoEuskadi. Available: www.geo.euskadi.eus/

Basque Government, 2015. Plan for the Interpretation, Research, Training and Education for the Sustainable Development of the Urdaibai Biosphere Reserve 2015-2025. Department of Environment and Territorial Policy, Vitoria-Gasteiz. [Spanish]

Basque Government. 2009. Strategy of Sustainable Development of the Urdaibai Biosphere Reserve 2009-2015. Department of Environment and Land Management. [Spanish]

Bonet-García, F.J., Pérez-Luque, A.J., Moreno-Llorca, R.A., Pérez-Pérez, R., Puerta-Piñero, C., Zamora, R. 2015. Protected areas as elicitors of human well-being in a developed region: A new synthetic (socioeconomic) approach. Biological Conservation 187, 221-229.

Bouamrane, M., Spierenburg, M., Agrawal, A., Boureima, A., Cormier-Salem, M.C., Etienne, M., et al., 2016. Stakeholder engagement and biodiversity conservation challenges in social-ecological systems: some insights from biosphere reserves in western Africa and France. Ecology and Society 21(4): 25.

Brebbia, C.A. & Pineda, F.D., 2004. Sustainable Tourism. Boston: WIT Press.

Brockington, D., Igoe, J. 2006. Evictions for conservation: A global overview. Conservation and Society 4, 424-470.

Brockington, D., Wilkie, D., 2015. Protected areas and poverty. Phil. Trans. R. Soc. B 370: 20140271.

Canavire-Bacarreza, G., Hanauer, M.M., 2013. Estimating the impacts of Bolivia's protected areas on poverty. World Development 41, 265-285.

Castro, A.J., Martín-López, B., López, E., Plieninger, T., Alcaraz-Segura, D., Vaughn, C.C., Cabello, J., 2015. Do protected areas networks ensure the supply of ecosystem services? Spatial patterns of two nature reserve systems in semi-arid Spain. Applied Geography 60, 1-9.

Costanza, R., De Groot, R.S., Sutton, P., Van der Ploeg, S., Anderson, S.J., Kubiszewski, I., et al., 2014a. Changes in the global value of ecosystem services. Global Environmental Change 26, 152-158.

Costanza, R., Kubiszewski, I., Giovannini, E., Lovins, H., McGlade, J., Pickett, K.E., et al., 2014b. Development: time to leave GDP behind. Nature 505, 283-285.

County Council of Biscay, 2015. Decree 75/2015, of the 19th May, to establish promotional measures for conservation, enhancement and development of forests in the Historical Territory of Biscay, setting the deadlines of the call and allocations for the year 2015. Official Gazette of Biscay, 26th May 2015, 98, 13039-13078. [Spanish]

De Groot, R.S., Brander, L., Van der Ploeg, S., Costanza, R., Bernard, F., Braat, L., et al., 2012. Global estimates of the value of ecosystems and their services in monetary units. Ecosystem Services 1, 50-61.

DeFries, R., Hansen, H., Turner, B.L., Reid, R., Liu, J. 2007. Land use change around protected areas: management to balance human needs and ecological function. Ecol. Appl. 17, 974-988.

Eastwood, A., Brooker, R., Irvine, R.J., Artz, R.R.E., Norton, L.R., Bullock, J.M., et al., 2016. Does nature conservation enhance ecosystem services delivery? Ecosystem Services 17, 152-162.

European Union., 2013. The economic benefits of the Natura 2000 network. Synthesis Report.

EUSTAT. Basque Statistical Institute. 2013. Basque Statistical Yearbook 2013.

EUSTAT., 2015. Basque Institute of Statistics. [Online]. Available: www.eustat.es

Ferraro, P.J., Hanauer, M.M., 2014. Quantifying causal mechanisms to determine how protected areas affect poverty through changes in ecosystem services and infrastructure. PNAS 111(11), 4332-4337.

Ferraro, P.J., Hanauer, M.M., Sims, K.R.E. 2011. Conditions associated with protected area success in conservation and poverty reduction. PNAS 108(34), 13913-13918.

Fisher, B., Christopher, T., 2007. Poverty and biodiversity: Measuring the overlap between human poverty and the biodiversity hotspots. Ecological Economics 62(1), 93-101.

Giannetti, B.F., Agostinho, F., Almeida, C.M.V.B., Huisingh, D., 2015. A review of limitations of GDP and alternative indices to monitor human wellbeing and to manage eco-system functionality. Journal of Cleaner Production 87, 11-25.

Groome, H., 1990. Historia de la política forestal en el estado español. Agencia de Medio Ambiente, Madrid.

Hanauer, M.M., Canavire-Bacarreza, G., 2015. Implications of heterogeneous impacts of protected areas on deforestation and poverty. Phil. Trans. R. Soc. B.

Heagney, E.C., Kovac, M., Fountain, J., Conner, N., 2015. Socio-economic benefits from protected areas in southeastern Australia. Conservation Biology 29(6), 1647-1657.

Helne, T., Hirvilammi, T., 2015. Wellbeing and Sustainability: A Relational Approach. Sustainable Development 23, 167-175.

Iriarte-Goñi, I., 2013. Forests, Fuelwood, Pulpwood, and Lumber in Spain, 1860-2000: A Non-Declensionist Story. Environmental History 18, 333-359.

IUCN, 2016. [Online] Available: www.iucn.org/ [Accessed 2016].

Kubiszewski, I., Costanza, R., Franco, C., Lawn, P., Talberth, J., Jackson, T., Aylmer, C., 2013. Beyond GDP: Measuring and achieving global genuine progress. Ecological Economics 93, 57-68.

Le Blanc, D., 2015. Towards Integration at Last? The Sustainable Development Goals as a Network of Targets. Sustainable Development 23, 176–187.

Li, G., Fang, C., 2014. Global mapping and estimation of ecosystem services values and gross domestic product: A spatially explicit integration of national ‘green GDP’ accounting. Ecological Indicators 46, 293-314.

Lopoukhine, N., Crawhall, N., Dudley, N., Figgis, P., Karibuhoye, C., Laffoley, D., et al., 2012. Protected areas: providing natural solutions to 21st Century challenges. Surveys and Perspectives Integrating Environment and Society 5, 117-131.

MA, 2005. Ecosystems and Human Well-Being: Synthesis. Island Press, Washington, DC.

Mackenzie, C.A., 2012. Accruing benefit or loss from a protected area: Location matters. Ecological Economics 76, 119-129.

Martín-López, B., García-Llorente, M., Palomo, I., Montes, C., 2011. The conservation against development paradigm in protected areas: Valuation of ecosystem services in the Doñana social–ecological system (southwestern Spain). Ecological Economics70, 1481-1491.

Oldekop, J.A., Holmes, G., Harris, W.E., Evans, K.L., 2015. A global assessment of the social and conservation outcomes of protected areas. Conservation Biology 30, 133-141.

Onaindia, M., Ballesteros, F., Alonso, G., Monge-Ganuzas, M., Peña, L., 2013a. Participatory process to prioritize actions for a sustainable management in a biosphere reserve. Environmental Science and Policy 33, 283-294.

Onaindia, M., Fernández de Manuel, B., Madariaga, I., Rodríguez-Loinaz, G., 2013b. Co-benefits and trade-offs between biodiversity, carbon storage and water flow regulation. Forest Ecology and Management289, 1-9.

Palacios-Agundez, I., Casado-Arzuaga, I., Madariaga, I., Onaindia, M., 2013. The relevance of local participatory scenario planning for ecosystem management policies in the Basque Country, northern Spain. Ecology and Society 18(3): 7.

Palacios-Agundez, I., Onaindia, M., Barraqueta, P., Madariaga, I., 2015. Provisioning ecosystem services supply and demand: The role of landscape management to reinforce supply and promote synergies with other ecosystem services. Land Use Policy 47, 145-155.

Palomo, I., Martín-López, B., López-Santiago, C., Montes, C., 2011. Participatory scenario planning for natural protected areas management under the ecosystem services framework: the Doñana social-ecological system, SW Spain. Ecology and Society 16, 23.

Palomo, I., Montes, C., Martín-López, B., González, J.A., García-Llorente, M., Alcorlo, P., García Mora, M.R., 2014. Incorporating the social-ecological approach in protected areas in the Anthropocene. Bioscience 64, 181-191.

Pullin, A.S., Bangpan, M., Dalrymple, S., Dickson, K. Haddaway, N.R., Healey, J.R., et al., 2013. Human well-being impacts of terrestrial protected areas. Environmental Evidence 2:19.

R Core Team, 2014. R: A Language and Environment for Statistical Computing. Available: www.r-project.org/

Rajeswar, J., 2001. Conservation ethics versus development: how to obviate the dichotomy? Sustainable Development 9, 16-23.

Rescia, A.J., Schmitz, M.F., Martin de Agar, P., de Pablo, C.L., Pineda, F.D., 1994. Influence of landscape complexity and land management on woody plant diversity in northern Spain. Journal of Vegetation Science 5, 505-516.

Rescia, A.J., Willaarts, B.A., Schmitz, M.F., Aguilera, P.A., 2010. Changes in land uses and management in two Nature Reserves in Spain: Evaluating the social-ecological resilience of cultural landscapes. Landscape and Urban Planning98, 26-35.

Rodríguez-Loinaz, G., Amezaga, I., Onaindia, M., 2013. Use of native species to improve carbon sequestration and contribute towards solving the environmental problems of the timberlands in Biscay, northern Spain. Journal of Environmental Management 120, 18-26.

Rodríguez-Rosa, M., Gallego-Alvarez, I., Vicente-Galindo. M.P., Galindo-Villardo. M.P., 2016. Are social, economic and environmental well-being equally important in all countries around the world? A study by income levels. Social Indicators Research 1-23.

Schmitz, M.F., de Aranzabal, I., Pineda, F.D., 2007. Spatial analysis of visitor preferences in the outdoor recreational niche of Mediterranean cultural landscapes. Environmental Conservation 34, 300-312.

Schmitz, M.F., Matos, D.G.G., De Aranzabal, I., Ruiz-Labourdette, D., Pineda, F.D., 2012. Effects of a protected area on land-use dynamics and socioeconomic development of local populations. Biological Conservation 149, 122-135.

Shanon, E.C., Weaver, W., 1949. Mathematical Theory of Communication. University of Illinois Press, Urbana.

Sims, K.R.E., 2010. Conservation and development: Evidence from Thai protected areas. Journal of Environmental Economics and Management 60, 94-114.

Stiglitz, J.E., Sen, A., Fitoussi, J.P., 2010. Mismeasuring Our Lives: Why GDP Doesn't Add Up. The New Press, New York.

Udalmap, 2016. [Online] Available: www.eustat.eus/about/udalmap_c.html [Accessed 2017]

UNESCO, 2016. [Online] Available: www.unesco.org/ [Accessed 2016].

Upton, C., Richard, L., David, H., Tao, J., Dan, B., Adams, W.M., 2008. Are poverty and protected area establishment linked at a national scale? Oryx 42(01), 19-25.

Watson, J.E.M., Dudley, N., Segan, D.B., Hockings, M., 2014. The performance and potential of protected areas. Nature 515, 67-73.

West, P., Igoe, J., Brockington, D., 2006. Parks and peoples: the social impact of protected areas, Annual Review of Anthropology 35, 251-277.

Appendix A. Codes and municipalities of the studies areas in Busturialdea and Uribe Kosta.

Busturialdea		Uribe Kosta	
Code	Municipality	Code	Municipality
BER	Bermeo	ARRI	Arrieta
BU	Busturia	BA	Bakio
EA	Ea	BAR	Barrika
ELAN	Elantxobe	FRU	Fruiz
ER	Ereño	GAM	Gamiz-Fika
GA	Gautegiz Arteaga	GAT	Gatika
GER	Gernika-Lumo	GO	Gorliz
IB	Ibarrangelu	LA	Laukiz
MEN	Mendata	LE	Lemoiz
MO	Morga	MA	Maruri-Jatabe
MUX	Muxika	ME	Meñaka
MUN	Mundaka	MUNG	Mungia
SUK	Sukarrieta	PL	Plentzia
ERR	Errigoiti	SO	Sopelana
FO	Forua	UR	Urduliz
KO	Kortezubi		
MU	Murueta		
NAB	Nabarniz		
AJ	Ajangiz		
ARR	Arratzu		

Appendix B. Landscape and socioeconomic and cultural variables used at the municipal level and measurement units.

a) Landscape variables (% per total surface)	
Variables	Description
Conifer plantations	*Pinus sylvestris*, *P. nigra*, *P. pinaster*, *P. radiate*, *Picea abies*, *Pseudotsuga menziesii*, *Larix spp.*, *Chamaecyparis lawsoniana* and other conifers plantations
Eucalyptus plantations	*Eucalyptus globulus* and *E. nitens* plantations
Broadleaves	*Quercus robur*, *Q. petraea*, *Q. pyrenaica*, *Q. faginea*, *Q. ilex*, *Q. rubra*, riverside forest, *Alnus glutinosa*, *Salix spp.*, *Platanus spp.*, *Populus alba*, *Fagus sylvatica*, *Castanea sativa*, *Betula spp.*, *Fraxinus spp.*, mixed forest and other broadleaves (do not include Eucalyptus and broadleaves plantations)
Scrubland	Surfaces covered by shrub vegetation
Pasture	Permanent herbaceous communities in extensive grazing
Meadow	Permanent herbaceous pastures, always green, produced by the human in a past and grazing
Cultivated land	Intensive and extensive crops, flooded and forced crops
Urban areas	Artificial areas including roads and mines and garbage dumps
Coastal beach and dunes	Beaches, dunes, sands and cliffs
Marshlands	Marshy land associated with the mouths of rivers, flooded during high tides

b) Socioeconomic and cultural variables		
Variables	Description	Units of measurement
Total population	Nº of people	Nº of people
Population >65 years	Nº of people >65 years old/Total population*100	%
Second home	Nº of second houses/Total houses*100	%
Population with higher education	Nº of people with higher education/Total population*100	%
Employment in the 1st sector	Mean nº of people working in the primary sector/Nº of active population*100	% of active people
Employment in the 2nd sector	Mean nº of people working in the secondary sector/Nº of active population*100	% of active people
Employment in the 3rd sector	Mean nº of people working in the tertiary sector/Nº of active population*100	% of active people
Employment	Total nº of jobs/Nº of active population*100	% of active people
Unemployment rate	Total nº of unemployed/Nº of active population*100	%
Total personal income	Total income of people/Total population	€
GDP	Municipal GDP/Total population	€
1st sector GVA	GVA of the primary sector/Municipal GVA*100	%
2nd sector GVA	GVA of the secondary sector/Municipal GVA*100	%
3rd sector GVA	GVA of the tertiary sector/Municipal GVA*100	%
Basque culture	Nº of Basque people/Total population*100	%
Social cohesion index (SC)*: SC = V+M-C	Voter turnout index (V) = Nº of voters/electoral roll*100	%
	External migratory balance index (M) = (Annual nº of immigrations-annual nº of emigrations)/total population*100	%
	Crime index (C) = Nº of crimes/Total population*100	%
Good relations index (GR)*: GR = H+R	Hotels index (H) = Nº of hotels/Total population*100	%
	Restaurants index (R) = Nº of restaurants/Total population*100	%
Sustainability index (S)*: S = EE+C+B-WD-EC-WG	Houses with energy efficiency certificate index (EE) = Nº of houses with energy efficiency certificates/Total nº of houses*1,000	‰
	Environmental certifications index (C) = Environmental certifications/Total nº of establishment*1,000	‰ of establishments
	Bikeway network index (B) = Nº of Km of bikeways/Total population*10,000	Km per 1,000 inhabitants
	Water demand index (WD) = Annual total volume of water demand/Total population/365 days	l per inhabitant per day
	Electric consumption index (EC) = Annual electric consumption/Total population	Kwh per inhabitant per year
	Waste generation index (WG) = Annual total volume of domestic wastes/Total population	Kg per inhabitant per year

* Values normalized and ranging from 1 to 10.

Appendix C. Shannon and Weaver diversity index for each municipality of Busturialdea and Uribe Kosta in both time periods.

	Busturialdea				Uribe Kosta		
	Past	Present	Change		Past	Present	Change
BER	2.044	2.054	0.010	ARRI	1.819	1.935	0.116
BU	2.141	2.137	-0.004	BA	2.000	2.141	0.141
EA	1.893	2.026	0.133	BAR	2.123	2.179	0.056
ELAN	1.999	2.032	0.033	FRU	1.851	1.957	0.106
ER	1.825	1.829	0.004	GAM	1.888	1.999	0.111
GA	1.981	1.971	-0.010	GAT	2.041	2.047	0.005
GER	1.899	1.956	0.057	GO	2.210	2.167	-0.043
IB	2.080	2.115	0.035	LA	1.982	1.979	-0.003
MEN	1.659	1.866	0.208	LE	2.135	2.104	-0.031
MO	1.858	1.909	0.050	MA	1.845	1.948	0.103
MUX	1.821	1.861	0.040	ME	1.875	1.927	0.051
MUN	2.049	2.120	0.070	MUNG	2.011	1.979	-0.032
SUK	2.131	2.253	0.122	PL	2.159	2.142	-0.017
ERR	1.857	1.957	0.100	SO	1.976	2.068	0.092
FO	1.963	2.028	0.065	UR	1.907	1.951	0.045
KO	1.854	2.062	0.208				
MU	1.778	2.026	0.248				
NAB	1.870	1.889	0.019				
AJ	1.735	1.934	0.199				
ARR	1.803	1.930	0.127				

Appendix D. Total values of landscape and socioeconomic and cultural variables, changes and ratios in Busturialdea-Uribe Kosta and Biscay-The Basque Country for each period of time.

a) Land uses (%)

	Busturialdea				Uribe Kosta			
	Past	Present	Change	Ratio	Past	Present	Change	Ratio
Conifer plantations [a]	47.617	43.493	-4.124	-8.661	20.243	13.145	-7.098	-35.064
Eucalyptus plantations [a]	7.847	9.513	1.666	21.231	16.504	20.761	4.257	25.794
Broadleaves[a]	10.697	15.766	5.069	47.387	7.506	11.897	4.391	58.500
Scrublands	4.347	3.988	-0.359	-8.259	10.313	7.736	-2.577	-24.988
Pastures	0.445	1.210	0.765	171.910	0.931	2.414	1.483	159.291
Meadows	24.690	18.932	-5.758	-23.321	36.383	28.330	-8.053	-22.134
Cultivated lands	3.058	2.376	-0.682	-22.302	4.382	2.352	-2.03	-46.326
Urban areas	2.402	3.744	1.342	55.870	7.444	10.875	3.431	46.091
Coastal beach and dunes	0.487	0.487	0	0	0.696	0.696	0	0
Marshlands	2.692	2.794	0.102	3.789	0.416	0.411	-0.005	-1.202

	Biscay				The Basque Country			
	Past	Present	Change	Ratio	Past	Present	Change	Ratio
Conifer plantations [a]	42.022	37.707	-4.315	-10.268	28.528	26.540	-1.988	-6.969
Eucalyptus plantations [a]	4.602	6.592	1.99	43.242	1.438	2.101	0.663	46.106
Broadleaves[a]	11.284	15.191	3.907	34.624	23.944	26.231	2.287	9.551
Scrublands	7.917	7.743	-0.174	-2.198	7.460	7.588	0.128	1.716
Pastures	1.858	4.412	2.554	137.460	3.508	5.484	1.976	56.328
Meadows	22.969	17.763	-5.206	-22.665	15.354	5.889	-9.465	-61.645
Cultivated lands	2.185	1.878	-0.307	-14.050	11.643	10.911	-0.732	-6.287
Urban areas	6.659	8.951	2.292	34.420	4.6580	6.343	1.685	36.174
Coastal beach and dunes [b]		0.203				0.123		
Marshlands [b]		0.360				0.174		

[a] The area of conifer plantations, eucalyptus plantations and broadleaves was measured through the mass state.

[b] Surface data of aquatic ecosystems (coastal beach and dunes and marshlands) was only calculated by aerial photographs for the present of Busturialdea and Uribe Kosta.

b) Socioeconomic and cultural variables

	Busturialdea				Uribe Kosta			
	Past	Present	Change	Ratio	Past	Present	Change	Ratio
Total population (Nº of people)	44,821	46,172	1,351	3.014	37,648	54,605	16,957	45.041
Population >65 years (%)	17.729	21.190	3.461	19.522	13.272	14.491	1.219	9.185
Second home (%)	16.478	11.197	-5.281	-32.049	32.111	18.632	-13.479	-41.976
Population with higher education (%)	7.155	13.898	6.743	94.242	9.901	20.053	10.152	102.535
Employment in the 1st sector (% of active people)	11.144	2.805	-8.339	-74.827	3.251	1.180	-2.071	-63.704
Employment in the 2nd sector (% of active people)	18.451	18.279	-0.172	-0.935	26.063	21.138	-4.925	-18.897
Employment in the 3rd sector (% of active people)	32.447	41.096	8.649	26.655	31.251	36.762	5.511	17.635
Employment (% of active people)	56.149	60.502	4.353	7.753	60.760	54.076	-6.684	-11.001
Unemployment rate (%)	17.500	15.200	-2.300	-13.143	17.800	13.600	-4.200	-23.596
Total personal income (€)	9,467.450	20,363.100	10,895.650	115.085	10,778.467	22,416.667	11,638.200	107.976
GDP (€)	13,214.500	28,034.866	14,820.366	112.152	13,978.000	25,793.333	11,815.333	84.528
1st sector GVA (%)	7.400	9.533	2.133	28.824	2.400	1.467	-0.933	-38.889
2nd sector GVA (%)	31.300	21.333	-9.967	-31.843	39.000	29.300	-9.700	-24.872
3rd sector GVA (%)	53.900	56.967	3.067	5.690	47.700	54.233	6.533	13.697
Basque culture (%)	75.101	70.181	-4.920	-6.551	47.897	48.386	0.489	1.021
Social cohesion index	6.385	5.018	-1.367	-	6.682	4.725	-1.957	-
Good relations index	4.074	4.015	-0.059	-	2.824	2.513	-0.311	-
Sustainability index	3.772	5.856	2.084	-	3.563	5.446	1.883	-

	Biscay				The Basque Country			
	Past	Present	Change	Ratio	Past	Present	Change	Ratio
Total population (Nº of people)	1,147,566	1,153,351	5,785	0.504	2,101,048	2,179,815	78,767	3.749
Population >65 years (%)	14.191	20.332	6.141	43.274	13.966	19.793	5.827	41.723
Second home (%)	4.515	3.801	-0.714	-15.814	4.134	5.094	0.960	23.222
Population with higher education (%)	7.843	15.149	7.306	93.153	7.883	14.331	6.448	81.796
Employment in the 1st sector (% of active people)	1.435	0.725	-0.710	-49.480	1.816	0.873	-0.943	-51.911
Employment in the 2nd sector (% of active people)	22.014	13.875	-8.139	-36.972	24.750	16.911	-7.839	-31.674
Employment in the 3rd sector (% of active people)	45.847	62.763	16.916	36.898	45.191	60.993	15.802	34.968
Employment (% of active people)	69.098	82.106	13.008	18.825	73.185	84.900	11.715	16.007
Unemployment rate (%)	23.150	16.000	-7.150	-30.886	21.250	14.900	-6.350	-29.882
Total personal income (€)	9,451.541	19,557.388	10,105.847	106.923	9,345.653	19,427.993	10,082.340	107.883
GDP (€)	13,856.000	30,064.330	16,208.330	116.977	14,989.000	31,356.670	16,367.670	109.198
1st sector GVA (%)	1.300	0.667	-0.633	-48.692	1.500	0.733	-0.767	-51.133
2nd sector GVA (%)	26.800	20.700	-6.100	-22.761	30.800	25.633	-5.167	-16.776
3rd sector GVA (%)	64.600	69.733	5.133	7.946	60.600	65.133	4.533	7.480
Basque culture (%)	20.972	30.379	9.407	44.855	28.092	36.216	8.124	28.919
Social cohesion index	-	-	-	-	-	-	-	-
Good relations index	-	-	-	-	-	-	-	-
Sustainability index	-	-	-	-	-	-	-	-

Chapter 4.2

sustainability This chapter corresponds to the article (submitted for publication):

Castillo-Eguskitza, N., Schmitz, M.F., Onaindia, M., Rescia, A.J., Linking biophysical and economic valuations of ecosystem services for a social–ecological approach to conservation planning: Application in a Biosphere Reserve (Biscay, Spain). *Sustainability*. (Submitted).

Linking biophysical and economic valuations of ecosystem services for a social–ecological approach to conservation planning: Application in a Biosphere Reserve (Biscay, Spain)

Nekane Castillo-Eguskitza, María F. Schmitz, Miren Onaindia, Alejandro J. Rescia

Abstract

Land use changes occurred over the last decades in the Urdaibai Biosphere Reserve social-ecological system due to the increase of pine and eucalyptus plantations have led to increased conflicts between conservation and economic development. Quantifying the economic impact of these changes in ecosystem services may be useful to advising policy makers and improving the sustainability of the landscape. However, if sustainable management is being guaranteed, it is fundamental to link biophysical and social aspects of social-ecological systems. In this study, first, we assessed the land use changes in a time series and estimated the monetary value of the ecosystem services based on the existing literature. Then, we link the monetary value of ES with their biophysical value according to the biosphere reserve zoning. Results showed that even if the land uses changes have not had such a big impact on the economic valuation of ES, they clearly have homogenised the territory with a subsequent loss of multifunctionality. Yet, results obtained from the biophysical-monetary correspondence analysis suggest that the establishment of the biosphere reserve has contributed to its conservation goal, being the core area the one with the highest coupling between both valuations. The procedure we used constitutes a useful tool to optimizing spatial planning and establishing specific policies or conservation strategies for the sustainable development of the area, including valuation of the effectiveness of protected areas.

Keywords:

Social-ecological systems; ecosystem services; land use changes; economic valuation protected area management; coupling

1. Introduction

The accelerated growth of the world population in the recent few decades has led to significant changes in land use and land management. These changes are the main direct drivers affecting the landscape, causing serious environmental and socioeconomic problems (Foley et al., 2005; Newbold et al., 2015). They are considered to have the largest global impact on biodiversity by the year 2100 (Sala et al., 2000) contributing to ecosystems degradation, undermining the ecosystem function and resilience and thus, threatening the ability of ecosystems to continuously supply services (de Groot et al., 2012). Land use changes, if anything, are even more worrying in cultural landscapes, closely linked to and affected by the socioeconomic structure and cultural aspects.

Cultural landscapes, as social-ecological systems (SES), are the result of the interrelationship between ecosystems and human activities shaped over time, conditioned by management policies to take advantage of their spatial heterogeneity and biodiversity (de Aranzabal et al., 2008; Rescia et al., 2012). These coupled-systems are increasingly widespread over the world. As Petrosillo et al. (2015) state, there are no social systems without nature and ecosystems without people. Therefore, the adaptation of conservation policies and the application of new approaches to these complex systems are essential (Levin et al., 2013). The conservation of cultural landscapes is very relevant within the framework of the European Landscape Convention of the Protected Areas Network and for the resilience of social-ecological systems in Europe´s rural area (Rescia et al., 2008; Mitchell et al., 2009). However, the method of exploiting ecosystems and the conflict of interest between stakeholders has led to a "conservation against development model" (Folke, 2006a; Martín-López et al., 2011; Suzuki and Parker, 2016), affecting the functionality of natural ecosystems and the sustainability of the coupled system (Schmitz et al., 2017). Development has been usually associated with the maximization of the supply of those ecosystem services (ES) with the highest economic direct values, usually provisioning services, which likely produce spatial and composition homogenization of the landscape and lead indirectly to the decline of the delivery of other regulating or cultural services (MA 2005; Karp et al., 2015). Specifically, these last services are not captured by the market and/or are not adequately quantified in comparable terms with economic services and products (Constanza et al., 1997; Balmford et al., 2002), implying their over-exploitation or damage at low or no cost. Hence, given the lack of consideration of the contributions that all types of ES deliver for human well-being, it seems necessary not only to quantify or map the supply of the services provided by the ecosystem, but to combine the biophysical valuation of ES with economic and socio-cultural valuation, so that they can be taken into account in decision making regarding their conservation. Certainly, economic valuation involves more understandable and comparable values for decision makers, while cultural valuation informs us about the preferences or interests of society (Laurila-Pant et al., 2015).

The ES approach and valuation have presupposed a change in the way that a landscape is being managed and conserved (de Groot et al., 2010, Liu et al., 2010). At present, a more holistic framework, which integrates the sustainability concept (including ecological, economic and socio-cultural dimensions), is demanded with the aim of addressing the management of different SES (Folke 2006b). In this sense, the inclusion of ES into land planning policies may be useful to fill gaps in biodiversity management and developmental policies and strengthen knowledge regarding human-nature interactions and well-being (MA, 2005). Certainly, conservation planning has often been focused on the biophysical values, leaving the interplay between society and environment in second place; and the ES framework has made visible the necessity for considering not only ecosystems, but social systems too. Sitas et al. (2014) highlighted the importance of recognizing human demands in decision-making for sustainable development, while Magliocca et al. (2015) and Wang et al. (2015) suggested that policy-makers must take into account the local situation and changes of land use for the sustainability of the landscape. Actually, the future capability of ecosystems to provide services is determined by changes in socioeconomic and cultural characteristics, land use, and biodiversity, among others (Metzger et al., 2006).

In particular, in environmental policy and decision-making circles, it has become essential to think about the human economic benefits derived from well-functioning ecosystems. Since the publication of Costanza et al. (1997) and The Economics of Ecosystems and Biodiversity (TEEB 2010), the study of the economic valuation of ES has increased steadily (Chaudhary et al., 2015; Quintas-Soriano et al., 2016). Countless studies have assessed the monetary value of the ES provided by protected areas specially (Martín-López et al., 2011; Hoyos et al., 2012; Jobstvogt et al., 2014, Verma et al., 2017; Zambrano-Monserrate et al., 2018). Its importance lies in that it can help to reflect the externalities (positive or negative) of environmental goods at the market price, and therefore, serve as a tool to quantify the trade-offs among different management options (Hicks et al., 2009). Likewise, it allows the development of specific policy analyses, urban and regional land use plans, ES payments, and common asset trusts (Costanza et al., 2014).

On the whole, the integration of economic and biophysical valuation of ES can inform decision-makers about conservation–conversion trade-offs of landscapes (Fisher et al., 2008; Posner et al., 2016). In addition, it may be a suitable tool to mirror their importance and based on this valuation, to make recommendations to develop sustainable policies focused on the SES. However, practical application of economic valuation into sustainable management plans does not normally occur (O'Farrell et al., 2010). Biosphere reserves aim to reconcile nature conservation with its sustainable use and increase human well-being (UNESCO, 2018), so they represent interesting places to understand the human-nature interaction on SES. In this paper, in order to provide useful information to policy making for sustainable development of a biosphere reserve, we first assessed the economic impact of land use changes and then, we link the monetary value of ES with their biophysical value according to its zoning. Specifically, the goals of our study were: a) to analyse the land use dynamics of the Urdaibai Biosphere Reserve (Basque Country) and its effects on the economic valuation of ES; b) to examine the correspondence between both valuations in the delimited sectors by the biosphere reserve zoning.

2. Study area

The SES of the Urdaibai estuary, located in Northern Spain (Biscay, the Basque Country) (Fig. 1), with an area of c. 22,000 ha, was designated by UNESCO as a biosphere reserve in 1984 (Urdaibai Biosphere Reserve, UBR). This type of conservation status consists of a core zone of strictly protected ecosystems, a buffer zone where human activity is limited, and a transition zone that extends to the outside area where greater activity is allowed considering the interests of different stakeholders such as local communities, management agencies or scientists. The UBR is a typical agrarian mosaic landscape that is distinguished by smallholdings and multiple land uses, which over time have maintained a viable and ecologically sustainable production system conserving a high level of landscape diversity (Atauri et al., 2004). It is characterized by its high natural (ecological variety and complexity) and cultural value in which nature and society have co-evolved throughout the years conforming to a resilient SES (Rescia et al., 2010). The main ecological values, on which the designation of the reserve was based, were the coastal ecosystems, marshlands and green oak forests (the core area of the reserve; Basque Government, 2004). However, with the beginning of the industrialization in the 60s, farms were abandoned, and to counteract, fast-turnover plantations were expanded thanks to policies that encouraged subsidized planting of Pinus radiata and Eucalyptus sp. monocultures. Consequently, the social-ecological resilience of the study area has been threatened (Rescia et al., 2010) and the landscape diversity has been reduced with serious ecological consequences (Atauri et al., 2004; Rescia et al., 2010), altering its capacity to supply ES (Onaindia et al., 2013).

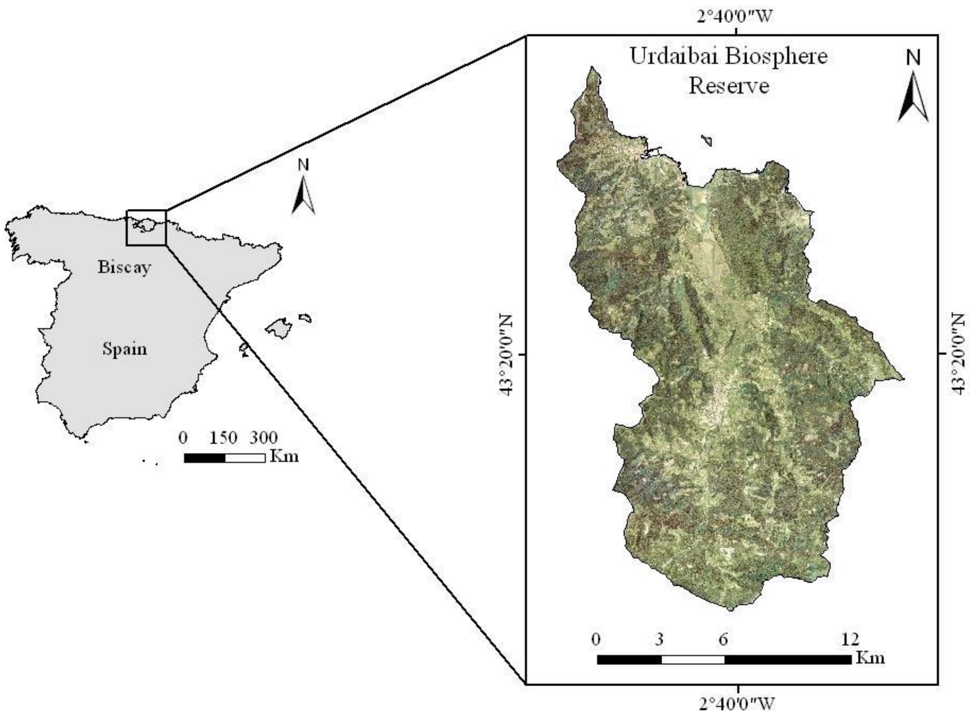


Fig. 1. Study area.

3. Methods

3.1. Identification, classification and temporal evolution of land uses

We identified and classified land uses into eight common major categories by using high-resolution aerial photos (paper and digital format) of the landscape from 1965 and 1983, as well as available cartography for 2009. These time interval capture the years in which land use changes were most significant: 1965 was the year that changes in economic activity from agriculture and livestock farming to forestry began, 1983 was the year that preceded the designation of the area as a biosphere reserve, and 2009 corresponds to the year of the last update of the habitat EUNIS (European Nature Information System) map in The Basque Country (Basque Government, 2009a), linked to the European Union Habitats Directive (EUHD 1992).

For each year, we generated a grid system of overlapping polygons of approximately 400 m^2 in size, which was the smallest area we were able to identify in the case of aerial photos from 1965, and assigned them a dominant land use category in accordance of the majority land use. In the case of the 2009 habitats EUNIS layer, we used the software ArcGIS 10.4 (ESRI, 2016) and established the land use categories through maximum area method, after their reclassification and mapping. The land use classification included those habitats we considered the most representative, previously used in other studies (Rescia et al., 2010; Costanza et al., 1997, 2014), and which therefore, best fit for subsequent valuation. This classification was divided in: croplands, natural and semi-natural grasslands, coastal system, native forest, scrubland, pine and eucalyptus plantations, clear cuts and urban areas (Supplementary material Table S1).

3.2. Selection and valuation of ecosystem services

We selected a total of nine ES due to their relevance for conservation planning and socioeconomic development of the area, including three provisioning (food production, timber, fresh water), four regulating (carbon storage, water regulation and purification, pollination and biological control, habitat for species) and two cultural services (tourism and recreation and aesthetic enjoyment).

3.2.1. Estimation of the biophysical value of ecosystem services

Because of the difficulty in measuring ES, a key phase in the valuation procedure is the selection of suitable indicators (Liquete et al., 2016). Scientists have tended to consider land uses as proxies for the provision of services (Eigenbrod et al., 2010). We used biophysical proxies to assess the capacity of the different land use categories identified to provide ES.

Food production was estimated by adding the relative values of the supply of food from agriculture, livestock and fishing, which were in turn calculated on the basis of the average yield of the main crops and livestock, and weight of fish, respectively (Basque Government, 2017; UBEGI, 2018; Supplementary material Table S4). Fresh water was determined by using a runoff water proxy, as follows:

$$FW = P - EV \quad (1)$$

where FW is the annual water flow (mm year^{-1}), P is the annual rainfall (mm year^{-1}), and EV is the annual evapotranspiration (mm year^{-1}). To calculate annual evapotranspiration, we used potential and real evapotranspiration maps from the period 1980/81-2005/06, supplied by the Water Information System of the Ministry of Agriculture, Food, and Environment of Spain (MAPAMA, 2015). But since the potential evapotranspiration does not consider the limitation of water in soil or vegetation impact, and so as to calculate a more realistic value for the evapotranspiration, we applied a vegetation correction factor for the different vegetation types and rescaled the values to the real evapotranspiration of the Oka river basin. The correction factors used were those in the InVEST – Integrated Valuation of Ecosystem Services and Tradeoffs (Sharp et al., 2018).

To assess the supply of carbon storage we used the same procedure of Onaindia et al. (2013), and estimated the C stored in living biomass and soil. C stored in soil was based on the "Inventory of organic C stored in the first 30 cm of the soil" of the Basque Country (Neiker-Ihobe, 2004), whereas C stored in living trees was calculated by following the equation of the average annual increment in biomass (IPCC, 2003):

$$CB = V\ BEF\ (1+R)\ D\ CF \quad (2)$$

where CB is the carbon stocks in living biomass (t C ha^{-1}); V is the merchantable volume data for each tree species (m^3 ha^{-1}), obtained from the Forest Inventory of the Basque Country for the year 2011 (Basque Government, 2011); BEF is the biomass expansion factor for the conversion of merchantable volume to aboveground tree biomass obtained from the study region (Montero et al., 2005); R is the root-to-shoot ratio to include belowground tree biomass; D is the basic wood density (t d.m.m^{-3}), obtained from the northern Iberian Peninsula forests (CPF, 2004; Madrigal et al., 1999); and CF is the carbon fraction of dry matter, t C.

To estimate the supply of water regulation and purification, we used the water retention index developed by Maes (2010) through ESTIMAP (Ecosystem Services Mapping) model. A pollination index of the likely abundance of pollinator species in each ecosystem was estimated to quantify pollination and biological control by using the InVEST software (Sharp et al., 2018). Habitat for species was estimated following the procedure of Onaindia et al. (2013) by adding native plant richness, habitat quality (successional level) and legal protection. Finally, we used recreation and landscape aesthetic indices estimated by Peña et al. (2015) to quantify the supply of tourism and recreation and aesthetic enjoyment, respectively. For further details, see Supplementary Material Table S4.

Every ES was mapped and, using zonal statistics tool in ArcGIS 10.4 (ESRI, 2016), mean values of each ES for each land use category and zone were quantified.

3.2.2. Estimation of the monetary value of ecosystem services

We estimated the monetary value of ES (ESV) for each land use category identified in the UBR as follows (Mamat et al., 2018):

$$\mathrm{ESV} = \sum_{k=1}^{n} A_k VC_k \tag{3}$$

where ESV refers to the total value of the ecosystem service function; A_k is the area (ha) of each land use category, k, and VC_k is the monetary value coefficient (Int.$ $ha^{-1}yr^{-1}$) for each land use category, k.

We assessed the impact of land use changes in the monetary value of ES (ESV) by calculating the differences among monetary values in the time series considered.

The economic valuation method was based on the benefit transfer approach. This methodology involves estimating the ESV for one context by utilizing results from existing studies (Brookshire & Neill, 1992; Richardson et al., 2015). It constitutes a simple tool that avoids the complexity of other methods and allows gaining in understanding, comparability, fast and easy calculation and feasibility when the time and budget are limited (Van Nes & Scheffer 2005; Troy & Wilson 2006). Hence, benefit transfer is increasingly being used to inform about nonmarket ES values in a manner relevant to the timeframe and budget within which decisions often have to be made (Richardson et al., 2015). Yet, its practicality may be highly reduced because of the lower level of validity and reliability of transferred value estimates (Bauer & Johnston, 2013).

Aware of the importance of sites similarities when transferring monetary values, if possible, literature from close areas with similar characteristics was used. The VC of fresh water provision, water regulation and purification, and habitat for species (except for coastal systems) were estimated according to the data available from the project Valuation of Spanish Natural Assets (Esteban Moratilla, 2010). Carbon storage ESV was estimated by multiplying the tones of carbon stored in living biomass and soil for each land use (see section 2.3.1) by its monetary value traded on the European Energy Exchange (EEX), which during the last 5 years since 2009, has ranged from 2.64€ to 16.83€, with a mean value of about 10€ $t^{-1}C$ (EEX, 2018). Similarly, estimates for timber provided by native forest and pine and eucalyptus plantations were determined on the basis of the livestock production and authorized wood cuts. Then, we used the averaged values developed by Costanza et al. (2014), which derived from the values used in de Groot et al. (2012) and the Ecosystem Service Valuation Database (Van der Ploeg & de Groot, 2010), containing more than 1,350 data-points from over 300 case studies with different valuation methods. These studies are the most complete and reliable for a first approximation of economic quantification and have been widely applied in estimating ecosystem services values all over the world (Zhao et al., 2004; Mendoza-González et al., 2012; Mamat et al., 2018). We were careful to choose monetary values calculated for European countries, similar to our area in terms of their ecological, socio-cultural and economic characteristics. Still, some of them were not available and we had to use values for other continents. Besides, there is a lack of data for some ES and land uses, so other sources, as similar as possible to our study area, were needed to complete the values. Lastly, in spite of classifying urban areas and although the provision of ES by urban green infrastructures is well-known (Gómez-Baggethun & Barton 2013; Haase et al., 2014; Luederitz et al., 2015), we excluded them from the valuation process for two main reasons: first, the territorial scope of the Plan for Use and Management, basic instrument to manage the area of the biosphere reserve, is only focused on urban undeveloped lands (Basque Government 2004); second, our spatial analysis was not precise enough to distinguish green spaces in urban areas. Likewise, clear cuts neither were valued assuming that their value is likely negligible because this type of management involves the temporal destruction of the ecosystem.

All of the obtained values were adjusted to 2009 Euros per hectare per year so as to make possible the comparison of the values which were assessed in different units. Following the procedure applied in de Groot et al. (2012), if necessary, we converted the estimates into Euros by using official exchange rates and then, adjusted to 2009 values using the GDP deflators (World Bank, 2009). Supplementary material Tables S1 and S2 show the most representative biomes used as proxies for the land use categories and the ES classification, respectively, and Table S3 displays the details of all data used for the benefit transfer and the VC of ES.

However, given the uncertainties associated with the VC and an accurate equivalence of the biomes used as proxies and our land use categories, a sensitivity analysis was carried out to evaluate the changes in ESV for each change in VC, as follows (Zhang et al., 2016):

$$CS_k = \frac{(ESV_j - ESV_i)/ESV_i}{(VC_{jk} - VC_{ik})/VC_{ik}} \tag{4}$$

where ESV is the estimated ES monetary value; VC is the value coefficient; i and j represent the initial and adjusted (±50%) values, respectively; and k represents the land use category.

If CS<1, then the estimated ecosystem value is inelastic in relation to VC and the results of the ESV calculations are reliable even if the VC has relatively low accuracy. On the contrary, if CS>1, then the estimated monetary value is considered to be elastic, and consequently, ESV changes with variations in the VC, i.e. when VC associated to a specific land use category varies ±50%, also the ESV provided by the total study area changes accordingly (Aretano et al., 2013; Fu et al., 2016; Crespin & Simonetti 2016).

3.3. Integrating biophysical and monetary valuation of ecosystem services. Spatially explicit coincidence

We evaluated the degree to which economic valuation of ES matches biophysical valuation of ES, or vice versa, by considering the zoning schemes of biosphere reserves, i.e. core area, buffer zone and transition area. In doing so, we analysed the spatial interaction between both valuations following the procedure used in previous studies which quantified the relationship between preferences of visitors and landscape features (Schmitz et al., 2007; de Aranzabal et al., 2009).

To analyse the spatial relationship between both the biophysical and monetary values of ES for each land use category and zone (i.e. core, buffer and transition zones of the biosphere reserve), we performed a matrix-vector multiplication, based on two data sets: 1) a matrix (a_{mxk}) of biophysical standardized values, the elements of which are the standardized biophysical values of the different land use categories and zones of the UBR; and 2) a vector (b_{kx1}) quantifying the monetary values of the different land use categories. Since ES biophysical units are different, to allow their comparison, each ES was scaled individually for each land use category and zone from 0 to 1, according to their minimum and maximum, as follows, and compared as relative values:

$$\frac{x-\min(x)}{\max(x)-\min(x)} \tag{5}$$

The matrix calculation resulted in a product vector (c_{mx1}) whose elements quantify and express in a spatially explicit way the degree of interaction or coupling between biophysical and monetary values of ES across the zoning of the UBR. This algebraic analysis approach with spatial reference allows mapping the coupling vector obtained (Schmitz et al., 2017). Figure 2 provides a general overview and the steps followed for the calculation of this biophysical-monetary correspondence vector.

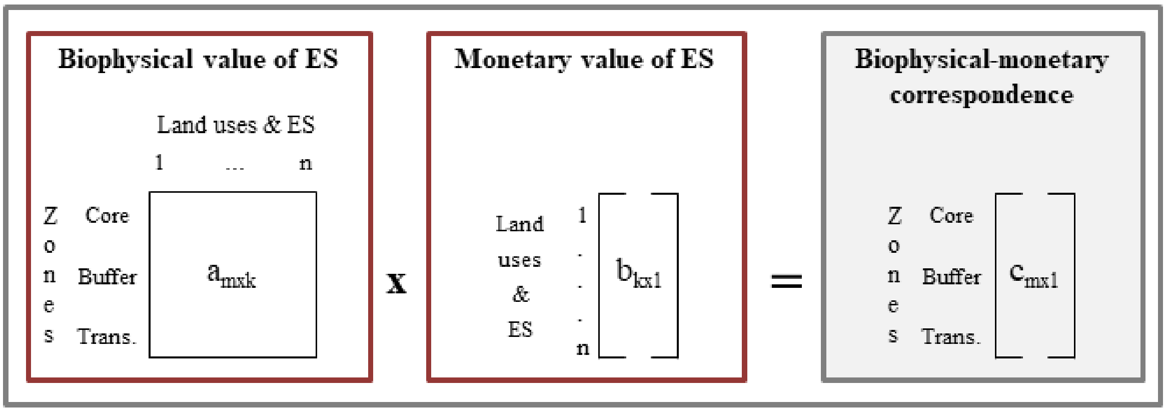


Fig. 2. General overview and steps followed for the calculation of the biophysical-monetary correspondence vector, where a_{mxk}=a matrix of standardized biophysical values, b_{kx1}=a vector of monetary values, and c_{mx1}=a product vector of coupling between biophysical and monetary values.

4. Results

4.1. Changes in the monetary value of ES

The land use changes that occurred in the study period (App. A) faced a decrease of 5.6% in the ESV, resulting in a loss of around 30x105 € (Table 1). In fact, whilst the ESV of regulating services seemed to increase 27.4x105 €, provisioning services and cultural services reduced their ESV almost 56x105 and 1x105 €, respectively. This change in ESV was mainly due to the abandonment of multiple agricultural activities and its transformation to predominance of forestry activity (pine and eucalyptus plantations). The decrease in the agricultural area (-67%) led to a reduction of the food production service, concretely, the most valued service in monetary terms, so the impact on the global ESV was noteworthy, even if regulating services ESV presumably increased. Likewise, although from 1965 to 1983, the area of the natural and semi-natural grasslands and the native forest decreased by 35.8% and 14.4%, respectively, from 1983 to 2009, with the appearance of clear cuts, natural and semi-natural grasslands were expanded by 88.6%, and native forest increased by 15% its area, resulting in an increase of 13.9x105 and 25.8x105 €, respectively (Table 1). The coastal system has remained practically unchanged in the area throughout the study period, but scrubland has been drastically reduced (-73.3%), representing losses of ≈15x105 €. Finally, in spite of not being valued economically, it is important to point out that urban areas demonstrated the largest increase growing more than 200%, especially during the last period between 1983 and 2009, though their coverage represents only 2.2% of the total area (App. A).

Sensitivity analysis indicated that the estimation of the ESV was reasonably robust because in all cases the sensitivity coefficients (CS) were less than 1 (Table 2). Therefore, the use of alternative coefficients (±50%) had small effects on the ESV and only varied by about or less than 5%. The results reflected the importance of the monetary value of cropland, ranging from 0.1 to 0.3, as well as the relevance of the area of pine and eucalyptus plantations, whose CS varied between 0.3 and 0.5 (Table 2).

Table 2. Percentage of change in the estimated total monetary value of ecosystem services (ESV) and coefficient of sensitivity (CS) resulting from a 50% adjustment of ecosystem valuation coefficients (VC).

Change in valuation coefficient	1965		1983		2009	
	%	CS	%	CS	%	CS
Cropland VC ± 50%	± 17.2	0.3	± 12.8	0.3	± 6.0	0.1
Natural and semi-natural grassland VC ± 50%	± 4	0.1	± 2.6	0.1	± 5.2	0.1
Coastal system VC ± 50%	± 2.6	0.1	± 2.6	0.1	± 2.6	0.1
Native forest VC ± 50%	± 9.6	0.2	± 8.3	0.2	± 10	0.2
Scrubland VC ± 50%	± 1.8	0.0	± 0.6	0.0	± 0.5	0.0
Pine and eucalyptus plantations VC ± 50%	± 14.7	0.3	± 23.1	0.5	± 25.7	0.5

Table 1. Total monetary value of ecosystem services (ESV in 2009€x10^5/yr) and percentage (in brackets) estimated for each land use category and divided by their three main categories according to CICES (2018).

Land uses	1965				1983				2009				Changes		
	Prov.	Reg.	Cult.	Total	Prov.	Reg.	Cult.	Total	Prov.	Reg.	Cult.	Total	1965-1983	1983-2009	1965-2009
Cropland	111.9	60.2	20.4	192.5 (34.4%)	83.1	44.7	15.2	143 (25.6%)	36.9	19.8	6.7	63.4 (12.0%)	-49.5	-79.6	-129.1
Natural and semi-natural grassland	25.0	16.8	3.5	45.3 (8.1%)	16.1	10.8	2.2	29.1 (5.2%)	30.3	20.4	4.2	54.9 (10.4%)	-16.2	25.8	9.6
Coastal system	11.2	12.4	5.0	28.6 (5.1%)	11.2	12.4	5.0	28.6 (5.1%)	11.0	12.2	4.9	28 (5.3%)	0.0	-0.6	-0.6
Native forest	9.1	75.2	23.7	108 (19.3%)	7.8	64.3	20.3	92.4 (16.5%)	9.0	74.0	23.3	106.3 (20%)	-15.6	13.9	-1.7
Scrubland	3.9	16.2	0.1	20.3 (3.6%)	1.4	5.6	0.0	7.0 (1.3%)	1.1	4.3	0.0	5.4 (1%)	-13.3	-1.6	-14.9
Pine and eucalyptus plantations	26.6	119.5	18.9	165.1 (29.5%)	41.7	187.3	29.7	258.8 (46.3%)	43.9	197.0	31.2	272.1 (51.3%)	93.7	13.4	107.1
Total	187.8	300.3	71.7	559.8	161.2	325.2	72.5	558.9	132.0	327.7	70.5	530.2	-0.9	-28.6	-29.6

Prov.=Provisioning services; Reg.=Regulating services; Cult.=Cultural services.

4.2. Biophysical value of ES

Native forest was the highest contributor of ES, followed by scrublands and croplands, while coastal system apparently contributed the least to ES (App. B). If we divide ES by group of services, cropland was the main provider of provisioning services, whereas native forest and coastal system were the ones that contribute the most to regulating services and cultural services, respectively (App. B). As for the lowest biophysical values, coastal system had the lowest ones both in provisioning services and regulating services, and pine and eucalyptus plantations were the ones with the lowest ones in cultural services (App. B). However, when zoning was only considered, we found that the core area was the one presenting the highest values, while the transition area had the lowest values. Still, differences among zones were not significant at all, and overall, it seemed that ES are well-distributed across every zone, except for the supply of cultural services which presumably was higher in the core area (App. B).

4.3. Biophysical-monetary correspondence analysis

Figure 3 shows the degree to which biophysical valuation of ES matches economic valuation of ES, or vice versa, across the core, buffer and transition zones of the UBR. The product vector (c) we obtained by multiplying the standardized biophysical matrix (a) by the monetary vector of ES (b), enables us to understand the interactions between biophysical and monetary values across the zoning of the UBR, and thus, their coupling or adjustment.

The core area represented the highest coupling between biophysical and monetary values; it was followed by the buffer zone, on the way to the transition zone, which showed the worst adjustment between both valuations (Fig. 3c).

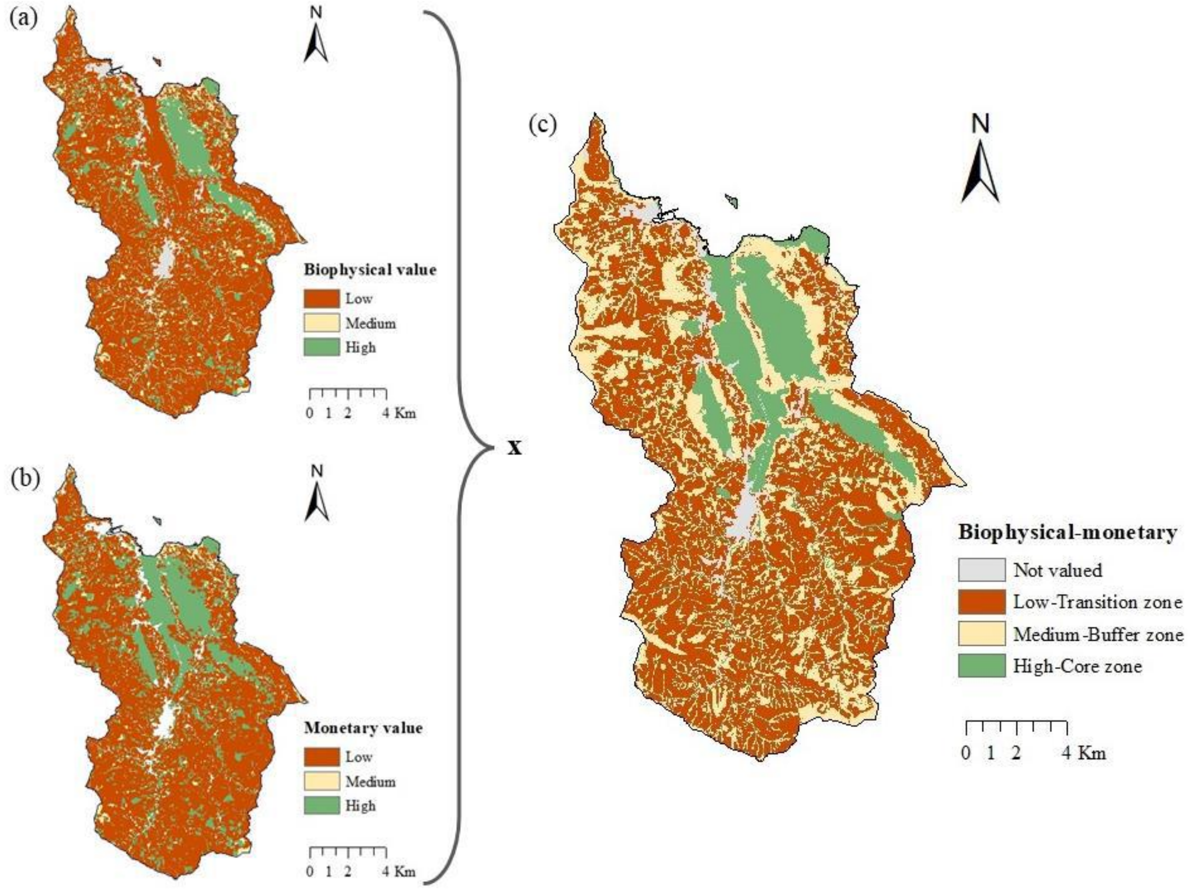


Fig. 3. Standardized biophysical values of ES for each land use category and zone (a) and monetary values of ES for each land use category (b), both ranked on low-medium-high equal scale (only for cartographic representation). (c) Correspondence between biophysical and monetary values of ES across the core, buffer and transition zones of the UBR (in green, high degree of coupling; in yellow, medium; and in brown, low). Not valued corresponds to urban areas.

5. Discussion

5.1. Lights and shadows of the conservation policies

Management policies in protected areas have usually been based on conservation *per se*, which often has provoked confrontations between the interest of conservation and exploitation of resources. However, this traditional strategy of conservation, based on establishing protected areas without any human intervention, is clearly being questioned (Hill et al., 2015; Schmitz et al., 2012, 2016). In the very specific case of biosphere reserves, even if their primary focus in the early 1980s was conservation, nowadays it has advanced to enhance both the conservation of natural resources and the rural cultural landscape (UNESCO 2005; Price et al., 2010). Under this context, in opposition to conservationist strategies, exotic plantations of pine and eucalyptus have been promoted in the UBR, occupying more than the half of its total area from 1983, and still continuously increasing over time. These types of monoculture plantations of rapidly growing species and the type of management to which they are subjected have given rise to some environmental problems, such as soil erosion, compaction and loss of nutrients (Atauri et al., 2004) and fresh water supplies (Garmendia et al., 2012), as well as loss of species diversity, aesthetic and cultural values (Onaindia et al., 2013; Rodríguez-Loinaz et al., 2013). Thus, considering the high surface occupied by forest plantations in the study area and their increase over the years, conservation policies of the biosphere reserve have called into question (Rescia et al., 2010).

Several studies state that unsustainable practices not only have a negative impact ecologically speaking, but also as regards economy. For example, Balmford et al. (2002) asserted that land use changes for agriculture, aquaculture, or forestry produced considerable economic losses. More specifically, it was detected that agrarian intensification had a negative effect on pest control (Gavier-Pizarro et al., 2012) and that the high forest management intensity negatively affected the maintenance of biodiversity (Duncker et al., 2012). Similarly, Hao et al. (2012) and Mendoza-González et al. (2012) valued the economic impact of wetlands and coastal system reduction, respectively; and Li et al. (2014) and Song et al. (2015) measured the changes in the ESV due to urban sprawl. That is, whatever the valuation technique, all of these studies agreed that land conversion for human use leads significant environmental and economic impacts. In fact, land use changes might seem economically profitable in the short term, but the capacity of ecosystems to provide services is usually altered and in the medium/long term the losses may outweigh the economic benefits. And this is precisely why the economic valuation of ES has got more attention in scientific circles for a while so as to bring to light the importance of natural and semi-natural ecosystems in providing services that contribute to our well-being, and somehow, increase society awareness.

Economic valuation of ES emerges as a valuable tool to improve decision making. Yet, one of the obstacles that hinders is its cost, and here is where benefit transfer may provide useful information while reducing costs. In spite of the limitations of the benefit transfer method, which have been greatly debated in the environmental economics literature (Brouwer, 2000; Johnston & Rosenberger, 2010; Richardson et al., 2015), these monetary valuations provide a credible basis for policy decisions, especially when comparing the changes in ESV under different scenarios like land use changes. Indeed, value accuracy is less critical for time series than a specific point of time because the coefficients have less influence (Li et al., 2010).

In this regard, contrary to what we could have expected, the land use changes occurred in the UBR during the last 44-year period only revealed a decrease of about 5% in the ESV. This decrease was mainly due to the abandonment of agricultural activity from 1983 to 2009, which was one of the most economically valued land use, and their substitution by forest plantations. Actually, although a Strategy of Sustainable Development was developed in 2009-2012 in the Reserve to enhance the sustainable ecological agriculture (Basque Government, 2009b), these objectives have not been achieved yet. In contrast, the surface of coastal system and native forest has remained fairly constant, so does the ESV. Specifically, as for the native forests, there was a decrease in the first period due to the replacement by pines and eucalyptus plantations, but a significant increase (14.1%) in the second period after the biosphere reserve designation. Similarly, other valuable land uses, such as natural grasslands, have had a similar dynamic. All this could be understood to be a success thanks to the management rules established by the Reserve Government for the conservation of biodiversity and natural resources. Among others, a Territorial Action Plan has been developed for the suitable management of the Cantabrian evergreen-oak forest and their protection zones, LIFE projects (a financial instrument supported by the European Union) have been carried out for the regeneration of coastal sands and restoration of marshlands, and broad-leaf species have been planted in public lands as well as private lands through cession agreements. However, the Governance Plan for Use and Management approved in 1993 and which should have been reviewed 15 years ago, is still trying to be approved after its rejection one year before. Some reasons to reject the reviewed version of the Plan included the criticism of ecologist groups arguing that the protection of the biosphere reserve would be reduced, and the disagreement on the part of the Association of Foresters of Biscay who stated that forestry would be highly limited.

After all, management has been focused on only a few marketed services, i.e. timber, with the subsequent loss of landscape heterogeneity and multifunctionality. Surprisingly, biophysical valuation of ES presented higher values for pine and eucalyptus plantations than coastal system, which is, together with native forest, the main reason for the designation of the UBR. In this sense, one limitation of this study that must be taken into account not to misunderstand the results is the temporal scale of the valuation process. Certainly, pine and eucalyptus plantations are the highest suppliers of water regulation and purification service, and carbon storage is some of the most valued ES, too; nevertheless, every 30 and 10 years, respectively (Mateos et al., 2017), the provision of these regulating services is negatively impacted because of their management and clear cuts, leading to previously mentioned disservices such as soil loss, water quality worsening and silting of rivers. Still, forest managers of the region, taking advantage of the current interest on carbon sequestration, persist in the idea of pine and eucalyptus plantations culture, arguing that these species sequester a big quantity of carbon. A study carried out in Biscay by Rodriguez-Loinaz et al. (2013) denied this theory, though. According to Rodríguez-Loinaz et al. (2013), the substitution of existing exotic plantations by plantations of native species has the greatest potential for increasing carbon sequestration in the long-term (>50 years), while avoiding the environmental problems the actual plantations cause.

On the other side, it is well-known that there is a bias for terrestrial ecosystems, so suitable indicators of ES in aquatic ecosystems are challenging (Hattam et al., 2015). Thus, it may have happened that the descriptors used to value ES did not adjust to coastal system category since they were based on terrestrial ones. To give an example, habitat for species service did not include underground biodiversity. Again, another argument we found is the weight of each ES and their contribution to human well-being. Here, we have considered all services to be of equal weight, but this can be argued and besides, it might occur that the same ES is valued differently by different group of people of the same area depending on their context (Casado-Arzuaga et al., 2013; Castillo-Eguskitza et al., 2018).

Yet, the core area, which is considered to be the most ecologically valuable zone, aimed at enhancing the conservation of natural resources and the rural cultural landscape, was the one with the highest biophysical and monetary value. As a result, the biophysical-monetary correspondence analysis showed that while the core area presented an intense coupling of the relationship between nature and human societies, the transition zone, with the lowest restrictions and highest activity such as forestry, had the highest degree of decoupling for one another. In any case, differences in the value of biophysical-monetary correspondence vector among zones were almost irrelevant, suggesting that the territory is practically equally valuable from the two dimensions considered.

5.2. Guidelines for management

The development of effective policies requires understanding both ecosystems, as ES providers, and social systems, where ES are demanded and managed. Yet, the design of management policies often does not take into consideration these last and sometimes they tend to be inappropriate. Beyond some methodological caveats, this study enables us to characterise the links between nature and human societies across the three different zones of the UBR, so that it may be useful to give some recommendations to consider in the future management of the protected area, now being reviewed, and contribute to a better zoning scheme. However, given the mixture of different land uses within each zone, and therefore, the difficulty to establish specific measures within them, to ensure sustainable conservation policies that integrates both biophysical and monetary values of ES, it would be necessary to create maps at a lower scale to distinguish land use categories.

Schmitz et al. (2007) and de Aranzabal et al. (2009) have already used a similar procedure to integrate landscape analysis and tourist perceptions so as to contribute to the design of tourism planning and management. Likewise, Ruiz-Labourdette et al. (2013) and Schmitz et al. (2017) have also applied a correspondence analysis to obtain variation models of forests and socio-ecological systems, respectively, under different climate change scenarios. For the particular case of the protected areas, they found that their designation did not foresee the decoupling of the secular relationship between human societies and nature, but instead an abandonment or replacement of cultural landscapes by new activities was observed (Schmitz et al., 2012; 2017).

Here, it seems that the establishment of the biosphere reserve may have satisfied social demands, with the highest biophysical and monetary values in the core area; but also, as said before, across the whole territory since the supply of ES fits the demand almost equally across the three zones. These results are in line with previous studies in the UBR in which the designation of the biosphere reserve was demonstrated not to be negative, but somehow good for its conservation and local population's quality of life (Castillo-Eguskitza et al., 2017). However, when economic valuation of ES was locally assessed, important mismatches were found between supply and demand in the UBR (Castillo-Eguskitza et al., 2018) and other protected areas (Martín-López et al., 2014; Castro et al., 2014). In fact, these differences between biophysical and monetary values are usually related to the relative abundance of ES within naturally functioning ecosystems and economies (Farber et al., 2002). That is, a service can be more abundant and consequently, its monetary value can be high; and vice versa, a service can be scarce or deteriorated, and precisely because of that, its monetary value can be even higher. Therefore, even if benefit transfer method might give insights for ES economic valuation and conservation decision making, it is fundamental to work locally, and include other value dimensions like socio-cultural.

Conservation criteria change over time and socio-cultural context. New approaches to balance these conservation goals and social needs are demanded and adaptive management is promising (Williams & Brown, 2014). Yet, only a holistic approach to landscape description can explain landscape complexity and trade-offs and synergies between ES (Li, 2000). Thus, conserving multifunctional landscapes that provide multiple ES should be priority. Moreover, considering that 92% of the territory is privately owned, the involvement of affected local populations is necessary and their ES preferences should also be taken into account. Palacios-Agundez et al. (2013) revealed that the high-priority services considered in the region were air and water regulation, water supply, biodiversity (as provider of ES), environmental education, traditional knowledge and research, with woodlands management representing one important direct driver of change, among others. In other words, multifunctional landscapes are in demand. In this sense, the challenge in the UBR is to improve ES in relation to the control of pine and eucalyptus plantations' expansion and management, while promoting local traditional agriculture, cultural heritage of the territory, and implement more protection measures on native forests.

In the last decades, drop of timber prices has leaded the forest sector to a deep crisis. Timber prices of pine and eucalyptus have fallen by 63% and 34%, respectively, over 13 years since 2003 (EUSTAT 2013; 2017). Now, if it was not enough, the collapse of pine plantations is becoming reality due to three main fungi that progressively, and spurred by climate change, are weaking their health (Press area of the Department of Sustainability and Natural Environment of the Provincial Council of Biscay; http://www.bizkaia.eus): red band (*Dothistroma pini*), brown band (*Lecanosticta acicola*) and *Fusarium* spp. This dramatic situation might be seen as an opportunity to bet on sustainable forestry based on native forest, though. To this end, the role of the Administration is key not to fall into the already known problem of eucalyptus monocultures, which is, indeed, the actual intention of the forestry sector in order to obtain biomass for the pulp and paper industry and for bioenergy.

As was suggested by Rodríguez-Loinaz et al. (2013), we propose to replace pine and eucalyptus plantations with native broadleaf deciduous species in areas with slopes higher than 30% or with erosion risk, areas with riparian forest and areas surrounding oak forest. Besides, the replacement of forestry land with high agrological capacity by sustainable agriculture would improve landscape multifunctionality, increase self-provisioning, recover natural ecosystems and maintain biodiversity and a diverse flow of ES (Palacios-Agundez et al., 2015; Onaindia et al., 2018). By doing so, however, returns to the foresters would be reduced. Agreements between the private and public sectors to equilibrate factors that usually generate a trade-off situation such as private interest, provisioning versus other ES and lack of accounting for all stakeholders, should lead to a type of win-win solution (Howe et al., 2014). Therefore, management plan should include an economic validity study which support local population involved in maintaining or restoring the sustainability of the territory economically by paying for ES, agro-environmental incentives or stewardship mechanisms (Rescia et al., 2017).

6. Conclusions

The land uses changes occurred during the last 44-year period have not had such a big impact on the economic valuation of ES, but clearly have homogenised the territory with a subsequent loss of multifunctionality. However, results obtained from the biophysical-monetary correspondence analysis suggest that the establishment of the biosphere reserve has contributed to its conservation goal, being the core area the one with the highest coupling between both valuations. Besides, similarities among zones revealed that, overall, the monetary value of ES is perceived as that based upon biophysical values across not only the core are, but also the buffer zone and the transition area. All in all, even if it would be necessary to assess interactions at a lower (land use category) scale, the procedure we have developed for this study enables us to examine relationships between biophsysical and economic valuation of ES, which may be useful for decision making and design and zoning of the biosphere reserve. This procedure, furthermore, results especially appropriate for social-ecological systems like the UBR because of its consideration of the interdependencies between the biophysical and more social monetary dimensions, which together with the socio-cultural one, are completely necessary to guarantee a sustainable management. Hence, it may allow optimizing spatial planning and establishing specific policies or conservation strategies for the sustainable development of the area, including valuation of the effectiveness of protected areas.

References

Aretano, R., Petrosillo, I., Zaccarelli, N., Semeraro, T., Zurlini, G., 2013. People perception of landscape change effects on ecosystem services in small Mediterranean islands: A combination of subjective and objective assessments. Landscape Urban Plan. 112, 63-73.

Atauri, J.A., de Pablo, C., de Agar, P., Schmitz, M.F., Pineda, F.D., 2004. Effects of management on understory diversity in the forest ecosystems of northern Spain. Environ. Manage. 34, 819-828.

Balmford, A., Bruner, A., Cooper, P., Costanza, R. et al., 2002. Economic reasons for conserving wild nature. Science 297, 950-953.

Basque Government, 2004. Governance Plan for Use and Management of Urdaibai Biosphere Reserve. Refunded text. Department of Land Management and Environment, Basque Government, Vitoria-Gasteiz.

Basque Government, 2009a. geoEuskadi. Available: http://www.geoeuskadi.eus/

Basque Government, 2009b. Strategy of Sustainable Development of the Urdaibai Biosphere Reserve 2009-2015. Directorate of Biodiversity and Environmental Participation. Technical Office of the Urdaibai Biosphere Reserve [Spanish]

Basque Government, 2011. Forest Inventory 2011. Department of Economic Development and Competitiveness.

Bauer, D., Johnston, R., 2013. The Economics of Rural and Agricultural Ecosystem Services: Purism versus Practicality. Agricultural and Resource Economics Review 42(1).

Brookshire, D.S., Neill, H.R., 1992. Benefit transfers: conceptual and empirical issues. Water Resour. Res. 28, 651-655.

Brouwer, R., 2000. Environmental value transfer: state of the art and future prospects. Ecol. Econ. 32(1), 137-152.

Casado-Arzuaga, I., Madariaga, I., Onaindia, M., 2013. Perception, demand and user contribution to ecosystem services in the Bilbao Metropolitan Greenbelt. J. Environ. Manage. 129, 33-43.

Castillo-Eguskitza N, Rescia AJ, Onaindia M., 2017. Urdaibai Biosphere Reserve (Biscay, Spain): Conservation against development? Sci. Total Environ. 592, 124-133.

Castillo-Eguskitza, N., Martín-López, B., Onaindia, M., 2018. A comprehensive assessment of ecosystem services: Integrating supply, demand and interest in the Urdaibai Biosphere Reserve. Ecol. Indic. 93, 1176-1189.

Castro, A.J., Verburg, P.H., Martín-López, B., García-Llorente, M., et al., 2014. Ecosystem service trade-offs from supply to social demand: a landscape-scale spatial analysis. Landsc. Urban Plan. 132, 102-110.

CPF. Centre de la Propietat Forestal., 2004. Annexe Indicadors dendrométrics En: Manual de redacción de plans tècnics de gestió i millota forestal (PTGMF) i plans simples de gestió forestal (PSGF. Instruccions de redacció i l'inventari forestal. Generalitat de Catalunya, Departament de Medi Ambient i Habitatge, Centre de la Propietat Forestal. Barcelona España. pp. 211-314.

Chaudhary, S., McGregor, A., Houston, D., Chettri, N., 2015. The evolution of ecosystem services: a time series and discourse-centered analysis. Environ. Sci. Policy 54, 25-34.

Costanza, R., d'Arge, R., de Groot, R.S., Farber, S. et al., 1997. The value of the world's ecosystem service and natural capital. Nature 387, 253-260.

Costanza, R., de Groot, R.S., Sutton, P., Van der Ploeg, S. et al., 2014. Changes in the global value of ecosystem services. Global Environ. Chang. 26, 152-158.

Crespin, S.J., Simonetti, J.A., 2016. Loss of ecosystem services and the decapitalization of nature in El Salvador. Ecosyst. Serv. 17, 5-13.

de Aranzabal, I., Schmitz, M.F., Aguilera, P., Pineda, F.D., 2008. Modelling of lanscape changes derived from the dynamics of social-ecological systems. A case of study in a semiarid Mediterranean landscape. Ecol. Indic. 8, 672-685.

de Aranzabal, I., Schmitz, M.F., Pineda, F.D., 2009. Integrating landscape analysis and planning: a multi-scale approach for oriented management of tourist recreation. Environ. Manage. 44(5), 938-951.

de Groot, R.S., Alkemade, R., Braat, L., Hein, L., Willemen, L., 2010. Challenges in integrating the concept of ecosystem services and values in landscape planning, management and decision making. Ecol. Complex. 7(3), 260-272.

de Groot, R.S., Brander, L., Van der Ploeg, S., Costanza, R. et al., 2012. Global estimates of the value of ecosystems and their services in monetary units. Ecosyst. Serv. 1, 50-61.

Duncker, P.S., Raulund-Rasmussen, K., Gundersen, P., Katzensteiner, K. et al., 2012. How forest management affects ecosystem services, including timber production and economic return: synergies and trade-offs. Ecol. Soc. 17(4):50.

EEX. European Energy Exchange, 2018. EU Emission Allowances | Secondary Market. Available: www.eex.com/

Eigenbrod, F., Armsworth, P.R., Anderson, B.J., Heinemeyer, A., et al., 2010. The impact of proxy- based methods on mapping the distribution of ecosystem services. J. Appl. Ecol. 47, 377-385.

ESRI, 2016. ArcGIS 10.4. Redlands. Environmental Systems Research Institute, California, USA.

Esteban Moratilla, F., 2010. Proyecto VANE. Valoración de los activos naturales de España. Ministerio de Medio Ambiente y Medio Rural y Marino, Gobierno de España [Spanish]

EUHD (European Union Habitats Directive), 1992. Council Directive 92/43/EEC, on the conservation of natural habitats and wild flora and fauna.

EUSTAT, 2013. Basque Statistical Institute. Basque Statistical Yearbook 2013.

EUSTAT, 2017. Basque Institute of Statistics. Available in: www.eustat.es

Farber, S.C., Costanza, R., Wilson, M.A., 2002. Economic and ecological concepts for valuing ecosystem services. Ecol. Econ. 41(3), 375-392.

Fisher, B., Turner, K., Zylstra, M., Brouwer, R. et al., 2008. Ecosystem services and economic theory: integration for policy-relevant research. Ecol. Appl. 18(8), 2050-2067.

Foley, J., DeFries, R., Asner, G., Barford, C. et al., 2005. Global Consequences of Land Use. Science 309, 570-574.

Folke, C., 2006a. The economic perspective: conservation against development versus conservation for development. Conserv. Biol. 20, 686-688.

Folke, C., 2006b. Resilience: The emergence of a perspective for social–ecological systems analyses. Global Environ. Chang. 16(3), 253-267.

Fu, B., Li, Y., Wang, Y., Zhang, B. et al., 2016. Evaluation of ecosystem service value of riparian zone using land use data from 1986 to 2012. Ecol. Indic. 69, 873-881.

Garmendia, E., Mariel, P., Tamayo, I., Aizpuru, I., Zabaleta, A., 2012. Assessing the effect of alternative land uses in the provision of water resources: Evidence and policy implications from southern Europe. Land Use Policy 29, 761-770.

Gavier-Pizarro, G.I., Calamari, N.C., Thompson, J.J., Canavelli, S.B. et al., 2012. Expansion and intensification of row crop agriculture in the Pampas and Espinal of Argentina can reduce ecosystem service provision by changing avian density. Agr. Ecosyst. Environ. 154, 44-55.

Gómez-Baggethun, E., Barton, D.N., 2013. Classifying and valuing ecosystem services for urban planning. Ecol. Econ. 86, 235-245.

Haase, D., Larondelle, N., Andersson, E., Artmann, M. et al., 2014. A quantitative review of urban ecosystem service assessments: concepts, models, and implementation. AMBIO 43, 413-433.

Hao, F., Lai, X., Ouyang, W., Xu, Y. et al., 2012. Effects of land use changes on the ecosystem service values of a reclamation farm in northeast China. Environ. Manage. 50(5), 888-99.

Hattam, C., Atkins, J.P., Beaumont, N., Börger, T., et al., 2015. Marine ecosystem services: Linking indicators to their classification. Ecol. Indic. 49, 61-75.

Hicks, C.C., McClanahan, T.R., Cinner, J.E., Hills, J.M., 2009. Trade-offs in values assigned to ecological goods and services associated with different coral reef management strategies. Ecol. Soc. 14(1):10.

Hill, R., Miller, C., Newell, B., Dunlop, M., Gordon, I., 2015. Why biodiversity declines as protected areas increase: the effect of the power of governance regimes on sustainable landscapes. Sustain. Sci. 10, 357-369.

Hoyos, D., Mariel, P., Pacual, U., Etxano, I., 2012. Valuing a Natura 2000 network site to inform land use options using a discrete choice experiment: an illustration from the Basque Country. J. For. Econ. 18, 329-344.

Howe, C., Suich, H., Vira, B., Mace, G., 2014. Creating win-wins from trade-offs? Ecosystem services for human well-being: A meta-analysis of ecosystem service trade-offs and synergies in the real world. Global Environ. Chang. 28, 263-275.

IPCC, 2003. Good Practice Guidance for Land Use, Land-Use Change and Forestry. Ed J. Pennan et al. Institute for Global Environmental Strategies, Kanagawa.

Johnston, R.J., Rosenberger, R.S., 2010. Methods, trends and controversies in contemporary benefit transfer. J. Econ. Surv. 24, 479-510.

Jobstvogt, N., Hanley, N., Hynes, S., Kenter, J., Witte, U., 2014. Twenty thousand sterling under the sea: Estimating the value of protecting deep-sea biodiversity. Ecol. Econ. 97, 10-19.

Karp, D.S., Mendenhall, C.D., Callaway, E., Frishkoff, L.O. et al., 2015. Confronting and resolving competing values behind conservation objectives. P. Natl. A. Sci. USA. 112, 11132-11137.

Laurila-Pant, M., Lehikoinen, A., Uusitalo, L., Venesjärvi, R., 2015. How to value biodiversity in environmental management? Ecol. Indic. 55, 1-11.

Levin, S., Xepapadeas, T., Crépin, A., Norberg, J. et al., 2013. Social-ecological systems as complex adaptive systems: modeling and policy implications. Environ. Dev. Econ. 18, 111-132.

Li, B-L., 2000. Why is the holistic approach becoming so important in landscape ecology? Landscape Urban Plan. 50(1-3), 27-41.

Li, J., Wang, W., Hu, G., Wei, Z., 2010. Changes in ecosystem service values in Zoige Plateau, China. Agr. Ecosyst. Environ. 139, 766-770.

Li, F., Ye, Y.P., Song, B.W., Wang, R.S., Tao, Y., 2014. Assessing the changes in land use and ecosystem services in Changzhou municipality, Peoples' Republic of China, 1991-2006. Ecol. Indic. 42, 95-103.

Liquete, C., Cid, N., Lanzanova, D., Grizzetti, B., Reynaud, A., 2016. Perspectives on the link between ecosystem services and biodiversity: The assessment of the nursery function. Ecol. Indic. 63, 249-257.

Liu, S., Costanza, R., Farber, S., Troy, A. 2010. Valuing ecosystem services Theory, practice, and the need for a transdisciplinary synthesis. Ann. NY Acad. Sci. 1185, 54-78.

Luederitz, C., Brink, E., Gralla, F., Hermelingmeier, V. et al., 2015. A review of urban ES: six key challenges for future research. Ecosyst. Serv. 14, 98-112.

MA, 2005. Ecosystems and Human Well-Being: Synthesis. Island Press, Washington, DC.

Madrigal, A., Álvarez, J.G., Rodríguez, R., Rojo, A. (Eds.), 1999. Tablas de producción para los montes españoles.

Fundación Conde del Valle de Salazar, Madrid, Spain.

Maes, J., 2010. Water Retention Index. European Commission, Joint Research Centre (JRC) [Dataset]

Magliocca, N.R., Rudel, T.K., Verburg, P.H., McConnell, W.J. et al., 2015. Synthesis in land change science: methodological patterns, challenges, and guidelines. Reg Environ Change 15, 211-226.

Mamat, A., Halik, Ü., Rouzi, A., 2018. Variations of Ecosystem Service Value in Response to Land-Use Change in the Kashgar Region, Northwest China. Sustainability 10, 200.

MAPAMA, 2015. National Spacial Data Infraestructure. NDSI. Available: http://www.magrama.gob.es/es/cartografia-y-sig/ide/descargas/agua/simpa.aspx

Martín-López, B., García-Llorente, M., Palomo, I., Montes, C., 2011. The conservation against development paradigm in protected areas: Valuation of ecosystem services in the Doñana social–ecological system (southwestern Spain. Ecol. Econ. 70, 1481-1491.

Martín-López, B., Gómez-Baggethun, E., García-Llorente, M., Montes, C., 2014. Trade-offs across value-domains in ecosystem services assessment. Ecol. Indic. 37, 220-228.

Mateos, E., Edeso, J.M., Ormaetxea, L., 2017. Soil erosion and forests biomass as energy resource in the basin of the oka river in biscay, Northern Spain. Forests 8, 258.

Mendoza-González, G., Martínez, M.L., Lithgow, D., Pérez-Maqueo, O., Simonin, P., 2012. Land use change and its effects on the value of ecosystem services along the coast of the Gulf of Mexico. Ecol. Econ. 82, 23-32.

Metzger, M.J., Rounsevell, M.D.A., Acosta-Michlik, L., Leemans, R., Schröter, D., 2006. The vulnerability of ecosystem services to land use change. Agr. Ecosyst. Environ. 114(1), 69-85.

Mitchell, N., Rössler, M., Tricaud, J.M., 2009. World heritage cultural landscapes. A handbook for conservation and management. Paris, UNESCO World Heritage Centre.

Montero, G., Ruiz-Peinado, R., Muñoz, M., 2005. Monografías INIA: Serie Tierras forestales (13). Producción de biomasa y fijación de CO2 por los bosques españoles. Ed. Instituto Nacional de Investigación y Tecnología Agraria y Alimentaria (INIA) y Ministerio de Educación y Ciencia, Madrid, Spain.

Neiker-Ihobe, 2004. Estudio sobre la potencialidad de los suelos y la biomasa de zonas agrícolas, pascícolas y forestales de la CAPV como sumideros de carbono. Informe [Spanish]

Newbold, T., Hudson, L.N., Hill, S.L.L., Contu, S., et al., 2015. Global effects of land use on local terrestrial biodiversity. Nature 520, 45-50.

O'Farrell, P.J., Anderson, P.M., 2010. Sustainable multifunctional landscapes: A review to implementation. Curr. Opin. Sust. 2, 59-65.

Onaindia, M., Fernández de Manuel, B., Madariaga, I., Rodríguez-Loinaz, G., 2013. Co-benefits and trade-offs between biodiversity, carbon storage and water flow regulation. Forest Ecol. Manag. 289, 1-9.

Onaindia, M., Peña, L., Fernández de Manuel, B., Rodríguez-Loinaz, G., et al., 2018. Land use efficiency through analysis of agrological capacity and ecosystem services in an industrialized region (Biscay, Spain). Land Use Policy 78, 650-661.

Palacios-Agundez, I., Casado-Arzuaga, I., Madariaga, I., Onaindia, M., 2013. The relevance of local participatory scenario planning for ecosystem management policies in the Basque Country, northern Spain. Ecol. Soc. 18(3):7.

Palacios-Agundez, I., Onaindia, I., Barraqueta, P., Madariaga, I., 2015. Provisioning ecosystem services supply and demand: The role of landscape management to reinforce supply and promote synergies with other ecosystem services. Land Use Policy 47, 145-155.

Peña, L., Casado-Arzuaga, I., Onaindia, M., 2015. Mapping recreation supply and demand using an ecological and a social evaluation approach. Ecosyst. Serv. 13, 108-118.

Petrosillo, I., Aretano, R., Zurlini, G., 2015. Socioecological systems. Reference Module in Earth Systems and Environmental Sciences, Elsevier.

Posner, S., Getz, C., Ricketts, T., 2016. Evaluating the impact of ecosystem service assessments on decision-makers. Environ. Sci. Policy 64, 30-37.

Price, M.F., Park, J.J., Bouamrane, M., 2010. Reporting progress on internationally designated sites: The periodic review of biosphere reserves. Environ. Sci. Policy 13, 549-557.

Quintas-Soriano, C., Martín-López, B., Santos-Martín, F., Loureiro, M., et al., 2016. Ecosystem services values in Spain: A meta-analysis. Environ. Sci. Policy 55(1), 186-195.

Rescia, A.J., Schmitz, M.F., Pineda, F.D., 2008. Ecological considerations for planning and management of cultural fragmented landscapes. In: A. Dupont, H. Jacobs. Landscape Ecology Research Trends: 125-136. Nova Science Publishers, Inc.

Rescia, A.J., Willaarts, B.A., Schmitz, M.F., Aguilera, P.A., 2010. Changes in land uses and management in two Nature Reserves in Spain: Evaluating the social-ecological resilience of cultural landscapes. Landscape Urban Plan. 98, 26-35.

Rescia, A.J., Pérez-Corona, M.E., Arribas-Ureña, P., Dover, J.W., 2012. Cultural landscapes as complex adaptive systems: the cases of northern Spain and northern Argentina, in: Plieninger T, Bieling C. (Eds.) Resilience and the Cultural Landscape: Understanding and Managing Change in Human-Shaped Environments, Cambridge University Press, Cambridge.

Rescia, A.J., Sanz-Cañada, J., del Bosque-González, I., 2017. A new mechanism based on landscape diversity for funding farmer subsidies. Agro. Sustain. Dev. 37(2):9.

Richardson, L., Loomis, J., Kroeger, T., Casey, F., 2015. The role of benefit transfer in ecosystem service valuation. Ecol. Econ. 115, 51-58.

Rodríguez-Loinaz, G., Amezaga, I., Onaindia, M., 2013. Use of native species to improve carbon sequestration and contribute towards solving the environmental problems of the timberlands in Biscay, northern Spain. J. Environ. Manage. 120, 18-26.

Ruiz-Labourdette, D., Schmitz, M.F., Pineda, F.D., 2013. Changes in tree species composition in Mediterranean mountains under climate change: indicators for conservation planning. Ecol. Ind. 24, 310-323.

Sala, O., Stuart Chapin, F., Armesto, J.J., Berlow, E. et al., 2000. Global biodiversity scenarios for the year 2100. Science 287, 1770-1774.

Schmitz, M.F., De Aranzabal, I., Pineda, F.D., 2007. Spatial analysis of visitor preferences in the outdoor recreational niche of Mediterranean cultural landscapes. Environ. Conserv. 34(4), 300-312.

Schmitz, M.F., Matos, D.G.G., de Aranzabal, I., Ruiz-Labourdette, D., Pineda, F.D., 2012. Effects of a protected area on land-use dynamics and socioeconomic development of local populations. Biol. Conserv. 149(1), 122-135.

Schmitz, M.F., Herrero-Jáuregui, C., Arnaiz-Schmitz, C., Sánchez, I.A. et al., 2016. Evaluating the role of a protected area on hedgerows conservation: the case of a Spanish cultural landscape. Land Degrad. Dev.

Schmitz, M.F., Arnaiz-Schmitz, C., Herrero-Jauregui, C., Diaz, P., et al., 2017. People and nature in the Fuerteventura Biosphere Reserve (Canary Islands): socio-ecological relationships under climate change. Environ. Conserv. 45(1), 20-29.

Sharp, R., Tallis, H.T., Ricketts, T., Guerry, A.D., et al., 2018. InVEST 2.6.0 User's Guide. The Natural Capital Project, Stanford University, University of Minnesota, The Nature Conservancy, and World Wildlife Fund.

Sitas, N., Prozesky, H.E., Esler, K.J., Reyers, B., 2014. Exploring the Gap between Ecosystem Service Research and Management in Development Planning. Sustainability 6, 3802-3824.

Song, W., Deng, X., Yuan, Y., Wang, Z., Li, Z., 2015. Impacts of land-use change on valued ecosystem service in rapidly urbanized North China Plain. Ecol. Model. 318, 245-253.

Suzuki, N., Parker, K.L., 2016. Potential conflict between future development of natural resources and high-value wildlife habitats in boreal landscapes. Biodivers. Conserv. 25, 3043-3073.

TEEB, 2010. The Economics of Ecosystems and Biodiversity. Ecological and Economic Foundations. Edited by Pushpam Kumar. Earthscan, London and Washington.

Troy, A., Wilson, M., 2006. Mapping ecosystem services: Practical challenges and opportunities in linking GIS and value transfer. Ecol. Econ. 60, 435-449.

UNESCO, 2005. Biosphere reserves: Benefits and opportunities. Paris, France: Programme on Man and the Biosphere (MAB).

UNESCO, 2018. Available at: www.unesco.org/ [Accessed 2018].

Van der Ploeg, S., de Groot, R.S., 2010. The TEEB Valuation Database – a searchable database of 1310 estimates of monetary values of ecosystem services. Foundation for Sustainable Development, Wageningen, The Netherlands.

Van Nes, E.H., Scheffer, M., 2005. A strategy to improve the contribution of complex simulation models to ecological theory. Ecol. Model. 185(2-4), 153-164.

Verma, M., Negandhi, D., Khanna, C., Edgaonkar, A., et al., 2017. Making the hidden visible: Economic valuation of tiger reserves in India. Ecosyst. Serv. 26(A), 236-244.

Wang, Z., Dehua, M., Lin, L., Mingming, J. et al., 2015. Quantifying changes in multiple ecosystem services during 1992-2012 in the Sanjiang Plain of China. Sci. Total Environ. 514, 119-130.

Williams, B.K., Brown, E.D., 2014. Adaptive Management: From More Talk to Real Action. Environ. Manage. 53(2), 465-479.

World Bank, 2009.World Development Indicators. World Bank Publications, ISBN: 0821369598.

Zambrano-Monserrate, M.A., Silva-Zambrano, C.A., Ruano, M.A., 2018. The economic value of natural protected areas in Ecuador: A case of Villamil Beach National Recreation Area. Ocean Coast. Manage. 157, 193-202.

Zhang, Z.M., Gao, J.F., Fan, X.Y., 2016. Assessing the variable ecosystem services relationships in polders time: A case study in the eastern Chaohu Lake Basin, China. Environ. Earth Sci. 75, 856-867.

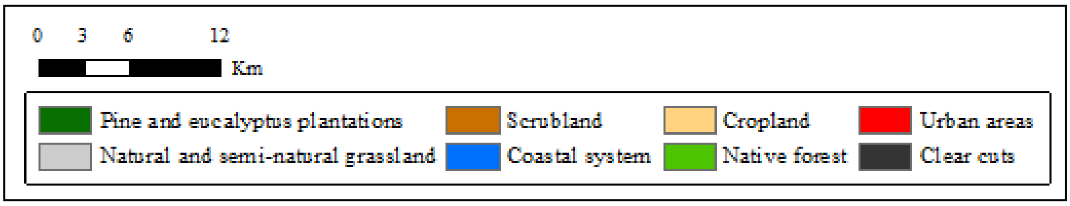
Zhao, B., Kreuter, U., Li, B., Ma, Z., Chen, J., Nakagoshi, N., 2004. An ecosystem service value assessment of land-use change on Chongming Island, China. Land Use Policy 21(2), 139-148.

Appendix A. Land use changes and their evolution in time.

Table A.1. a) Land use changes in the UBR in 1965, 1983 and 2009 expressed in ha and percentage; b) Increment of the land use changes (%) in the three time ranges studied. Pixels in the maps correspond to the predominant land use category.

a)

Years	Extent of land uses					
1965	Cropland	Natural and semi-natural grassland	Coastal system	Native forest	Scrubland	
	6,006.9 (27.6%)	2,378.5 (10.9%)	902.8 (4.1%)	3,246.5 (14.9%)	2,013.9 (9.3%)	
		Pine and eucalyptus plantations		Clear cuts	Urban areas	
			7,066.0 (32.5%)	0 (0%)	156.3 (0.7%)	
1983	Cropland	Natural and semi-natural grassland	Coastal system	Native forest	Scrubland	
	4,461.8 (20.5%)	1,527.8 (7.0%)	902.8 (4.1%)	2,777.8 (12.8%)	694.4 (3.2%)	
		Pine and eucalyptus plantations		Clear cuts	Urban areas	
			11,076.4 (50.9%)	104.2 (0.5%)	225.7 (1.0%)	
2009	Cropland	Natural and semi-natural grassland	Coastal system	Native forest	Scrubland	
	1,979.2 (9.1%)	2,881.9 (13.2%)	885.4 (4.1%)	3.194.4 (14.7%)	538.2 (2.5%)	
		Pine and eucalyptus plantations		Clear cuts	Urban areas	
			11,649.3 (53.5%)	156.3 (0.7%)	486.1 (2.2%	



b)

Years	Cropland	Natural and semi-natural grassland	Coastal system	Native forest	Scrubland	Pine and eucalyptus plantations	Clear cuts	Urban areas
1965-1983	-25.7	-35.8	0	-14.4	-65.5	56.8	104.2	44.4
1983-2009	-55.6	88.6	-1.9	15	-22.5	5.2	50	115.4
1965-2009	-67.0	21.2	-1.9	-1.6	-73.3	64.9	156.3	211.0

Appendix B. Standardized biophysical values[1] obtained from the mapping procedure for each ES and land use category and zone, and their added values by group of services. Measurement units are indicated in brackets.

	Core area						Buffer zone						Transition area						UBR					
	CR	GR	CO	NAT	SCR	PI	CR	GR	CO	NAT	SCR	PI	CR	GR	CO	NAT	SCR	PI	CR	GR	CO	NAT	SCR	PI
Provisioning services	1.83	0.69	0.31	0.40	0.46	1.24	1.17	0.50	0.98	0.57	0.68	1.03	0.35	0.64	1.01	1.17	0.66	1.02	1.96	0.93	0.44	0.60	1	1.17
Food production (t/ha)	1	0.01	0.01	0	0	0	0.75	0.01	0.01	0	0	0	0.69	0.01	0.01	0	0	0	1	0.01	0.01	0	0	0
Timber (m^3/ha)	0	0	0	0.40	0	0.95	0	0	0	0.51	0	0.89	0	0	0	1	0	0.88	0	0	0	0.60	0	1
Fresh water (mm/ha)	0.83	0.68	0.30	0	0.46	0.29	0.42	0.50	0.97	0.05	0.68	0.14	0.66	0.63	1	0.17	0.66	0.14	0.96	0.92	0.43	0	1	0.17
Regulating services	1	1.65	0.89	3.34	2.37	2.44	1.82	1.86	0.70	3.09	2.35	2.29	1.49	1.85	0.33	2.92	2.36	2.33	1.52	1.91	0.56	3.54	2.58	2.65
C storage (tC/ha)	0.11	0.04	0	0.72	0.08	0.63	0.32	0.08	0	0.74	0.13	0.65	0.24	0.04	0	1	0.13	0.64	0.31	0.07	0	1	0.16	0.84
Water regulation and purification (-)	0.59	0.48	0.35	0.62	1	0.91	0.80	0.66	0.06	0.66	0.82	0.82	0.71	0.76	0	0.82	0.86	0.99	0.63	0.64	0	0.54	0.85	1
Pollination and biological control (-)	0.30	0.82	0	1	0.75	0.61	0.56	0.83	0.11	0.71	0.79	0.55	0.48	0.80	0.07	0.63	0.78	0.45	0.58	0.97	0	1	0.94	0.59
Habitat for species (-)	0	0.31	0.54	1	0.54	0.29	0.14	0.29	0.52	0.97	0.61	0.27	0.06	0.26	0.26	0.47	0.60	0.25	0	0.23	0.56	1	0.63	0.22
Cultural services	1.13	1.28	1.76	1.29	1.59	0.57	0.67	0.96	1.71	1.17	1.08	0.35	0.42	0.65	1.49	0.18	0.85	0	0.45	0.76	2	1.20	1.13	0
Tourism and recreation (-)	0.56	0.70	0.76	0.68	0.87	0.27	0.21	0.43	0.86	0.56	0.52	0.15	0.09	0.31	1	0.15	0.45	0	0.13	0.42	1	0.71	0.66	0
Aesthetic enjoyment (-)	0.57	0.58	1	0.61	0.72	0.30	0.46	0.53	0.85	0.61	0.57	0.21	0.33	0.34	0.49	0.03	0.39	0	0.32	0.34	1	0.49	0.47	0
Total	3.96	3.62	2.96	5.03	4.42	4.23	3.66	3.32	3.39	4.83	4.11	3.67	3.26	3.14	2.83	4.27	3.87	3.35	3.93	3.60	3	5.34	4.71	3.82
	24.22						22.98						20.72											

[1] Since ES units are different, and consequently it was not possible their comparison, each ES was scaled individually for each land use category and zone, according to their minimum and maximum and compared as relative values. CR=Cropland, GR=Natural and semi-natural grassland, CO=Coastal system, NAT=Native forest, SC=Scrubland, PI=Pine and eucalyptus plantations.

Table S1. Land use categories identified in the study area with their EUNIS habitat type code and the most representative biomes (de Groot et al., 2012) used as proxies.

Land use category	EUNIS Habitat Type Code	The most representative biome	Description
Cropland	FB.4, G1.D(X), I1.2	Cropland	Croplands and orchards
Natural and semi-natural grassland	EI.26, E2.11, E2.13(Y), E2.21, E3.41, E5.6, H3.2, H5.6	Grasslands	Temperate grasslands, tropical grasslands, boreal grasslands and mountainous grasslands
Coastal system	A2.511, A2.627, A2.636, A2.63C, A2.651, A2.654, A2.658, B1.21, B1.31, B1.32, B1.42, B3.23, B3.31, F4.231, C2.4, C3.21	Coastal systems	Estuaries, sea-grass fields, shallow seas of continental shelves, rocky shores and beaches found in the terrestrial near-shore as well as the intertidal zones
Native forest	F9.12(Y), F9.2(X), F9.2(Y), G1.21(Z), G1.62, G1.7B1, G1.86, G1.A1, G1.A1(X), G1.C(X), G1.C(Y), G1.C1, G1.C2, G2.121, G4.(Z), G4.F, G5.61, G5.72, G5.73	Temperate forest	Temperate deciduous forest, temperate broadleaf and mixed forest, temperate coniferous forest, temperate rainforest
Scrubland	E5.31(X), E5.31(Y), F3.11(X), F3.11(Y), F3.15(X), F3.15(Y), F4.23(X), F5.21(Y), F7.44(Y), FA.1, FA.3, I2.3	Woodlands	Shrublands, scrublands, savannas and chaparral interleaved with one another in mosaic landscape patterns
Pine and eucalyptus plantations	G1.C3, G2.81, G3.F(L), G3.F(M), G3.F(P), G3.F(Q), G3.F(S), G3.F(T), G3.F(U), G3.F(Y), G5.74, G5.81, G5.82	/	Plantations of conifers (basically *Pinus radiata*) and eucalyptus species
Clear cuts	/	/	/
Urban areas	E2.6, I2.1, I2.2, J1, J2, J3.2, J4.1, J4.2, J4.3, J4.5, J4.6, J4.7, J6	/	/

Table S2. Ecosystem services classification used and its equivalence with other classification systems.

Ecosystem services	Costanza et al. (2014)	CICES class	CICES description
Provisioning services			
Food production	Food production	Cultivated terrestrial plants grown for nutritional purposes	Any crops and fruits grown by humans for food; food crops
		Wild plants used for nutrition	Food from wild plants
		Animals reared for nutritional purposes	Livestock raised in housing and/or grazed outdoors
		Wild animals used for nutritional purposes	Food from wild animals
Timber	Raw materials	Fibres and other materials from cultivated plants, fungi, algae and bacteria for direct use or processing	Material from plants, fungi, algae or bacterial that we can use
		Fibres and other materials from reared animals for direct use or processing (excluding genetic materials)	Material from animals that we can use
		Fibres and other materials from wild plants/animals for direct use or processing (excluding genetic materials)	Materials from wild plants/animals
Fresh water	Water supply	Surface water for drinking	Drinking water from sources at the ground surface
		Surface water used as a material (non-drinking purposes)	Surface water that we can use for things other than drinking
Regulating services			
Carbon storage	Gas regulation	Regulation of temperature and humidity, including ventilation and transpiration	Regulating the physical quality of air for people
		Dilution by atmosphere	Diluting wastes
	Climate regulation	Regulation of chemical composition of atmosphere and oceans	Regulating our global climate
Water regulation and purification	Water regulation	Hydrological cycle and water flow regulation	Regulating the flows of water in our environment
	Waste treatment	Filtration/sequestration/storage/accumulation by micro-organisms, algae, plants, and animals	Filtering wastes
		Bio-remediation by micro-organisms, algae, plants, and animals	Decomposing wastes
		Water conditions	Controlling the chemical quality of freshwater
Pollination and biological control	Pollination	Lifecycle maintenance, habitat and gene pool protection	Spreading the seeds of wild plants
	Biological control	Disease control	Controlling disease
		Pest control (including invasive species)	Controlling pests and invasive species
Habitat for species	Habitat/Refugia Genetic resources	Maintaining nursery populations and habitats (Including gene pool protection)	Providing habitats for wild plants and animals that can be useful to us

Table S2 (Continued)

Ecosystem services	Costanza et al. (2014)	CICES class	CICES description
Cultural services			
Tourism and recreation	Recreation	Characteristics of living systems that that enable activities promoting health, recuperation or enjoyment through active or immersive interactions	Using the environment for sport and recreation; using nature to help stay fit
		Characteristics of living systems that enable activities promoting health, recuperation or enjoyment through passive or observational interactions	Watching plants and animals where they live; using nature to distress
Aesthetic enjoyment	Cultural	Characteristics of living systems that are resonant in terms of culture or heritage	The things in nature that help people identify with the history or culture of where they live or come from
		Characteristics of living systems that enable aesthetic experiences	The beauty of nature
		Elements of living systems that have symbolic meaning	Using nature to as a national or local emblem

Table S3. Monetary value coefficients in 2009 €/ha/yr estimated for each land use category, valuation method and source of the data.

Ecosystem services	Land use category	Estimation method	Source	Ecosystem services coefficient (€/ha/yr)
Food production	Cropland	Market based	Costanza et al. (2014)	1724
	Natural and semi-natural grassland	Market based	Costanza et al. (2014)	884
	Coastal system	Market based	Costanza et al. (2014); Martín-López et al. (2011)	1237
	Native forest	-	-	0[1]
	Scrubland	-	-	0[1]
	Pine and eucalyptus plantations	-	-	0[1]
Timber	Cropland	-	-	0[1]
	Natural and semi-natural grassland	-	-	0[1]
	Coastal system	-	-	0[1]
	Native forest	Market based	Costanza et al. (2014)	44
	Scrubland	-	-	0[1]
	Pine and eucalyptus plantations	Market based	EUSTAT (2014)	197
Fresh water	Cropland	Replacement Cost	Esteban Moratilla (2010)	139
	Natural and semi-natural grassland	Replacement Cost	Esteban Moratilla (2010)	167
	Coastal system	-	-	0[2]
	Native forest	Replacement Cost	Esteban Moratilla (2010)	237
	Scrubland	Replacement Cost	Esteban Moratilla (2010)	196
	Pine and eucalyptus plantations	Replacement Cost	Esteban Moratilla (2010)	179
Carbon store	Cropland	Market based	EEX (2018)	943
	Natural and semi-natural grassland	Market based	EEX (2018)	629
	Coastal system	Market based	Santín et al. (2007), Sousa et al. (2017)	545
	Native forest	Market based	EEX (2018)	1816
	Scrubland	Market based	EEX (2018)	752
	Pine and eucalyptus plantations	Market based	EEX (2018)	1615
Water regulation and purification	Cropland	Replacement Cost	Esteban Moratilla (2010)	6
	Natural and semi-natural grassland	Replacement Cost	Esteban Moratilla (2010)	10
	Coastal system	Contingent Valuation	Martín-López et al. (2011)	105
	Native forest	Replacement Cost	Esteban Moratilla (2010)	8
	Scrubland	Replacement Cost	Esteban Moratilla (2010)	8

Table S3 (Continued)

Ecosystem services	Land use category	Estimation method	Source	Ecosystem services coefficient (€/ha/yr)
Pollination and biological control	Cropland	-	Costanza et al. (2014)	41
	Natural and semi-natural grassland	Factor Income / Production Function	Costanza et al. (2014)	49
	Coastal system	Contingent Valuation	García-Llorente et al. (2008, 2011)	533
	Native forest	Replacement Cost	Costanza et al. (2014)	348
	Scrubland	Factor Income / Production Function	de Groot et al. (2012)	23
	Pine and eucalyptus plantations	-	-	41[3]
Habitat for species	Cropland	Conservation Cost estimation	Esteban Moratilla (2010)	12
	Natural and semi-natural grassland	Conservation Cost estimation	Esteban Moratilla (2010)	19
	Coastal system	Contingent Valuation	Costanza et al. (2014)	193
	Native forest	Conservation Cost estimation	Esteban Moratilla (2010)	144
	Scrubland	Conservation Cost estimation	Esteban Moratilla (2010)	23
	Pine and eucalyptus plantations	Conservation Cost estimation	Esteban Moratilla (2010)	27
Tourism and recreation	Cropland	-	Costanza et al. (2014)	61
	Natural and semi-natural grassland	Market based	Costanza et al. (2014)	23
	Coastal system	Market based	Costanza et al. (2014)	522
	Native forest	Contingent Valuation, Travel Cost	Costanza et al. (2014)	730
	Scrubland	Market based	de Groot et al. (2012)	5
	Pine and eucalyptus plantations	-	-	268[4]
Aesthetic enjoyment	Cropland	Contingent Valuation	Nikodinoska et al. (2018)	279
	Natural and semi-natural grassland	Contingent valuation, Hedonic Pricing	Costanza et al. (2014)	124
	Coastal system	Contingent Valuation, Market based	Costanza et al. (2014)	32
	Native forest	Travel Cost	Costanza et al. (2014)	1
	Scrubland	-	-	na
	Pine and eucalyptus plantations	-	-	na

[1] Since the biophysical value was rated as zero, even if the supply of these services might be higher, we did not estimate their monetary value.
[2] We assumed that coastal systems are a kind of embayment where rivers meet and mix with ocean, so fresh water outflow cannot be important.
[3] Due to lack of data and considering that its biophysical value was equal to croplands, we assigned the same monetary value as in croplands.
[4] No data available. However, being this service usually estimated on the basis of people's perception, and assuming that when visiting a place people perceive all the landscape as a whole, we believed that mean value of the rest of land use categories could display its monetary value.

Table S4. Biophysical indicators used for the assessment of the capacity of the different land use categories to provide ecosystem services.

Ecosystem services	Indicator	Equation	Variables	Format (Resolution_m)	Data sources
Food production[a]	Food production (FP) from agriculture, livestock and fishing (t/ha)	FP=AG+LI-FI	AG = Agricultural production for each type of crops per surface (t/ha) (2011-2015)	Shape_1:10,000	Basque Government, 2017
			LI = Average total weight of slaughtered cattle (2011-2015) per surface of grazed lands (t/ha)	Shape_1:10,000	Request to the Basque Government
			FI = Weight of fish individuals sampled in the rivers (t/ha) (2011-2017)	-	UBEGI, 2018
Timber	Timber species' growth rate (TI) (m^3/ha)	TI=AIT/S	AIT = Annual increase of tree species (m^3)	Shape_1:10,000	Basque Government, 2011a
			S = Total surface (ha)		EUSTAT, 2017
Fresh water	Runoff water (FW) (mm/ha)	FW=R–EV	R = Total annual rainfall (mm/ha) (SIMPA model)	Raster (125 x 125)	MAPAMA, 2015
			EV = Total annual evapotranspiration (mm/ha) (SIMPA model)	Raster (125 x 125)	MAPAMA, 2015; Sharp et al., 2015
Carbon storage[b]	Total C storage (C) (tC/ha)	C=CS+CLB	CS = Stored C in soil (tC/ha)	Shape_1:25,000	Neiker-Ihobe, 2004
			CLB = Stored C in living biomass (tC/ha)	Shape_1:10,000	IPCC, 2013; Basque Government, 2011a; CPF, 2004; Madrigal et al., 1999; Montero et al., 2005
Water regulation and purification	Water retention index (WRI)	-	WRI = f(retention in vegetation, soil and groundwater retention, slope and soil sealing) (ESTIMAP model)	Raster (100 x 100)	Maes, 2010
Pollination and biological control	Pollination index (PO)	PO=f(N, F)	N = Habitat availability for nesting F = Food availability	Shape_1:10000	Larrinaga, 2004; Lonsdorf et al., 2009; Zulian et al., 2013
Habitat for species	Natural diversity index (HAB)	HAB=NPR+HQ+ +LP	NPR = Native plant richness	Shape_1:10,000	Onaindia et al., 2013
			HQ = Habitat quality (successional level)	Shape_1:10,000	
			LP = Legal protection	Raster (2 x 2)	
Tourism and recreation	Recreation index (TR)	TR=PR+CR	PR = Potential for recreation = f(naturalness index, legal protection, presence of water bodies and peaks) CR = Capacity for recreation = f(Accessibility, areas for recreation, tourist spots and birds observation points)	Shape_1:10,000	Peña et al., 2015
Aesthetic enjoyment	Landscape aesthetic index (AE)	AE=SP+T+LD+ +WB+LL-NE	SP = Perception of society T = Topography LD = Diversity of landscapes WB = Presence of water bodies LL = Influence of landscape landmark NE = negative elements	Shape_1:10,000	Peña et al., 2015

[a] Agricultural production was estimated using available data from Biscay and as for livestock, cattle, sheep, goats and horses were only included. To estimate fishing service we used available data for *Anguilla anguilla*, *Barbatula quignardi*, *Gobio lozanoi*, *Parachondrostoma miegii*, *Phoxinus bigerri* and *Salmo trutta fario* species. The supply of (shell)fishing was not possible to quantify since there was no weight data. Besides, professional (shell)fishing is not permitted in the estuary (Orden, de 20 de octubre de 2017) and recreational (shell)fishers do not have the obligation to declare their captures.

[b] There was no data available for coastal system in the UBR, so other data from other nearby places with similar characteristics (Santín et al., 2007; Sousa et al., 2017) were used to estimate carbon storage.

References

Basque Government, 2011a. Forest Inventory 2011. Department of Economic Development and Competitiveness.

Basque Government, 2011b. geoEuskadi. Available: www.geo.euskadi.eus/

Basque Government, 2017. Statistics. Department of Economic Development and Infrastructures. Available: www.euskadi.eus/gobierno-vasco/estadisticas-agricultura-pesca-politica-alimentaria/inicio/

Costanza, R., de Groot, R., Sutton, P., van der Ploeg, S., et al., 2014. Changes in the global value of ecosystem services. Global Environ. Change 26:152-158.

CPF. Centre de la Propietat Forestal., 2004. Annexe Indicadors dendrométrics En: Manual de redacción de plans tècnics de gestió i millota forestal (PTGMF) i plans simples de gestió forestal (PSGF). Instruccions de redacció i l'inventari forestal. Generalitat de Catalunya, Departament de Medi Ambient i Habitatge, Centre de la Propietat Forestal. Barcelona España. pp.211-314.

de Groot, R., Brander, L., van der Ploeg, S., Costanza, R., et al., 2012. Global estimates of the value of ecosystems and their services in monetary units. Ecosyst. Serv. 1(1), 50-61.

EEX. European Energy Exchange, 2018. EU Emission Allowances | Secondary Market. Available: www.eex.com/

Esteban Moratilla, F., 2010. Proyecto VANE. Valoración de los activos naturales de España. Ministerio de Medio Ambiente y Medio Rural y Marino, Gobierno de España [Spanish]

EUSTAT, 2014. Basque Statistical Institute. Basque Statistical Yearbook 2014.

EUSTAT, 2017. Basque Institute of Statistics. Available in: www.eustat.es

García-Llorente, M., Martín-López, B., González, J.A., Alcorlo, P., Montes, C., 2008. Social perceptions of the impacts and benefits of invasive alien species: implications for management. Biol. Conserv. 141, 2969-2983.

García-Llorente, M., Martín-López, B., Nunes, P.A.L.D., González, J.A., et al., 2011. Analyzing the social factors that influence willingness to pay for the management of invasive alien species under two different strategies: eradication and prevention. Environ. Manage. 48, 418-435.

IPCC, 2003. Good Practice Guidance for Land Use, Land-Use Change and Forestry. Ed J. Pennan et al. Institute for Global Environmental Strategies, Kanagawa.

Larrinaga, 2004. Tesis doctoral. Factores que afectan a la selección del fruto por parte de aves frugívoras del genero Turdus.

Lonsdorf, E., Kremen, C., Ricketts, T., Winfree, R., et al., 2009. Model-ling pollination services across agricultural landscapes. Ann. Bot. 103, 1589-1600.

Madrigal, A., Álvarez, J.G., Rodríguez, R., Rojo, A. (Eds.), 1999. Tablas de producción para los montes españoles.

Fundación Conde del Valle de Salazar, Madrid, Spain.

Maes, J., 2010. Water Retention Index. European Commission, Joint Research Centre (JRC) [Dataset]

MAPAMA, 2015. National Spacial Data Infraestructure. NDSI. Available: http://www.magrama.gob.es/es/cartografia-y-sig/ide/descargas/agua/simpa.aspx

Martín-López, B., García-Llorente, M., Palomo, I., Montes, C., 2011. The conservation against development paradigm in protected areas: Valuation of ecosystem services in the Doñana social–ecological system (southwestern Spain). Ecol. Econ. 70, 1481-1491.

Montero, G., Ruiz-Peinado, R., Muñoz, M., 2005. Monografías INIA: Serie Tierras forestales (13). Producción de biomasa y fijación de CO2 por los bosques españoles. Ed. Instituto Nacional de Investigación y Tecnología Agraria y Alimentaria (INIA) y Ministerio de Educación y Ciencia, Madrid, Spain.

Neiker-Ihobe, 2004. Estudio sobre la potencialidad de los suelos y la biomasa de zonas agrícolas, pascícolas y forestales de la CAPV como sumideros de carbono. Informe [Spanish]

Nikodinoska, N., Paletto, A., Pastorella, F., Granvik, M., Franzese, P.P., 2018. Assessing, valuing and mapping ecosystem services at city level: the case of Uppsala (Sweden). Ecol. Model. 368, 411-424

Onaindia, M., Fernández de Manuel, B., Madariaga, I., Rodríguez-Loinaz, G., 2013. Co-benefits and trade-offs between biodiversity, carbon storage and water flow regulation. Forest Ecol. Manag. 289, 1-9.

Orden, de 20 de octubre de 2017, de la Consejera de Desarrollo Económico e Infraestructuras, por la que se establece la clasificación de las zonas de producción de moluscos bivalvos del litoral de la Comunidad Autónoma del País Vasco. Boletín Oficial del País Vasco, 22 de noviembre de 2017, núm. 223 [Spanish]

Peña, L., Casado-Arzuaga, I., Onaindia, M., 2015. Mapping recreation supply and demand using an ecological and a social evaluation approach. Ecosyst. Serv. 13, 108-118.

Santín, C., Otero, X.L., Fernández, S., González-Pérez, M., Álvarez, M.A., 2007. Variations of organic carbon stock in reclaimed estuarine soils (Villaviciosa estuary, NW Spain). Sci. Total Environ. 378, 138-142.

Sharp, R., Tallis, H.T., Ricketts, T., Guerry, A.D., et al., 2018. InVEST 2.6.0 User's Guide. The Natural Capital Project, Stanford University, University of Minnesota, The Nature Conservancy, and World Wildlife Fund.

Sousa, A.I., Santos, D.B., da Silva, E.F., Sousa, L.P., et al., 2017. "Blue Carbon" and Nutrient Stocks of Salt Marshes at a Temperate Coastal Lagoon (Ria de Aveiro, Portugal). Sci. Rep. 7, 41225.

UBEGI, 2018. Information of the state of the water bodies of the Basque Country [Online]. Available in: www.uragentzia.euskadi.eus [Spanish]

Zulian, G., Maes, J., Paracchini, M., 2013. Linking land cover data and crop yields for mapping and assessment of pollination services in Europe. Land 2, 472-492.

Chapter 4.3

This chapter corresponds to the article (submitted for publication):

Castillo-Eguskitza, N., Hoyos, D., Onaindia, M., Czajkowski, M., Economic valuation of ecosystem services: An application to Biosphere Reserve management. *Land Use Policy*. (Second review).

Economic valuation of ecosystem services: An application to Biosphere Reserve management

Nekane Castillo-Eguskitza, David Hoyos, Miren Onaindia, Mikolaj Czajkowski

Abstract

Economic valuation of ecosystem services emerges as a valuable tool to promote conservation and sustainable land management. In this application, a discrete choice experiment is used to analyse preferences for provisioning, regulating and cultural ecosystem services and the willingness-to-pay for protection of these ecosystem services in the case of the Urdaibai Biosphere Reserve in the Basque Country, Spain. The ecosystem services considered included water quality control, agricultural production, native forest protection, biodiversity and recreation. A random parameters model allowing for correlation in willingness-to-pay (WTP) space was used to analyse preferences and estimate marginal WTP welfare measures for different scenarios. Results indicate that the local population is willing to financially support a new management plan focused on improvement of ecosystems health and landscape multifunctionality and sustainability. Recreation was the least valued ecosystem service, indicating that respondents gave more importance to functionality and regulating services. Our findings may be useful to inform conservation and management policies to maximize social well-being while minimizing land use conflicts.

Keywords:

Ecosystem services, discrete choice experiment, social preferences, economic valuation, Urdaibai Biosphere Reserve

1. Introduction

The ecological and social-economic impacts of environmental degradation we are dealing with have clearly changed our point of view about nature and human well-being (MA, 2005). At present, rather than the mere act of conserving biodiversity, the need to incorporate ecosystem services (ES) in land management is being claimed as necessary if sustainable development is to be achieved. The ES framework contributes to the understanding of the relationship between ecosystems and human well-being by integrating the ecological, economic and socio-cultural dimensions of ecosystems (Haines-Young & Potschin, 2010; Martín-López et al., 2014). Thus, valuing ES and incorporating these values in decision-making may be fundamental for ensuring sustainable conservation policies. Yet, their application in policy is limited and uncertain.

One of the main limitations is that while the costs of biodiversity losses are clear, benefits provided by ecosystems are usually hidden or unnoticed due to the lack of markets. In this sense, economic valuation of ES is increasingly being used as a tool to make visible the benefits of ES and underpin informed decisions and safeguard biodiversity (TEEB, 2010; Costanza et al., 2014; Hansjürgens et al., 2017). Actually, it may be a powerful tool to demonstrate the importance of nature and the need to invest in green infrastructure, including protected areas, and achieve desirable levels of ES supply according to the demands of society (Tagliafierro et al., 2013; Bernués et al., 2015).

Certainly, the status of ES is linked not only to their provision (supply-side) but also to the social systems, i.e. management, resulting from the needs and desires of human societies (demand-side). Thus, proper environmental management requires considering both the ecosystems and the local people. And so, the challenge for policy makers has also expanded to understanding human attitudes towards the environment (Casado-Arzuaga et al., 2013; Pascual et al., 2017). In fact, as Oldekop et al. (2015) suggested, conservation targets are more likely to be achieved when socioeconomic benefits are encouraged through sustainability rather than imposing strict protection.

In this regard, the discrete choice experiment (DCE) technique arises as an appropriate valuation tool due to its capability to quantify environmental changes of different attributes by evaluating social preferences (Hanley et al., 2001). The DCE methodology involves the generation and analysis of alternative choice data based on a hypothetical market, so that the values of the attributes being analysed can be inferred from trade-offs that people make among the different alternatives (Louviere et al., 2000; Hoyos, 2010). Since DCE was first developed in the early 90s by Louviere and Woodworth (1983), the literature on this topic has grown rapidly and it has gained much popularity in environmental valuation studies, including ES (Christie et al., 2015; Chaikaew et al., 2017), landscape and land use management (Hoyos et al., 2012a; de Ayala et al., 2015) or even the design of landowners' contracts to improve the provision of ES (Vedel et al., 2015; Górriz-Mifsud et al., 2016). Precisely, because of their significance to conserve biodiversity and consequently ES, DCE studies are frequent in protected areas (Börger et al., 2014; Mueller et al., 2017; Xuan et al., 2017; Valasiuk et al., 2018).

Here, we implemented a DCE valuation method for the valuation of different management schemes and their related ES in the Urdaibai Biosphere Reserve (UBR) (northern Spain), where land use changes and management policies have determined the supply and demand of ES. Abandonment of agriculture, forestry intensification and industry are threatening the delivery of ES in the territory (Rescia et al., 2010; Onaindia et al., 2013a; Rodríguez-Loinaz et al., 2013). Hence, more policy intervention is needed to ensure more equitable and sustainable land management that maximizes societal benefits and preferences. And considering that biosphere reserves promote the involvement of local communities in their management to reconcile nature conservation and sustainable development (UNESCO, 2016), DCE application may result useful to give recommendations to develop sustainable management policies in the UBR. Specifically, the goals of the study are 1) to evaluate local social preferences and trade-offs for different land use options and ES; and 2) to value these changes in monetary terms by estimating the marginal willingness-to-pay (WTP) for a change in a hypothetical choice scenario.

2. Methods

2.1. Study are

The UBR is located in the Basque province of Biscay, Spain (Fig. 1). It has an area of approximately 220 km2 and it is organised administratively into 22 municipalities, clearly distinguishing an urban area (Bermeo-Gernika), which hosts nearly 75% of the inhabitants and most of the industrial activity and services, and a rural area, with a very low population density. The UBR represents a complex social-ecological system, i.e., human-natural system shaped over time because of the existing interrelationships between ecosystems and human activities (Liu et al., 2007) where contrary interests coexisted. As a result, its management turns out to be fraught with conflict and controversy (Onaindia et al., 2013b).

In 1984, this area was declared a reserve to protect its coastal ecosystems, marshlands and the Cantabrian holm oak as the main naturalistic values. Later, in 1989, special legislation was established to protect the integrity and promote the recovery of the natural ecosystems, and in 1993, a Governance Plan for Use and Management was approved, now being reviewed. The estuary is the central area of the UBR and it encompasses the most extensive coastal area and best-preserved salt marshes in the region. Nonetheless, industrial activities (metallurgic, shipyard, dies or cutlery) throughout the last century, harbor activities and inefficient sewage disposal have compromised its original unpolluted state (Puy-Azurmendi et al., 2013; de los Ríos et al., 2016). According to the criteria established by the Water Framework Directive, the global state of the transitional waters is considered bad (AZTI-Tecnalia, 2016) and the biggest aquifer in the UBR is diagnosed to be in bad chemical state (Agencia Vasca del Agua, 2016). The not infrequent dredging of the estuary to facilitate the launching of boats from the shipyard has also modified its hydrodynamics affecting different activities such as surfing, fishing and bird watching (Monge-Ganuzas, 2013). Further, the almost total predominance of exotic plantations of *Pinus radiata* and *Eucalyptus* sp. at the expense of rural abandonment and replacement of native forests has led to multiple conflicts between conservation and economic development (Onaindia et al., 2013b). The unsustainable management of these plantations, including clear cutting, mono-specificity and heavy machinery, brings about erosion, worsening of water quality, decrease of freshwater supplies and loss of aesthetic values (Onaindia et al., 2013a; Rodríguez-Loinaz et al., 2013). Meanwhile, the decline of the traditional "caserio," based on a mixed production of horticulture, cattle and forestry, has also implied a reduction in local food production, together with a loss of cultural identity and traditional knowledge (Agnoletti, 2014).

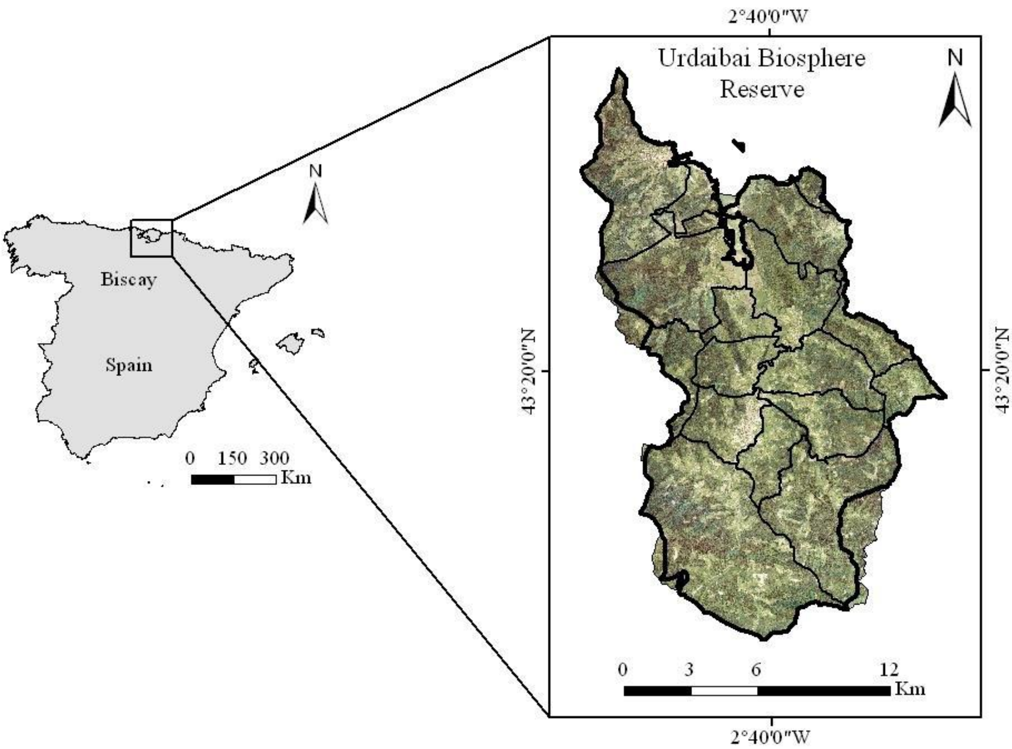


Fig. 1. Study area (only municipalities containing more than the third part of their area in the Urdaibai Biosphere Reserve, black boundary, were included).

2.2. Discrete choice experiment

The experimental design involves the selection and combination of the attributes and levels used to construct the alternatives included in the choice sets (Hoyos, 2010). The identification of the ES and land use attributes was facilitated by a biophysical literature review and an interest ranking of ES, which was previously conducted in the study area (Castillo-Eguskitza et al., 2018). According to this last, food from agriculture, climate and air regulation, water regulation and purification and habitat for species were the most important ES for respondents' own personal well-being, whereas timber and tourism and recreation were one of the least important (Castillo-Eguskitza et al., 2018). Thus, on the basis of these results, we selected the attributes, and considering sustainability as the main goal of the biosphere reserve, we consulted experts to assign the different levels. Lastly, we carried out a focus group with local volunteer people in the UBR to confirm the suitability of the survey design and pre-tested the design to ensure that the choice sets were relevant.

Table 1 shows the ES and land use attributes and their levels used in the DCE. In total, we selected six attributes: 1) organic farming, represented by the percentage of farming area with good agricultural practices in the UBR; 2) biodiversity protection, measured by the number of endangered species of flora and fauna within the Basque Catalogue of Threatened Species with management plans; 3) quality of water bodies, based on the global state of water bodies according to the European Union Water Framework Directive; 4) native forest, represented by the land area covered by broadleaf forest and increased through the substitution of pine and eucalyptus plantations for native forest; 5) recreation, on the basis of the state of maintenance of paths and recreational areas and 6) monetary attribute or cost, specified as an annual income tax for all Basque citizens over the next 10 years to be allocated to a foundation exclusively dedicated to protecting the UBR. Each ES and land use attribute was described using three different levels: current situation (status quo) and two different management scenarios (Programme 1 and Programme 2), whereas the monetary attribute was distributed in 6 levels ranging from 0 € to 100 € per capita.

All these attributes and their respective levels led to 1458 (35x61) possible combinations, so to simplify the choice sets, we applied a Bayesian D-efficient design. We obtained thirty choice sets randomly divided in five blocks, i.e., each respondent made six choices. A sample choice task is given in Figure 2.

Table 1. Attributes, attributes levels and ecosystem services (ES) related to the attributes.

Attributes	Levels						ES related
Organic farming	0.5%*	2%	5%				Provisioning: Food Regulating: Erosion control, nutrient regulation, pollination, biological control, habitat for species Cultural: Traditional knowledge, ecotourism, aesthetic enjoyment
Biodiversity protection	5*	15	25				Regulating: Habitat for species Cultural: Ecotourism
Quality of water bodies	No changes*	Better	Optimum				Provisioning: Freshwater Regulating: Water quality control, water regulation, habitat for species Cultural: Ecotourism, aesthetic enjoyment
Native forest	17%*	30%	40%				Provisioning: Food, freshwater, timber Regulating: Climate/air regulation, water regulation and purification, erosion control, nutrient regulation, habitat for species Cultural: Ecotourism, aesthetic enjoyment, local identity
Recreation	No changes*	Better	Optimum				Cultural: Ecotourism
Cost	0 €*	5 €	15 €	30 €	50 €	100 €	–

* Status quo scenario

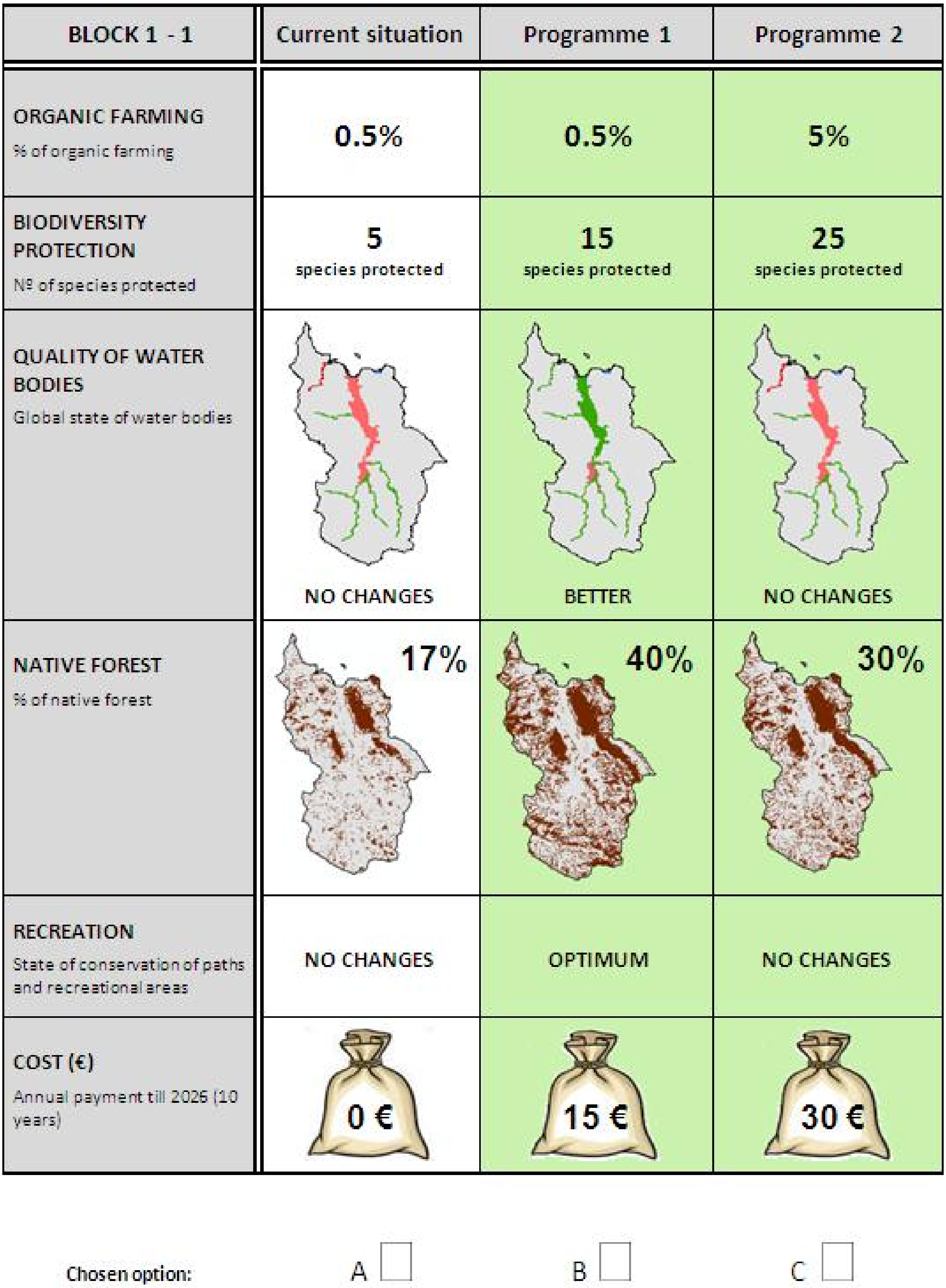


Fig. 2. Example of a set of choices.

2.3. Sampling strategy and survey design

We designed and implemented the survey following the recommendations of the current state of practice in stated preference methods (Johnston et al., 2017). The survey collected data from the local population living in the UBR, accounting for around 30,000 people aged 18 and over. We randomly interviewed a representative sample of the population across the different municipalities according to the official statistical information of age, gender and town size (EUSTAT, 2017). Sample points covered all the variety of environments like beaches, recreation areas, paths, croplands or urban zones. We restricted all questionnaires to citizens older than 18 years old and included different stakeholders, i.e., potential users/beneficiaries, providers and people affected. We offered the option to answer the survey in the local Basque language or in Spanish, both official languages.

We conducted a total of 266 direct face-to-face questionnaires from August to October 2016. The questionnaire was divided into 4 sections (see Questionnaire A). The first section contained a brief explanation of the purpose of the study and a description of the UBR, including ES and land use attributes. The second section dealt with the different levels of ES and proposed land uses to be considered and explained the need to contribute economically. The DCE was presented in the third section. In case respondents chose no change (status quo) in the first choice, they were asked to provide their principal reason in order to identify protest responses. Protest responses differ from real zero ones because even if the respondents value the programme in question, they are not willing to pay. Reasons for protest responses usually include feeling that we pay enough taxes, lack of confidence in the programme, disagreement with the vehicle of payment, etc. (Jorgensen et al., 1999; Meyerhoff & Liebe, 2010). Finally, the fourth section collected some socioeconomic data and other relevant information about respondents' relationship with the area and environmental issues. Besides, we included some warm-up and follow-up questions along with the questionnaire as well as other questions relevant to the DCE exercise. Visual information like maps and pictures were also used with the aim of making the survey more pleasant and familiar to the respondents.

2.4. Econometric framework

Choice preferences were based on the Random Utility Theory (McFadden, 1974), which assumes that individual n chooses the alternative j in choice situation t with regard to the highest utility:

$$U_{njt} = -\alpha_n c_{njt} + \beta'_n X_{njt} + e_{njt} \quad (1)$$

where c_{njt} and X_{njt} are the cost and other non-monetary observable attributes, respectively; α and β are individual-specific coefficients associated with them (negative sign indicates a decreasing utility in cost); and e_{njt} is a stochastic component identically and independently distributed with a constant variance $k_n^2(\pi^2/6)$, with k_n^2 being an individual-specific scale parameter.

The usual procedure is to estimate the distribution of the utility coefficients and then derive the distribution of the WTP (preference space). Here, we directly estimated the distribution of the WTP by re-parameterizing the model so that the parameters are the marginal WTP for each attribute (WTP space). Given that the WTP for an attribute is the ratio of the attribute's coefficient to the cost coefficient, $w_n = b_n/-\alpha_n$, the WTP space model was specified as (Train and Weeks, 2005):

$$U_{njt} = -\alpha_n(c_{njt} + (\beta'_n/-\alpha_n)X_{njt}) + \varepsilon_{njt} = -\alpha_n c_{njt} + w'_n X_{njt} + \varepsilon_{njt} \quad (2)$$

Thus, although behaviourally equivalent to the model in preference space, the advantage of the WTP space model specification is twofold: firstly, it allows a money-metric utility function so that the vector of parameters associated with non-price attributes, w_n, can be directly interpreted as expressions of marginal WTP, rather than deriving welfare estimates indirectly as in the traditional preference space, and secondly, it allows for a more convenient specification of WTP distributions, avoiding the problem of skewing in the distribution and being more stable.

We used multinomial logit (MNL) and multinomial mixed logit (MXL) models with uncorrelated and correlated random parameters to estimate the WTP for the different management alternatives. We applied the MNL model, where all respondents are assumed to have exactly the same preference parameters, to understand the factors affecting respondents' choices. Then, MXL models with uncorrelated and correlated random parameters were used. The MXL model generalizes the MNL model by allowing for preference heterogeneity via the use of random parameters and correlation among choices (Banzhaf et al., 2001). According to the common practice in the literature, environmental attributes with unclear direction of preferences were normally distributed, whereas the cost coefficient, for which we expect every respondent to prefer a lower level, was given a lognormal distribution. Since lognormal distribution implies positive coefficients, we reversed the sign of the cost attribute levels.

The probability that an individual n chooses alternative j in a set of C alternatives was represented by:

$$P(j|C)=\frac{\exp(-\alpha_n c_{njt} + w'_n X_{njt})}{\sum_{k=1}^{C} \exp(-\alpha_n c_{nkt} + w'_n X_{nkt})} \quad (3)$$

Because equation (3) has no closed form solution when applying a random parameter specification, we made a simulation by averaging over D draws from the distributions assumed for the random parameters (Revelt and Train, 1998). So, parameter estimates were obtained by maximising the simulated log-likelihood function, as follows:

$$\log L = \sum_{n=1}^{N} \log \frac{1}{D} \sum_{d=1}^{D} \prod_{t=1}^{T} \sum_{j=1}^{C} y_{njt} \frac{\exp(-\lambda_n c_{njt} + (\lambda_n w_n)' X_{njt})}{\sum_{j=1}^{C} \exp(-\lambda_n c_{njt} + (\lambda_n w_n)' X_{njt})} . \quad (4)$$ [1,2]

[1] We estimated the models presented here using a DCE package developed in Matlab and available at https://github.com/czaj/DCE. The code and data for estimating the specific models presented in this study, as well as supplementary results, are available from http://czaj.org/research/supplementary-materials.

[2] In simulation of the log-likelihood function we used 10,000 Sobol draws with a random linear scramble (Czajkowski and Budziński, 2017).

3. Results

3.1. Basic statistic

The proportion of protest responses in the sample was around 30%, which is considered within normal values (Johnston et al., 2017). In accordance with the common procedure for treating protest responses (de Ayala et al., 2015; Torres et al., 2017) and in order to obtain reliable and unbiased welfare estimates, we excluded them from the sample, reducing the dataset to 189 respondents (1,134 observations).

Table 2 shows respondents' socioeconomic information, some environmental issues and other variables of interest. The sample gender differentiation (47% female), mean age (42.95 years), number of families with dependent children (45% ≥1 child), employment situation (67% employed and 14% unemployed), personal income (1,259.45 € per month) were in line with those of the overall population of the UBR region in 2016 (EUSTAT, 2017). Besides, 56% of the respondents had high education level and almost 10% had a monthly disposable income higher than 2,500 €.

Table 2. Characterisation of the respondents and summary statistics (n=189). SD = Standard deviation.

Variables	Description	Mean	SD	Population values*
Socioeconomic information				
FEMALE	Female	0.47	0.50	50.75%
AGE	Age range (midpoint is used): 1: 18-30; 2:31-45; 3: 46-60; 4: 61-75; 5: >76	42.95	15.38	45.83
CHILD	≥1 child at home (only emancipated, n=151)	0.45	0.50	37.68%
HSTUD	High education level	0.56	0.50	36.08%
EMP	Employed	0.67	0.47	58.43%
UNEMP	Unemployed	0.14	0.35	10.47%
PINCOME	Monthly income range (midpoint is used): 1: 0 €; 2: <450 €; 3: 451-900 €; 4: 901-1.500 €; 5: 1.501-2,000 €; 6: 2,000-2,500 €; 7: >2,500 €	1,259.45	800.10	1,560.58 €
HINCOME	Monthly income >2,500 €	0.08	0.28	25.87%
Environmental issues				
BIOSPH	Knowledge of the UBR	0.91	0.29	
HLABEL	High consumption of agricultural products with quality label	0.37	0.48	
NGO	Economic collaboration with an environmental NGO	0.06	0.23	
Other variables of interest				
RURAL	Living in a rural area	0.31	0.46	
FARM	Vegetable garden owner (only emancipated, n=151)	0.23	0.42	
FOREST	Forest landowner (only emancipated, n=151)	0.13	0.34	
HREC	Frequent use of paths and recreational areas in the UBR	0.64	0.51	
BATH	Good quality of bathing areas	0.58	0.49	
IDENTB	Basque cultural identity above the average level	0.44	0.50	

* It includes the region of Busturialdea, i.e., Ea, Mendata, Morga and Errigoiti municipalities were added to the municipalities of the study area.

If we look into the data, we observe that 31% of the respondents lived in a rural area, and 23% and 13% of those emancipated had vegetable gardens and forest lands, respectively. Moreover, nearly everybody had some knowledge of the UBR and the consumption of agricultural products with a quality label was highly demanded (37%), even though the economic collaboration with environmental Non-Governmental Organizations (NGO) was quite low (6%). Other variables of interest considered included the high frequency of use of paths and recreational areas in the UBR (64%), the appreciation of good quality bathing areas (only 58% agreed), and the respondents' Basque cultural identity (with almost the half of the respondents considering themselves above the average level).

3.2. Model specification

The estimates of the models in WTP space are presented in Table 3. The means of the coefficients had the expected signs and the estimates were fairly consistent across models in terms of significance. The MXL specifications significantly improved the MNL specification (used as a benchmark), suggesting that the data showed a strong influence of heterogeneous preferences. Furthermore, the large amount of significant standard deviations also supported the fact of high heterogeneity in the population with respect to the attributes.

The MXL model with correlated coefficients was the best fitting model. Although this model includes 90 parameters, the likelihood ratio test favours this one allowing for correlation among parameters. Results suggest that respondents prefer moving away from the status quo and implementing protection actions in the UBR. However, consistent with economic theory, the higher the cost, the lower the probability of choosing any alternative.

Positive coefficients indicated that higher levels of an attribute increased the probability of being chosen. Hence, the most highly ranked attribute was quality of water bodies, followed by native forest, organic farming and biodiversity protection, which showed similar preferences. On the contrary, recreation was the least valued attribute.

3.3. Marginal WTP and welfare measures

Table 4 shows simulated mean marginal WTP and the corresponding 95% confidence intervals. The confidence intervals were simulated following a two-step Krinsky and Robb procedure, drawing coefficients from the vector of estimates and the asymptotic variance-covariance matrix and next drawing correlated random parameters from their respective distributions described by these coefficients. Each step uses 10,000 iterations. In this way, we were able to reliably simulate means (and other moments, e.g., quartiles) of WTP as well as their standard errors and confidence intervals.

Mean marginal annual WTP for increasing the quality of water bodies to "better" and "optimum" was estimated at 33.46 € and 40.26 € per person, respectively. Similarly, the WTP for increasing the native forest surface from the current 17% to 30% and 40% varied from 12.40 € to 21.10 €, respectively, from 8.72 € to 10.61 € for increasing organic farming from 0.5% to 2% and 5%, respectively, and from 7.24 € to 19.10 € for increasing the number of protected species from 5 to 15 and 25 species, respectively. Finally, the WTP for improving the quality of paths and recreational areas to a better and optimal state was estimated at 3.08 € and 5.37 €, respectively.

Table 3. Estimated multinomial logit (MNL) and multinomial mixed logit (MXL) models with uncorrelated and correlated random parameters.

Variables	MNL			MXL						MXL (correlated parameters)					
	Mean		SE	Mean		SE	SD		SE	Mean		SE	SD		SE
ASC	0.027		0.070	-0.863	***	0.105	1.872	***	0.178	-0.728	***	0.004	1.741	***	0.008
Organic farming 2%	0.118	**	0.048	0.143	***	0.028	0.045		0.035	0.087	***	0.002	0.295	***	0.004
Organic farming 5%	0.154	***	0.047	0.154	***	0.028	0.113	***	0.041	0.106	***	0.003	0.093	***	0.002
Biodiversity protection 15	0.146	***	0.047	0.104	***	0.025	0.027		0.026	0.072	***	0.003	0.233	***	0.004
Biodiversity protection 25	0.154	***	0.047	0.172	***	0.032	0.266	***	0.033	0.191	***	0.002	0.355	***	0.004
Quality of water bodies better	0.411	***	0.050	0.396	***	0.030	0.166	***	0.033	0.335	***	0.004	0.354	***	0.005
Quality of water bodies optimum	0.497	***	0.051	0.508	***	0.031	0.426	***	0.042	0.403	***	0.004	0.618	***	0.005
Native forest 30%	0.188	***	0.049	0.116	***	0.030	0.030		0.028	0.124	***	0.004	0.276	***	0.003
Native forest 40%	0.195	***	0.047	0.166	***	0.026	0.038		0.037	0.211	***	0.004	0.220	***	0.002
Recreation better	0.085	*	0.047	0.004		0.025	0.048	**	0.023	0.031	***	0.004	0.200	***	0.003
Recreation optimum	0.040		0.048	0.006		0.028	0.007		0.032	0.054	***	0.005	0.174	***	0.004
-Cost/100	2.192	***	0.163	2.280	***	0.345	1.275	***	0.334	6.321	***	1.473	3.934	**	0.798
Log likelihood at convergence			-1064.46						-706.61						-639.53
Log likelihood at constants only			-1205.66						-1205.66						-1205.66
McFadden's pseudo-R^2			0.12						0.41						0.47
Ben-Akiva-Lerman's pseudo-R^2			0.42						0.56						0.59
AIC/n			1.90						1.29						1.29
BIC/n			1.95						1.40						1.69
Observations			1134						1134						1134
Respondents			189						189						189
Parameters			12						24						90

SD = Standard deviation, SE = Standard error. AIC = Akaike Information Criterion, BIC = Bayesian Information Criterion.
Significance at the * = 10%, ** = 5% and *** = 1% levels.

Table 4. Simulated mean marginal willingness to pay (WTP) (€2016 per person and year) and confidence interval (C.I.) at 95%.

	WTP	
Variables	Mean	95% C.I.
Organic farming 2%	8.72	(7.99 - 9.47)
Organic farming 5%	10.61	(10.06 - 11.16)
Biodiversity protection 15	7.24	(6.49 - 7.96)
Biodiversity protection 25	19.10	(18.27 - 19.91)
Quality of water bodies better	33.46	(32.42 - 34.49)
Quality of water bodies optimum	40.26	(38.84 - 41.69)
Native forest 30%	12.40	(11.54 - 13.28)
Native forest 40%	21.10	(20.20 - 21.99)
Recreation better	3.08	(2.12 - 4.02)
Recreation optimum	5.37	(4.27 - 6.46)

4. Discussion and conclusions

The DCE may provide us with useful information for designing alternative management plans by considering social preferences and minimizing land use conflicts. Understanding the values and inclination of society toward the environment is essential for the improvement and support of policy decision-making. Furthermore, comprehending that environmental benefits have an economic value could be fundamental for ensuring sustainable management policies and maximizing social well-being. In fact, as for conservation, it is usually perceived as expenditure instead of an investment mostly because the ES do not have any direct market value. Thus, demonstrating its economic value may also turn out to be crucial for justifying spending on management policies that try to enhance conservation.

With this in mind, our findings suggest that the local population stands by a new landscape and management scenario in the UBR focused on improvement of ecosystems health and landscape multifunctionality and sustainability. Results show consistent preferences for certain management alternatives, which are directly linked to multiple ES, so that insights of the complex trade-offs associated with land uses can be provided (Foley et al., 2005; Berry et al., 2016).

4.1. Ecosystems health vs. recreation

The most valued attribute was the quality of water bodies. This means that residents are concerned about the water quality in the basin and the ecosystems health. Actually, the bad global state of the Oka river estuary and the aquifer of Gernika are a remote problem in time (Gobierno Vasco, 2004), affecting some bathing waters as well. Measures taken to improve the management of waste water in the UBR have not been enough. Currently, the Basque Government is implementing a sanitation plan for the region, but the treatment of the contaminated aquifer, resulting from industrial activities over the last few decades, is still in the very early stages, mostly due to institutional abandonment of the area and complex institutional architecture. This deficient quality of water bodies directly affects drinking waters, which together with the bad situation of the aquifer worsens the difficulties in guaranteeing the supply of water in the summer when rainfall declines significantly and the population in the area almost triples. But the quality of water bodies not only has a negative impact in water supply. It is also an indicator of ecosystems health and is directly related to other ES such as habitat for species and ecotourism and aesthetic values, which are principal attractions and objectives of the UBR.

On the contrary, even if we could think that tourism and recreation would be highly demanded, nothing further from the truth, the attribute of recreation has been the least valued, suggesting that either respondents are satisfied with the state of conservation of paths and recreational areas and/or they do not consider this attribute so important for their well-being. Specifically, a previous study in the UBR suggested that tourism and recreation is one of the least important ES for personal well-being, both for local population and visitors (Castillo-Eguskitza et al., 2018). Hence, on the one hand it seems that visitors might be interested in enjoying the supply of other ES, but tourism and recreation by itself; and on the other hand, it seems that local population link the improvement of the state of paths and recreational areas with a specific type of tourism, rejecting actions that might encourage large influx of tourists and asking for quality and sustainable tourism. It is widely acknowledged that sustainable tourism favours a small-scale, decentralized, environmentally and culturally friendly and locally-based approach where all stakeholders are involved (Brandful Cobbinah, 2015; Dangi & Jamal, 2016). Yet, a participatory process for sustainable management carried out in the UBR demonstrated that sustainable rural development is still far from being achieved in the territory (Onaindia et al., 2013b).

4.2 Landscape multifunctionality and Sustainable development

Our results show that the local population prefers variety of land uses and high levels of biodiversity, which commonly are associated with multifunctional landscapes (Pasari et al., 2013). Multifunctionality involves meeting multiple ecological, economic and socio-cultural services for multiple social actors within a territory. Changes in land uses can affect multifunctionality by increasing trade-offs or opposite situations among ES (Stürck & Verburg, 2017), so modifying land uses to counteract these trade-offs may facilitate multifunctional landscapes and enhance sustainability in human-dominated areas (Waldhardt et al., 2010).

The amount of native forest was highly valued by the local population. Despite the designation of the UBR, pine and eucalyptus plantations are the predominant land use and native forests occupy a very fragmented area, even though it is true that the protection and conservation of broadleaf native forests has been increased since the approval of the Governance Plan for Use and Management of the UBR (Castillo-Eguskitza et al., 2017). Environmental problems caused by the unsustainable management of pine and eucalyptus plantations have led to increased conflicts of interest between conservation and economic development (Onaindia et al., 2013b). According to Palacios-Agundez et al. (2013), woodlands management is recognized as one of the most important direct drivers for successful intervention in ES in Biscay and it has a significant influence on the landscape. On top of that, broadleaf forests also represent in some way the Basque cultural identity (Wing, 2015). It is especially relevant in the UBR, where we can find "*Gernikako Arbola*", a holm oak, symbol of Basque identity and traditional liberties. Likewise, native forests contribute the most to biodiversity and are very important for carbon storage and water regulation (Onaindia et al., 2013a).

Similarly, but to a lesser extent, the local population also supports an increase in the surface area of organic farming, suggesting that respondents prefer a landscape with higher levels of agriculture production, but also a more sustainable and diversified economic development. These results are in line with other studies in Biscay which show that users demand the local production of food (Casado-Arzuaga et al., 2013). Certainly, Biscay is highly dependent on imported food (Palacios-Agundez et al., 2015). Sustainable agriculture could be an appropriate response to enhance landscape multifunctionality and ES provision, at the same time that sustainability is increased, by decreasing the energy demand and/or water consumption of imported foods (Palacios-Agundez et al., 2015). Besides, organic farming is associated with regulating services such as erosion control, nutrient regulation, pollination, biological control and habitat for species (FAO/WHO, 1999; Lori et al., 2017) and cultural services like traditional knowledge, ecotourism and aesthetic enjoyment (Choo & Jamal, 2009; Agnoletti, 2014). Still, this willingness to increase organic farming in the area may also be related to the awareness of the quality of water bodies (Küstermann et al., 2010; Vincent & Fleury, 2015).

As far as biodiversity protection is concerned, the local population is also in favour of increasing the number of protected species. Protection of endangered animals and plants implies the conservation and protection of their habitats, and as previous studies in the UBR have suggested, biodiversity and ES are positively correlated (Onaindia et al., 2013a), which in turn, results in economic benefits (European Union, 2013; Costanza et al., 2014). Hence, the economic and cultural growth of the protected area could also be associated with the biodiversity conservation and landscape beauty, mainstays for (eco)tourism and recreation, which are indeed the main economic motor and attraction in the region (Castillo-Eguskitza et al., 2017).

4.3. Challenges and avenues for management

Overall, the WTP estimates obtained are relatively high when compared to other DCE studies, but the coefficient estimations are consistent. Ahtiainen et al. (2015) found that water resource policies focused on improving the quality of water bodies lead to higher welfare gains, just like Brouwer et al. (2016) and Pinto et al. (2016) who stated that public WTP for improving water quality levels of rivers is positive. Likewise, Hoyos et al. (2012a) concluded that people's WTP for increasing native forest and biodiversity conservation in the Basque Country is positive, but it is negative for increasing non-native tree plantations. Close to the

UBR, in Araba, de Ayala et al. (2015) estimated the total welfare benefits under a scenario that promotes native forests and organic farming at 5.05 million € per year. Following with organic farming, Schaufele & Hamm (2017) made a review of wine consumers' preferences and reported a WTP an extra amount for wine sustainably produced. With respect to biodiversity protection, people generally support a higher level of species protection (Hoyos et al., 2012b; Wallmo & Lew, 2016), and in similarity with native forests, native animal species are more appreciated than exotics (Yao et al., 2014). Finally, regarding recreation, several studies found a positive WTP for ecotourism (Adamu et al., 2015; Meleddu & Pulina, 2016) and new design improvements (Carson et al., 2015; Bertram et al., 2017).

As in many European countries, a large percentage of the territory in the UBR (92%) is privately owned. Consequently, conflicts between public and private interests have made its management difficult (Onaindia et al., 2013b). However, this study concludes that, despite significant preference heterogeneity for the different choices, in general the local population would be willing to pay for multifunctional and diverse landscapes with higher levels of ecological, economic and socio-cultural attributes in future alternative management plans.

Demonstrating the social benefits of the UBR may raise awareness, change local stakeholders' attitudes toward sustainability and foster funding. As demanded by the local population, the quality of transitional waters and the aquifer of Gernika need to be the first target. Besides, and taking advantage of the deflation in pine values (EUSTAT, 2017), we suggest funding allocation aimed at conifer plantations to native forest, such that pine and eucalyptus plantations can be replaced with native broadleaf deciduous species in areas with slopes higher than 60% or with erosion risk, areas with riparian forest and areas surrounding oak forest, as was suggested by Rodríguez-Loinaz et al. (2013). Rural activity, the cultural heritage of the territory, should also be encouraged and those farmers who implement good environmental practices and organic farming financially supported. Biodiversity protection must be a priority too. There are approximately 70 species of flora and fauna included in the Basque Catalogue of Threatened Species out of which only 5 are protected through management plans in the UBR (Sistema de Información de la Naturaleza de Euskadi, 2016).

Different monetary incentives, such as payment for ES, agro-environmental schemes and other subsidies, and land stewardship are becoming increasingly popular as a way of managing ecosystems and safeguarding or enhancing ES (van Noordwijk et al., 2012; Pascual et al., 2014; Ferguson et al., 2016). Compensatory measures are likely to reduce potential conflicts with local stakeholders and result in a type of win-win solution. In this sense, economic valuation can be applied as a complementary tool to traditional conservation strategies to promote sustainable land management. But above all, the DCE methodology may serve to help decision-makers understand social preferences and prioritize investments and allocation of funding, rather than obtain an accurate economic value for a specific policy design. Actually, since people's preferences are also motivated by non-economic reasons like ethic or their relationship with nature (Chan et al., 2016), DCE could be understood not only as a market value, but also a socio-cultural valuation indicator (Chan et al., 2012).

We acknowledge that the economic valuation of ES, on its own, is not able to reflect the whole complexity of value of ES but only a small part. The different metrics used to assess the commonly ecological, economic and socio-cultural value dimensions provide different information outputs (Martín-López et al., 2014; Langemeyer et al., 2015; Castillo-Eguskitza et al., 2018). Hence, a key challenge in the ES assessment is to somehow integrate ecological, economic and socio-cultural values of a service, including deliberative content, different beneficiaries and temporal and spatial scales (Jacobs et al., 2016; Small et al., 2017). Arguably, conservation strategies cannot be justified by taking into account exclusively local residents, so future research efforts include exploring differences in perceptions between stakeholders and non-local people from the Basque Country.

References

Adamu, A., Yacob, M.R., Radam, A., Hashim, R., Adam, S.U., 2015. Economic Valuation of Ecotourism Resources in Yankari Game Reserve, Bauchi Nigeria. Procedia Environmental Sciences 30, 139-144.

Agnoletti, M., 2014. Rural landscape, nature conservation and culture: Some notes on research trends and management approaches from a (southern) European perspective. Landsc. Urban Plan. 126, 66-73.

Agencia Vasca del Agua, 2016. Red de seguimiento del estado de las aguas subterráneas. Informe 2015. [Spanish]

Ahtiainen, H., Pouta, E., Artell, J., 2015. Modelling asymmetric preferences for water quality in choice experiments with individual-specific status quo alternatives. Water Resources and Economics 12, 1-13.

AZTI-Tecnalia., 2016. Red de seguimiento del estado ecológico de las aguas de transición y costeras de la Comunidad Autónoma del País Vasco. Informe de resultados. Campaña 2015. [Spanish]

Banzhaf, M.R., Johnson, F.R., Mathews, K.E., 2001. Opt-out alternatives and anglers stated preferences. In: Bennett, J., Blamey, R. (Eds.), The Choice Modelling Approach to Environmental Valuation. Edward Elgar, Cheltenham, UK, pp. 157-177.

Bernués, A., Rodríguez-Ortega, T., Alfnes, F., Clemetsen, M., Eik, L.O., 2015. Quantifying the multifunctionality of fjord and mountain agriculture by means of sociocultural and economic valuation of ecosystem services. Land Use Policy 48, 170-178.

Bertram, C., Meyerhoff, J., Rehdanz, K., Wüstemann, H., 2017. Differences in the recreational value of urban parks between weekdays and weekends: A discrete choice analysis. Landsc. Urban Plan. 159, 5-14.

Berry, P., Turkelboom, F., Verheyden, W., Martín-López, B., 2016. Ecosystem Services Bundles. In: Potschin, M. and K. Jax (eds): OpenNESS Ecosystem Service Reference Book.

Börger, T., Hattam, C., Burdon, D., Atkins, J.P., Austen, M.C., 2014. Valuing conservation benefits of an offshore marine protected area. Ecol. Econ. 108, 229-241.

Brandful Cobbinah, P., 2015. Contextualising the meaning of ecotourism. Tour. Manag. Perspect. 16, 179-189.

Brouwer, R., Bliem, M., Getzner, M., Kerekes, S., Milton, S., Palarie, T., et al., 2016. Valuation and transferability of the non-market benefits of river restoration in the Danube river basin using a choice experiment. Ecol. Eng. 87, 20-29.

Carson, R.T., DeShazo, J.R., Schwabe, K.A., Vincent, J.R., Ahmad, I., 2015. Incorporating local visitor valuation information into the design of new recreation sites in tropical forests. Ecol. Econ. 120, 338-349.

Casado-Arzuaga, I., Madariaga, I., Onaindia, M., 2013. Perception, demand and user contribution to ecosystem services in the Bilbao Metropolitan Greenbelt. J. Environ. Manage. 129, 33-43.

Castillo-Eguskitza, N., Rescia, A. J., Onaindia, M., 2017., Urdaibai Biosphere Reserve (Biscay, Spain): Conservation against development? Sci. Total Environ. 592, 124-133.

Castillo-Eguskitza, N., Onaindia, M., Martín-López, B., 2018. A comprehensive assessment of ecosystem services: Integrating supply, demand and interest in the Urdaibai Biosphere Reserve. Ecol. Indic. 93, 1176-1189.

Cerda, C., Ponce, A., Zappi, M., 2013. Using choice experiments to understand public demand for the conservation of nature: A case study in a protected area of Chile. J. Nat. Conserv. 21(3), 143-153.

Chaikaew, P., Hodges, A.W., Grunwald, S. 2017. Estimating the value of ecosystem services in a mixed-use watershed: A choice experiment approach. Ecosyst. Serv. 23, 228-237.

Chan, K.M.A., Satterfield, T., Goldstein, J., 2012. Rethinking ecosystem services tobetter address and navigate cultural values. Ecol. Econ. 74, 8-18.

Chan, K.M.A., Balvanera, P., Benessaiah, K., Chapman, M., Diaz, S., Gomez-Baggethun, E., et al., 2016. Why protect nature? Rethinking values and the environment. PNAS 113, 1462-1465.

Choo, H., Jamal, T., 2009. Tourism on organic farms in South Korea: A new form of ecotourism? J. Sustain. Tour. 17, 431-454.

Christie, M., Remoundou, K., Siwicka, E., Wainwright, W., 2015. Valuing marine and coastal ecosystem service benefits: Case study of St Vincent and the Grenadines' proposed marine protected areas. Ecosyst. Serv. 11, 115-127.

Costanza, R., De Groot, R.S., Sutton, P., Van der Ploeg, S., Anderson, S.J., Kubiszewski, I., et al., 2014. Changes in the global value of ecosystem services. Glob. Environ. Chang. 26, 152-158.

Czajkowski, M., Budziński, W., 2017. Simulation error in maximum likelihood estimation of discrete choice models, No 2017-18, Working Papers, Faculty of Economic Sciences, University of Warsaw.

Dangi, T.B., Jamal, T., 2016. An Integrated Approach to "Sustainable Community-Based Tourism". Sustainability 8, 475.

de Ayala, A., Hoyos, D., Mariel, P., 2015. Suitability of discrete choice experiments for landscape management under the European Landscape Convention. J. For. Econ. 21, 79-96.

de los Ríos, A., Pérez, L., Echavarri-Erasun, B., Serrano, T., Barbero, M.C., Ortiz-Zarragoitia, M., et al., 2016. Measuring biological responses at different levels of organisation to assess the effects of diffuse contamination derived from harbour and industrial activities in estuarine areas. Marine Pollution Bulletin 103(1-2), 301-312.

European Union., 2013. The economic benefits of the Natura 2000 network. Synthesis Report.

EUSTAT. 2017. Basque Institute of Statistics. [Online]. Available in: www.eustat.es

FAO/WHO, 1999. Codex Alimentarius guidelines on Production, Processing, Labelling and Marketing of Organically-Produced Foods (GL 32 - 1999, Rev. 1 - 2001).

Ferguson, I., Levetan, L., Crossman, N.D., Bennett, L.T., 2016. Financial Mechanisms to Improve the Supply of Ecosystem Services from Privately-Owned Australian Native Forests. Forests 7, 34.

Foley, J.A., Defries, R., Asner, G.P., Barford, C., Bonan, G., Carpenter, S.R., et al., 2005. Global consequences of land use. Science 309, 570-574.

Gobierno Vasco, 2004. Departamento de Medio Ambiente y Ordenación del Territorio. Dirección de Aguas. Red de vigilancia de la calidad de las masas de agua superficial de la Comunidad Autónoma del País Vasco. Informe de resultados campaña 2003. 22 tomos. [Spanish]

Górriz-Mifsud, E., Varela, E., Piqué, M., Prokofieva, I., 2016. Demand and supply of ecosystem services in a Mediterranean forest: Computing payment boundaries. Ecosyst. Serv. 17, 53-63.

Haines-Young, R., Potschin, M., 2010. The links between biodiversity, ecosystem services and human well-being. Ch. 6. In: Raffaelli, D. & Frid, C. (Eds.), Ecosystem Ecology: A New Synthesis. BES Ecological Reviews Series, CUP, Cambridge.

Hanley, N., Mourato, S., Wright, R.E. 2001., Choice modelling approaches: a superior alternative for environmental valuation? Journal of Economic Surveys 15, 435-462.

Hansjürgens, B., Schröter-Schlaack, C., Berghöfer, A., Lienhoop, N., 2017. Justifying social values of nature: Economic reasoning beyond self-interested preferences. Ecosyst. Serv. 23, 9-17.

Hoyos, D., 2010. The state of the art of environmental valuation with discrete choice experiments. Ecol. Econ. 69(8), 1595-1603.

Hoyos, D., Mariel, P., Pacual, U., Etxano, I., 2012a. Valuing a Natura 2000 network site to inform land use options using a discrete choice experiment: an illustration from the Basque Country. J. For. Econ. 18, 329-344.

Hoyos, D., Riera, P., Fernández-Macho, J., Gallastegui, C., Garcia, D., 2012b. Valuing environmental impacts of coastal development projects: A choice experiment application in Spain. Journal of Oceanography and Marine Science 3(2), 32-40.

Johnston, R.J., Boyle, K.J., Adamowicz, W., Bennett, J., Brouwer, R., Cameron, T.A., et al., 2017. Contemporary Guidance for Stated Preference Studies. Journal of the Association of Environmental and Resource Economists 4(2), 319-405.

Jorgensen, B.S., Syme, G.J., Bishop, B.J. et al., 1999. Environ. Resource Econ. 14: 131.

Küstermann, B., Christen, O., Hülsbergen, K.-J., 2010. Modeling nitrogen cycles of farming systems as basis of site- and farm-specific nitrogen management. Agr. Ecosyst. Environ. 135, 70-80.

Liu, J., Dietz, T., Carpenter, S.R., Alberti, M., Folke, C., Moran, E., et al., 2007. Complexity of coupled human and natural systems. Science 317, 1513-1516.

Lori, M., Symnaczik, S., Mäder, P., De Deyn, G., Gattinger, A., 2017. Organic farming enhances soil microbial abundance and activity-A meta-analysis and meta-regression. PLOS ONE 12(7): e0180442.

Louviere, J., Woodworth, G., 1983. Design and analysis of simulated consumer choice or allocation experiments: an approach based on aggregated data. J. Marketing Res. 20, 350-367.

Louviere, J.J, Hensher, D.A, Swait, J.D., 2000, Stated Choice Methods, Analysis and Application. Cambridge University Press, Cambridge, UK.

MA, 2005. Ecosystems and Human Well-Being: Synthesis. Island Press, Washington, DC.

Martín-López, B., Gómez-Baggethun, E., García-Llorente, M., Montes, C., 2014. Trade-offs across value-domains in ecosystem services assessment. Ecol. Indic. 37, 220-228.

McFadden, D., 1974. Conditional logit analysis of qualitative choice behaviour. In: Zarembka, P. (Ed.), Frontiers in Econometrics. Academic Press, New York, pp. 105-142.

Meleddu, M., Pulina, M., 2016. Evaluation of individuals’ intention to pay a premium price for ecotourism: An exploratory study. Journal of Behavioral and Experimental Economics 65, 67-78.

Meyerhoff, J, Liebe, U., 2010. Determinants of protest responses in environmental valuation: A meta-study. Ecol. Econ. 70, 366-374.

Monge-Ganuzas, M., Cearreta, A., Evans, G., 2013. Morphodynamic consequences of dredging and dumping activities along the lower Oka estuary (Urdaibai Biosphere Reserve, southeastern Bay of Biscay, Spain). Ocean Coast. Manage. 77, 40-49.

Mueller, J.M., Lima, R.E., Springer, A.E., 2017. Can environmental attributes influence protected area designation? A case study valuing preferences for springs in Grand Canyon National Park. Land Use Policy 63, 196-205.

Oldekop, J.A., Holmes, G., Harris, W.E., Evans, K.L., 2015. A global assessment of the social and conservation outcomes of protected areas. Conserv. Biol. 00(0), 1-9.

Onaindia, M., Fernández de Manuel, B., Madariaga, I., Rodríguez-Loinaz, G., 2013a. Co-benefits and trade-offs between biodiversity, carbon storage and water flow regulation. For. Ecol. Manage. 289, 1-9.

Onaindia, M., Ballesteros, F., Alonso, G., Monge-Ganuzas, M., Peña, L., 2013b.

Participatory process to prioritize actions for a sustainable management in a biosphere reserve. Environ. Sci. Policy 33, 283-294.

Palacios-Agundez, I., Casado-Arzuaga, I., Madariaga, I., Onaindia, M., 2013. The relevance of local participatory scenario planning for ecosystem management policies in the Basque Country, northern Spain. Ecol. Soc. 18(3): 7.

Pasari, J.R., Levi, T., Zavaleta, E.S., Tilman, D., 2013. Several scales of biodiversity affect ecosystem multifunctionality. Proc Natl Acad Sci USA 110:10219-10222.

Pascual, U., Phelps, J., Garmendia, E., Brown, K., Corbera, E., Martin, A., et al., 2014. Social Equity Matters in Payments for Ecosystem Services. BioScience 64(11), 1027-1036.

Pascual, U., Balvanera, P., Díaz, S., Pataki, G., Roth, E., Stenseke, et al., 2017. Valuing nature's contributions to people: the IPBES approach. Curr. Opin. Environ. Sustainability 26, 7-16.

Pinto, R., Brouwer, R., Patrício, J., Abreu, P., Marta-Pedroso, C., Baeta, A., et al., 2016. Valuing the non-market benefits of estuarine ecosystem services in a river basin context: Testing sensitivity to scope and scale. Estuarine. Coastal and Shelf Science 169, 95-105.

Puy-Azurmendi, E., Ortiz-Zarragoitia, M., Villagrasa, M., Kuster, M., Aragón, P., Atienza, J., et al., 2013. Endocrine disruption in thicklip grey mullet (Chelon labrosus) from the Urdaibai Biosphere Reserve (Bay of Biscay, Southwestern Europe). Sci. Total Environ. 443, 233-244.

Rescia, A.J., Willaarts, B.A., Schmitz, M.F., Aguilera, P.A., 2010. Changes in land uses and management in two Nature Reserves in Spain: Evaluating the social-ecological resilience of cultural landscapes. Landsc. Urban Plan. 98, 26-35.

Revelt, D., Train, K., 1998. Mixed logit with repeated choices: households' choices of appliance efficiency level. Rev. Econ. Stat. 80, 647-657.

Rodríguez-Loinaz, G., Amezaga, I., Onaindia, M., 2013. Use of native species to improve carbon sequestration and contribute towards solving the environmental problems of the timberlands in Biscay, northern Spain. J. Environ. Manage. 120, 18-26.

Schäufele, I., Hamm, U., 2017. Consumers' perceptions, preferences and willingness-to-pay for wine with sustainability characteristics: A review. Journal of Cleaner Production 147, 379-394.

Schirpke, U., Marino, D., Marucci, A., Palmieri, M., Scolozzi, R., 2017. Operationalising ecosystem services for effective management of protected areas: Experiences and challenges. Ecosyst. Serv. 28(A), 105-114.

Sistema de Información de la Naturaleza de Euskadi. 2016. [online] Available at: http://www.euskadi.eus/ [Accessed 2016].

Stürck, J., Verburg, P.H., 2017. Multifunctionality at what scale? A landscape multifunctionality assessment for the European Union under conditions of land use change. Landscape Ecol. 32(3), 481-500.

Tagliafierro, C., Longo, A., Van Eetvelde, V., Antrop, M., Hutchinson, W.G., 2013. Landscape economic valuation by integrating landscape ecology into landscape economics. Environ. Sci. Policy 32, 26-36.

TEEB., 2010. The Economics of Ecosystems and Biodiversity. Ecological and Economic Foundations. Edited by Pushpam Kumar. Earthscan, London and Washington.

Torres, C., Faccioli, M., Riera Font, A., 2017. Waiting or acting now? The effect on willingness-to-pay of delivering inherent uncertainty information in choice experiments. Ecol. Econ. 131, 231-240.

Train, K., Weeks, M., 2005. Discrete choice models in preference space and willingness-to pay space. In: Scarpa, R., Alberini, A. (Eds.), Applications of Simulation Methods in Environmental and Resource Economics. Springer, Dordrecht, pp. 1-16.

UNESCO., 2016. [online] Available at: www.unesco.org/ [Accessed 2016].

Valasiuk, S., Czajkowski, M., Giergiczny, M., Żylicz, T., Veisten, K., Landa Mata, I., et al., 2018. Is forest landscape restoration socially desirable? A discrete choice experiment applied to the Scandinavian transboundary Fulufjället National Park Area. Restor. Ecol. 26, 370-380.

van Noordwijk, M., Leimona, B., Jindal, R., Villamor, G.B., Vardhan, M., Namirembe, S., et al., 2012. Payments for Environmental Services: Evolution Toward Efficient and Fair Incentives for Multifunctional Landscapes. Annual Review of Environment and Resources 37(1), 389-420.

Vedel, S.E., Jacobsen, J.B., Thorsen, B.J., 2015. Forest owners' willingness to accept contracts for ecosystem service provision is sensitive to additionality. Ecol. Econ. 113, 15-24.

Vincent, A., Fleury, P., 2015. Development of organic farming for the protection of water quality: Local projects in France and their policy implications. Land Use Policy 43, 197-206.

Waldhardt, R., Bach, M., Borresch, R., Breuer, L., Diekötter, T., Frede, H.G., et al., 2010. Evaluating today’s landscape multifunctionality and providing an alternative future: a normative scenario approach. Ecol. Soc. 15:30.

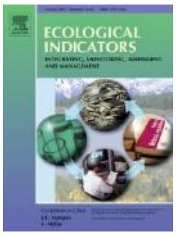
Wallmo, K., Lew, D.K., 2016. A comparison of regional and national values for recovering threatened and endangered marine species in the United States. J. Environ. Manage. 179, 38-46.

Wing, J.T., 2015. Roots of Empire: Forests and State Power in Early Modern Spain, c. 1500–1750. Leiden: Koninklijke Brill NV. pp. 268.

Xuan, B.B., Sandorf, E.D., Aanesen, M., 2017. Informing management strategies for a reserve: Results from a discrete choice experiment survey. Ocean Coast. Manage. 145, 35-43.

Yao, R.T., Scarpa, R., Turner, J.A., Barnard, T.D., Rose, J.M., Palma, J.H.N., Harrison, D.R., 2014. Valuing biodiversity enhancement in New Zealand's planted forests: Socioeconomic and spatial determinants of willingness-to-pay. Ecol. Econ. 98, 90-101.

Chapter 4.4



This chapter corresponds to the article:

Castillo-Eguskitza, N., Onaindia, M., Martín-López, B., 2018. A comprehensive assessment of ecosystem services: Integrating supply, demand and interest in the Urdaibai Biosphere Reserve. *Ecological Indicators* 93, 1176-1189. doi: 10.1016/j.ecolind.2018.06.004

A comprehensive assessment of ecosystem services: Integrating supply, demand and interest in the Urdaibai Biosphere Reserve

Nekane Castillo-Eguskitza, Berta Martín-López, Miren Onaindia

Abstract

Integrated assessment of ecosystem services involves the recognition of value pluralism and the inclusion of the different components of ecosystem services, ranging from supply to social demand and interest. Supply refers to the capacity of ecosystems to provide services, while demand refers to the allocation of money or willingness to obtain a particular service and interest to the importance assigned to services. Yet, a comprehensive assessment of ecosystem services which integrates these three components is still unexplored. This paper proposes a methodological approach to examine (mis)matches, i.e. differences or similarities in quality or quantity, when analysing the supply, demand and interest components of ecosystem services. We assessed twelve ecosystem services in four different units socioeconomically and environmentally similar of the social-ecological system of the Urdaibai Biosphere Reserve in Northern Spain. Results showed that the different ecosystem services components provide divergent but complementary information regarding their value. We also found that the information obtained is consistent across different spatial units with similar socio-economic characteristics, suggesting that the mismatch patterns among ecosystem services components are more related to the set of ecosystem services assessed than the socio-economic characteristics and land uses of the area of study. Our findings strengthen arguments of former calls for integration of the biophysical, monetary and socio-cultural values addressed by the supply, demand and interest components of ecosystem services.

Keywords:

Integrated assessment; operationalization; mismatches; Urdaibai Biosphere Reserve

1. Introduction

Since the concept of ecosystem services (ES) first emerged in the 1990s, efforts to value and quantify them remain challenging because of the comprehensive nature of linking ecological and social systems (Haines-Young & Potschin, 2010). Despite the conceptual advances in assessing ES along the ecosystems-society continuum (e.g. Burkhard et al., 2012a; Bennett et al., 2015; Díaz et al., 2015; Geijzendorffer et al., 2015), the identification of suitable indicators and methods for measuring the different components of ES are still a matter of debate (Wolff et al. 2015; Wei et al. 2017). Recently, with the recognition of the existence of plural values of ES (Gómez-Baggethun & de Groot, 2010), international policy initiatives such as the European Biodiversity Strategy to 2020 (European Commission, 2011) and the Intergovernmental Platform for Biodiversity and Ecosystem Services (IPBES) have called for the integration of multiple values that represent the importance of ES (Díaz et al., 2015; Pascual et al., 2017). This call for the recognition of value pluralism in the assessment of ES has led to the emergence of a new school of valuation, in which multiple disciplines and methods are combined to comprehensively assess ES (Gómez-Baggethun & Martín-López, 2015; Jacobs et al., 2016).

An integrated assessment of ES requires combining different values (value pluralism), interdisciplinarity, use of plural methodologies (qualitative and quantitative) and different knowledge systems (scientific and local or traditional knowledge) (Gómez-Baggethun et al., 2014; Gómez-Baggethun & Martín-López, 2015). However, so many ES frameworks exist, including the Millennium Ecosystem Assessment (MA, 2005), the cascade model (Haines-Young & Potschin, 2010), the Economics of Ecosystems and Biodiversity (TEEB, 2010), ES capacity, pressure, demand, and flow framework (Villamagna et al., 2013) and supply-and-demand framework (Geijzendorffer et al., 2015). Thus, concepts concerning the different values and components of ES are confusing and inconsistent among scientists, as the use of different components of ES and different terminologies to refer to the same component is common. Here, we focus on the supply-demand framework developed by Geijzendorffer et al. (2015) since it includes a societal dimension by distinguishing between different interlinked components of supply and demand. These components of the supply-demand framework of the ES are implicitly included in the criteria of value pluralism, as they address biophysical, monetary and socio-cultural values (Martín-López et al., 2014; Geijzendorffer et al., 2015). Therefore, their integration is considered essential for an integrated ES assessment (Schröter et al., 2016).

Certainly, the status of ES is linked not only to their provision (supply-side) but also to the social systems, i.e. management practices resulting from the needs and desires of human societies (demand-side). This comprehensive nature of ES, which links social and ecological systems, is reflected in the increasing application of integrated assessments of ES supply and demand (Wei et al., 2017). Supply-side refers to the biophysical components and properties required to provide an ecosystem service in a particular area over a period of time (Burkhard et al., 2012b; Wei et al., 2017). It depends on the quality of ecosystems (potential supply) and the interlinked relationships between ecological properties and management interventions developed by different stakeholders (managed supply) (Geijzendorffer et al., 2015). Demand-side can also be represented by two approaches: demand and interest (based on Martín-López et al., 2014). The demand involves the actual allocation of human resources to obtain, use or enjoy a particular ES (Geijzendorffer et al., 2015) or the willingness to obtain a service (Wolff et al., 2015; Wei et al., 2017). Interest is related to the importance given to the ES by stakeholders in a particular area for their well-being (Geijzendorffer et al., 2015). Each of these represents different components, so an integrated assessment of ES requires an analysis in which they are combined.

The integration of these components may improve the understanding of nature's value to society and better inform policy making in many research areas and contexts, such as landscape management (Palacios-Agundez et al., 2015; Cabral et al., 2016; Bark et al., 2016), conflict resolution and environmental justice (Villegas-Palacio et al., 2016; Aragão et al., 2016) and impact assessment (Phelan & Jacobs, 2016; Rosa & Sánchez, 2016). Moreover, assessing the supply, demand and interest of ES can be very useful in the identification of priority areas for conservation or potential conflicts among stakeholders (Castro et al., 2014). In fact, conflicts of interests may emerge when the ES that are in the highest demand and the most important for the general public are barely provided by ecosystems or, on the contrary, when a new management scenario is being developed and people do not perceive the particular ES that is supplied as important. These mismatches, i.e. differences (in quality or quantity) among ES supply, demand and interest components (Geijzendorffer et al., 2015), impact human well-being when social needs are not satisfied, which simultaneously leads to land use management or other policies that change the supply of ES (Wei et al., 2017). Therefore, if sustainable development is to be achieved, a key challenge in ES assessment is the identification of ES mismatches and their related values (i.e. biophysical, monetary and socio-cultural) (TEEB, 2010; Martín-López et al., 2014).

Yet, the analysis of mismatches among the three components in the assessment of ES is unexplored (Geijzendorffer et al., 2015; Wei et al. 2017) and to the best of our knowledge, assessment has only been applied empirically for one particular ES, i.e., the recreational service of wildlife tourism (Arbieu et al., 2017). In addition, mismatches between ES provision and stakeholders' preferences of ES may differ from one municipality to the next in the same social-ecological system (García-Llorente et al., 2015). In this context, this study aims to contribute to the existing research by conducting an integrated assessment of ES through the exploration of the information on mismatches when analysing different ES components (i.e. supply, demand and interest). The approach we present here requires the examination of exhaustive environmental and socio-economical information as well as the active role of stakeholders; as a consequence, it may lead to more consensus on decisions at the local level. We assessed 12 ES associated with provision, regulating and cultural services in four different units with similar socio-economic characteristics, as well as land uses of the social-ecological system of the Urdaibai Biosphere Reserve in Northern Spain. We hypothesize that each component of ES provides different information about the importance of the social-ecological system and mismatches can be found across units, which might be useful information for land managers and decision makers.

2. Methods

2.1. Study area

The Urdaibai Biosphere Reserve (UBR) is located on the Bay of Biscay coast, the Basque Country, Spain (43°19’ N, 2°40’ W) (Fig. 1). Ecologically, the UBR is characterized by coastal ecosystems, marshlands and Cantabrian woods of holm oak (*Quercus ilex*). Its topography is very irregular, and includes both narrow valleys and steep slopes. It is delimited by the Oka River hydrographic basin and covers an area of *ca.* 220 km^2 with 22 municipalities and approximately 45,000 inhabitants. The climate is temperate and humid and is regulated by the Cantabrian Sea, which ensures uniform atmospheric variables with an average temperature of 12.5 °C and average annual rainfall of 1,200 mm.

Broadly speaking, two areas can be distinguished: urban and rural. The urban area (Bermeo and Gernika-Lumo) is home to nearly 75% of the inhabitants of the UBR and most of the industrial activity and services. The rural area has a very low population density and different socio-economic units (SEU), i.e. areas that are socially or economically similar with consistent socio-economic and cultural characteristics and land uses types (Martín-López et al., 2017). SEU 1 comprises the municipalities of Ajangiz, Forua, Murueta and is defined by its high concentration of cultivated lands and important industrial activity, specifically the shipyard and automotive industries. SEU 2 (municipalitites of Bermeo, Gernika-Lumo) is the most urbanized and populated area. Its economy is based on diverse activities such as fishing, cattle farming, the canned fish industry or metallurgy. SEU 3 (municipalitites of Arratzu, Ereño, Errigoiti, Kortezubi, Mendata, Muxika, Nabarniz) is the unit the highest population of the elderly. It is mostly covered with pine and eucalyptus plantations. SEU 4 (municipalitites of Busturia, Elantxobe, Gautegiz Arteaga, Ibarrangelu, Mundaka, Sukarrieta) attracts most of the tourism because of its beaches and natural environment; therefore, its population increases significantly in the summer months (Fig. 1, App. A).

The UBR can be considered a social-ecological system because of the existing interrelationships between ecosystems and human activities shaped over time and characterized by spatial heterogeneity and high biodiversity (Atauri et al., 2004). Nevertheless, forest plantations of exotic species *(Pinus radiata* and *Eucalyptus sp.)* solely focused on wood production and different human activities such as industry and inefficient sewage disposal, have affected the supply of ES in the UBR. The increase of fast-turnover plantations (30- and 10-year rotation for *P. radiata* and *Eucalyptus sp.*, respectively (Mateos et al., 2017)) has had a detrimental effect on native forest and croplands and has led to loss of species diversity, aesthetic and cultural values, soil erosion and decrease of food provision (Onaindia et al., 2013a; Rodriguez-Loinaz et al., 2013). Moreover, the state of the transition waters and groundwater bodies is poor, based on criteria established by the Water Framework Directive (AZTI-Tecnalia, 2016; Agencia Vasca del Agua, 2016). In addition, the high landownership of the area (92% of the territory is private) does not ease the management of the UBR, and conflicts between entities engaged in conservation efforts and economic development are frequent (Onaindia et al., 2013b; Castillo-Eguskitza et al., 2017).

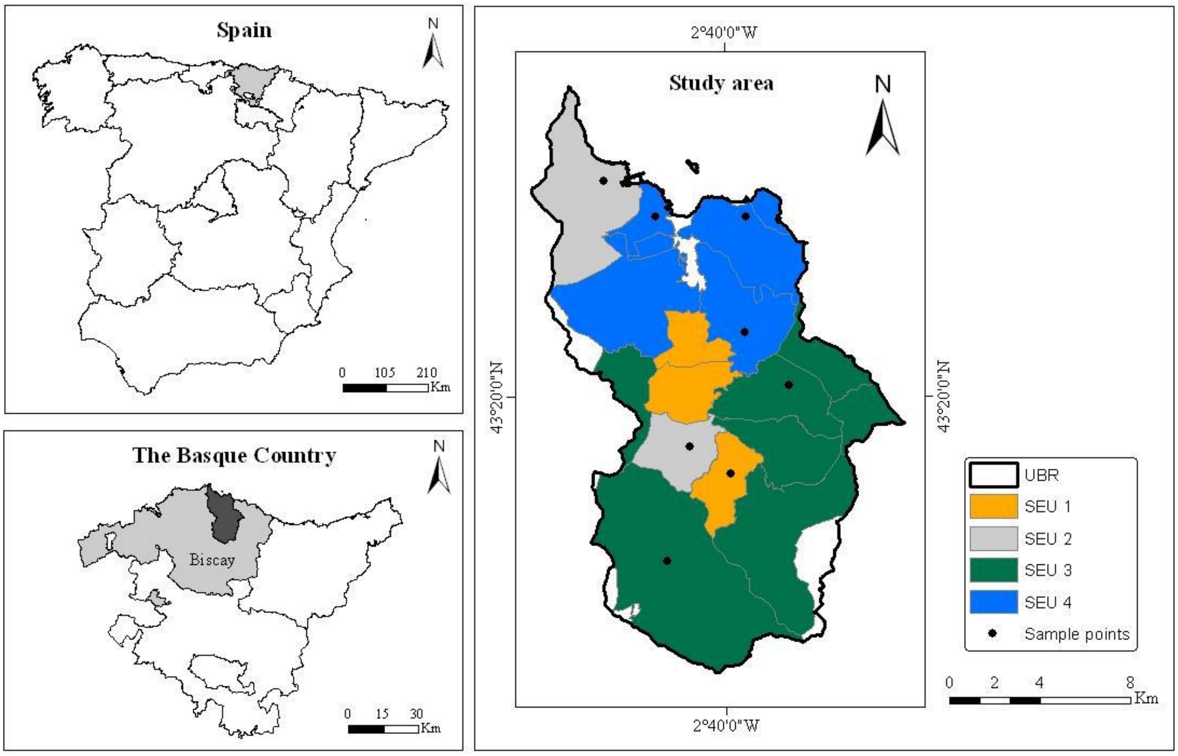


Fig. 1. Study area and division of socio-economic units (SEU) (only municipalities that contain more than the third part of their area within the UBR were included). Points indicate the municipalities used as sample points.

2.2. Assessing the different components of the ES

For the selection of the ES, we took into consideration the sustainable development goal of the biosphere reserve; we selected ES that are relevant for conservation planning and also important for the socioeconomic development of the area.

In total, we assessed 12 ES, including provisioning (food from agriculture, food from livestock, fishing, timber, fresh water), regulating (climate and air regulation, nutrient regulation, erosion control, water regulation and purification, habitat for species) and cultural services (tourism and recreation, aesthetic enjoyment). Figure 2 shows the different methodologies applied to assess the supply, demand and interest components of the aforementioned ES.

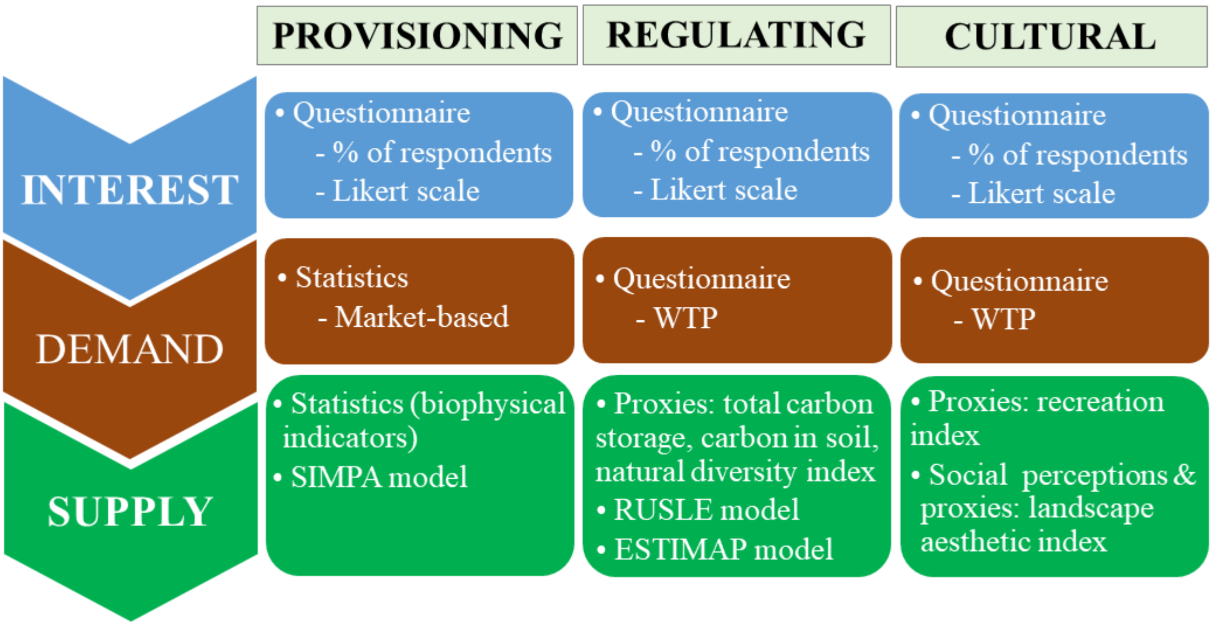


Fig. 2. Methods used for the different components and categories of ecosystem services (WTP = Willingness to pay, SIMPA = Simulation Precipitation-Contribution, RUSLE = Revised Universal Soil Loss Equation, ESTIMAP = Ecosystem Services Mapping tool).

2.2.1. Supply

Due to the historical importance of the society shaping the landscapes of the UBR, the supply of ES results from the interlinked relationships between ecological properties and management interventions developed by different stakeholders, i.e. managed supply (hereafter referred to as supply).

We used biophysical features to directly measure the supply of food from agriculture and livestock and fishing and timber (e.g. tones of 'product' per surface), whereas proxy measures, i.e. approximations of ES indicators, were used to quantify the supply of fresh water, regulating services and tourism and recreation. We used runoff water to estimate fresh water, carbon storage for carbon sequestration and nutrient regulation, laminar water soil retained for erosion control, a water retention index to assess water regulation and purification, and a recreation index for tourism and recreation. Likewise, we applied a landscape aesthetic index which mixes social perceptions and proxy measures such as the presence of water bodies or negative elements, to estimate aesthetic enjoyment. For further details, see Appendix B Table B.1.

Every ES was mapped, except for food from agriculture and livestock and fishing and timber, which were calculated numerically for each municipality by dividing the production with the total area of the municipality (EUSTAT 2009, 2017; Basque Government 2017). Fresh water was based on the SIMPA (Simulation Precipitation-Contribution) model (Ruiz, 1999) and calculated as follows:

$$FW = P - EV \quad (1)$$

where FW is the annual water flow (mm year-1), P is the annual rainfall (mm year-1), and EV is the annual evapotranspiration (mm year-1). To calculate annual evapotranspiration we used potential and real evapotranspiration maps from the period 1980/81-2005/06, supplied by the Water Information System of the Ministry of Agriculture, Food, and Environment of Spain (MAPAMA, 2015). As the potential evapotranspiration does not consider the limitation of water in soil or vegetation impact, so as to calculate a more realistic value for the evapotranspiration, we applied a vegetation correction factor for the different vegetation types and rescaled the values to the real evapotranspiration of the Oka river basin. The correction factors used were those in the InVEST – Integrated Valuation of Ecosystem Services and Tradeoffs (Sharp et al., 2018).

To assess the supply of carbon sequestration and nutrient regulation we used the same procedure of Onaindia et al. (2013a). For the assessment of carbon sequestration, we focused on the C stored in living trees and soil, whereas nutrient regulation was only based on organic C in soil. C stored in soil was based on the "Inventory of organic C stored in the first 30 cm of the soil" of the Basque Country (Neiker-Ihobe, 2004). C stored in living trees was calculated by following the equation of the average annual increment in biomass (IPCC, 2003):

$$CB = V\ BEF\ (1+R)\ D\ CF \quad (2)$$

where CB is the carbon stocks in living biomass (tC ha-1); V is the merchantable volume data for each tree species (m3 ha-1), obtained from the Forest Inventory of the Basque Country for the year 2011 (Basque Government, 2011a); BEF is the biomass expansion factor for the conversion of merchantable volume to aboveground tree biomass obtained from the study region (Montero et al., 2005); R is the root-to-shoot ratio to include belowground tree biomass; D is the basic wood density (t d.m. m-3), obtained from the northern Iberian Peninsula forests (CPF, 2004; Madrigal et al., 1999); and CF is the carbon fraction of dry matter, t C.

Erosion control and water regulation and purification were also based on models. We assessed the supply of erosion control by subtracting the potential laminar water erosion, a circumstance in which soil is totally devoid of vegetation, from the real laminar water erosion, calculated through the RUSLE (Revised Universal Soil Loss Equation) model (Basque Government, 2011b). To estimate the supply of water regulation and purification, we used the water retention index developed by Maes (2010) through ESTIMAP (Ecosystem Services Mapping) model. Habitat for species was also estimated following the procedure of Onaindia et al. (2013a) by adding native plant richness, habitat quality (successional level) and legal protection. Finally, we used recreation and landscape aesthetic indices estimated by Peña et al. (2015) to quantify the supply of tourism and recreation and aesthetic enjoyment, respectively. Tourism and recreation were estimated by adding a naturalness index, legal protection, presence of water bodies and peaks, accessibility, areas for recreation, tourist spots and birds' observation points (requested to Peña et al., 2015). Aesthetic enjoyment was estimated by considering societal perception, topography, diversity of landscapes, presence of water bodies, influence of landmarks and presence of negative elements (requested to Peña et al., 2015).

Once we obtained each map, we created a regular point grid covering the surface of the UBR (30 m, n=231,291) and extracted the values of the ES for each grid point. Next, we applied the Moran's index (Moran, 1950) for each SEU and ES to test for spatial autocorrelation of the data. Spatial autocorrelation is a measure of similarity or correlation between nearby observations and presents a problem for statistical testing as it transgresses on the assumption of independency (Legendre, 1993). Therefore, as the Moran indices indicated spatial autocorrelation, we randomly selected a sample containing 10% of the total pixels to reduce it, as suggested previously in ES mapping (Palomo et al., 2013; García-Nieto et al., 2015), and obtained the mean and standard deviation of each ES and SEU. The software used for geoprocessing and analysis was ArcGIS 9.3 (ESRI, 2009).

2.2.2. Demand

We used a contingent valuation method to estimate the demand of regulating and cultural services, and market-based techniques for the demand of provisioning services (Fig. 2; for further details, see Appendix B Table B.2). The contingent valuation procedure is a non-market method based on a hypothetical market in which people are asked through questionnaires about their willingness to pay (WTP) for the protection of nature (Mitchell & Carson, 1989).

From April to October, 2015, we conducted a total of 416 surveys (see Questionnaire B) at different sample points within each SEU (Fig. 1), including beaches, recreation areas, paths, croplands and urban zones. We chose the municipalities with the highest number of people and the highest diversity of environments within each SEU. For each sample point we identified at least 3 different locations to account for different types of respondents. We restricted the sampling to people 18 years of age and older, covering a wide range of stakeholders (such as local residents, tourists, landowners and scientists) and obtained a representative sample of 195 residents and 221 tourists. After explaining the different ES that the UBR provides to society, we asked the respondents about their WTP for maintaining regulating and cultural services in the statement provided below:

"Knowing that these ES contribute to human well-being, the authorities are considering protecting the UBR in a special way by creating a Basque Foundation which would ensure the provision of these regulating and cultural services. If this Foundation was set up, would you be willing to donate an annual voluntary amount of money so that these ES that the UBR provides could be preserved?"

Once respondents agreed to pay, we invited them to distribute the money among the different ES, including climate and air regulation, nutrient regulation, erosion control, water regulation and purification, habitat for species, tourism and recreation, and aesthetic enjoyment. This method has already been proven in other contingent valuation exercises of biodiversity (Martín-López et al., 2007; Ressurreição et al., 2012) or in ES research on the willingness of respondents to give up their time (García-Llorente et al., 2016). When respondents refused to participate in the hypothetical market, we asked them to provide their principal reason to distinguish between protest responses and real zero values. Protest responses differ from real zero values, because the former type of response indicates that even if a given respondent values the programme in question, they are unwilling to pay. Reasons for protest responses usually include the belief that it is not ethical to pay money for public goods or environmental issues, the feeling that we pay enough taxes and that the good should be preserved through public money, disagreement with the vehicle of payment or lack of confidence in the programme (Jorgensen et al., 1999). Following the common procedure for treatment of protest responses (de Ayala et al., 2015; Torres et al., 2017) and to ensure reliable and unbiased welfare estimates, we excluded these responses from the sample, which reduced the number of respondents included in the data to 334.

We used the Kaplan-Meier estimator to identify the survivor function for WTP responses, as recommended for open-ended elicitation formats (Bateman et al., 2002). Then, to estimate the monetary value of each ES, we carried out a Tobit regression model. The WTP data from open-ended format questions have a peculiar distribution, with a large proportion of responses centered on zero due to those who refused to participate in the hypothetical market. Thus, to avoid biased parameter estimates in the regression, we applied a Tobit model (Tobin, 1958), which is expressed as:

$$WTP_i = X_i\beta + \varepsilon_i \quad X_i\beta + \varepsilon_i > 0 \tag{3}$$

$$WTP_i = 0 \quad X_i\beta + \varepsilon_i < 0 \tag{4}$$

where X_i is a vector of explanatory variables, ε_i is a random disturbance term and β is a parameter vector common to all users. We used the LIMDEP statistical package to estimate the Tobit regression model.

For the selection of explanatory variables, we included the respondents' gender (WOMEN), age (AGE), employment (EMP), monthly personal income (PINCOME), origin (ORIGIN), and number of children at home (CHILDREN). To avoid multicollinearity among the explanatory variables, we estimated the Variance Inflation Factor (VIF) and included those with a VIF $\leq$ 2.75. We used XLSTAT software to perform these statistical analyses. For further details, see Appendix C.

The estimated WTP obtained by the Tobit regression was divided among the different ES selected by respondents, i.e. climate and air regulation, nutrient regulation, erosion control, water regulation and purification, habitat for species, tourism and recreation, and aesthetic enjoyment.

To analyse the demand of provisioning services, we used statistic data from EUSTAT (2009, 2017) and the Basque Government to calculate the monetary value associated with the production of food from agriculture and livestock, fishing, and timber in monetary units (€ per inhabitant and year). Similarly, we estimated the demand of fresh water on the basis of the water demanded per inhabitant and its price, according to the Busturialdea Water Consortium.

2.2.3. Interest

We estimated the interest for the different ES by conducting face-to-face surveys (see Questionnaire B), following the same sampling strategy as that used for the component of demand. We explained the different ES that the UBR provides to society and asked respondents about their perception of the five most important ES in terms of their own personal well-being. Then, we asked them to rank these five most important ES on a Likert scale from 1 to 5 (Fig. 2). Likert-type scaling is a unidimensional scaling method used to measure the level of agreement or disagreement with a statement (in this specific case, importance of the ES) according to a symmetric scale (Likert, 1932).

Thus, we obtained two different metrics to estimate the interest component: percentage of people with interest in a particular ES (hereafter referred to as % of interest) and the Likert value. By including these two metrics, we explored possible differences between them to assess the ES component of interest. This method has been widely applied in ES research to estimate the socio-cultural value of ES (e.g. Calvet-Mir et al., 2012; Martín-López et al., 2012; Casado-Arzuaga et al., 2013; Oteros-Rozas et al., 2014; Schmidt et al., 2017).

2.3. Integrating ES supply, demand and interest

We transformed all the values of supply, demand and interest for each ES by their natural logs to avoid problems with heteroscedasticity. To allow comparison between supply, demand and interest, despite their different units of analysis, we then scaled the values from 0 to 1 by dividing the difference between each individual value and the minimum value by the range of observed values, as follows:

$$\frac{x - \min(x)}{\max(x) - \min(x)} \qquad (5)$$

Since the supply units were different from one ES to another, and were therefore not comparable, each ES was scaled individually for the four SEU, according to their minimum and maximum and compared as relative values. In contrast, demand and interest components with equal units of analysis -i.e., €/inhabitant/year (demand) and % of interest and Likert value (interest)- were scaled together for the whole range of ES at once, by using the minimum and maximum values of the total range of ES for each component. We used this information to calculate the standardized mean values and standard deviation of the supply, demand and interest components of each ES for the four SEUs, and constructed a matrix to compare the different components of ES.

We examined the relationship among the variables, i.e. supply, demand, % of interest and Likert value, by applying a principal component analysis (PCA). For interpretation of the PCA results, we considered those factors with eigenvalues higher than 1 (i.e. Kaiser criterion; Costello & Osborne, 2005). We also rotated the first three factors of the PCA orthogonally (Varimax rotation) so we could associate each ES component with one of these factors

(Kaiser, 1958). Then, we depicted a heat map with the scores of the rotated factors to visualize the (dis)associations among ES in each component (supply, demand and interest) across each SEU. The hierarchical cluster analysis of the heat map was performed using Ward's method as an agglomerative hierarchical method and Euclidean distance (Ward, 1963). All statistical analyses were performed using XLSTAT software.

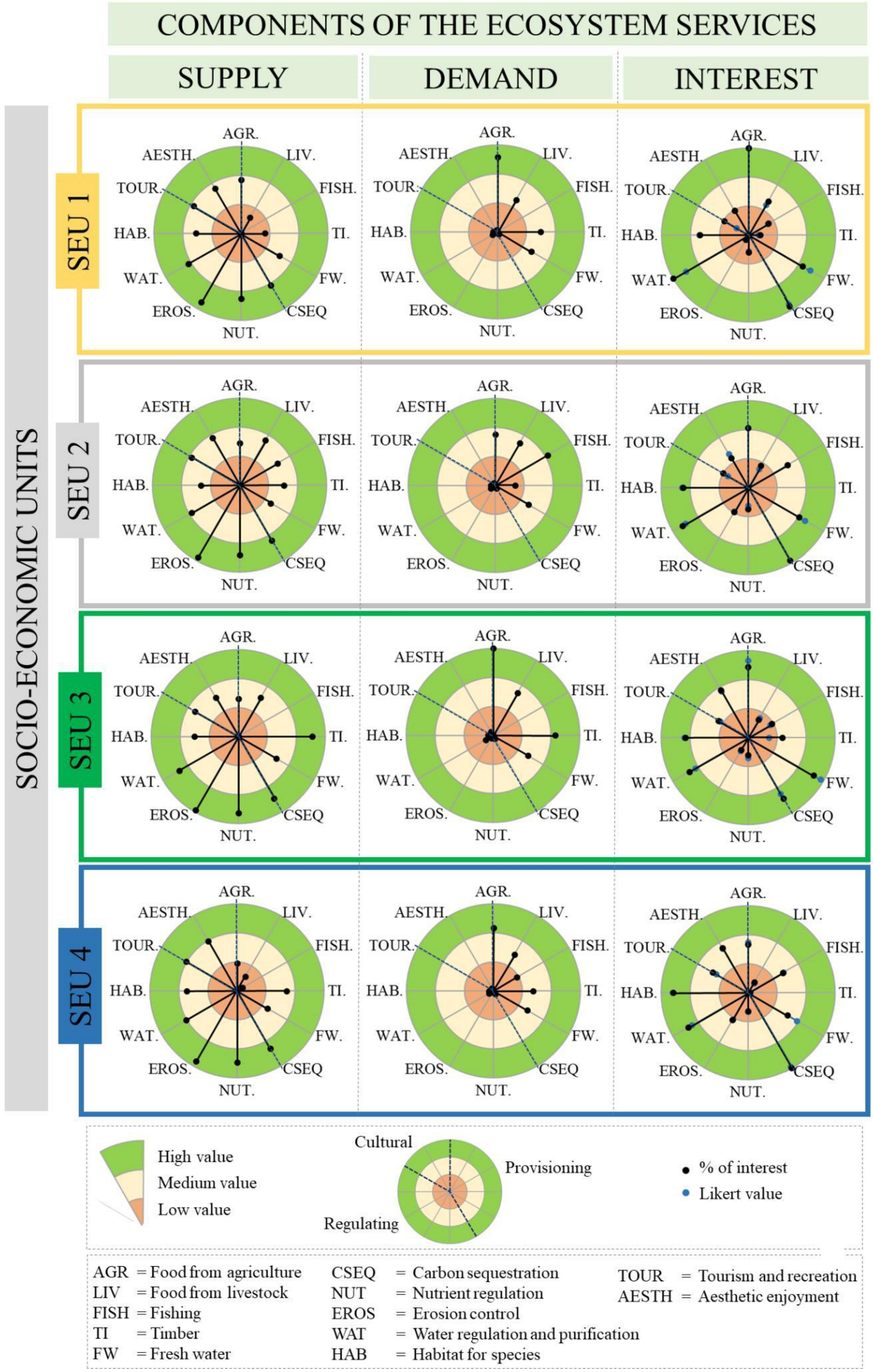
3. Results

3.1. Values of ES

The comparison of the standardized mean values of the ES supply, demand and interest reveals differences across SEUs (Fig. 3). Due to the different measurement units of the supply component of ES, it was not possible to compare the supply among ES, but SEUs. Overall, the supply of food from agriculture and livestock seemed to be the lowest in the SEU 4 and the highest in the SEU 1 and the SEU 2, respectively. However, timber and water regulation and purification were higher in the SEU 3. Carbon sequestration, nutrient regulation, erosion control, habitat for species and cultural services were fairly similar across SEUs, but habitat for species seemed to be mildly higher in the SEU 4. Tourism and recreation and aesthetic enjoyment also seemed to present lower values in the SEU 3.

Regarding the demand component, provisioning services presented higher values than regulating and cultural services across SEUs. Food from agriculture had the highest value across the SEUs, followed by food from livestock and timber. The unit with the highest demand of provisioning services was the SEU 3, except for fishing, which presented the highest value in the SEU 2. Although regulating and cultural services presented low values in the demand, respondents considered them very important in the interest component. The ES with the highest values of interest across SEUs were food from agriculture, climate and air regulation, water regulation and purification, and habitat for species, whereas timber, erosion control and nutrient regulation were the least important. In the SEU 3, fresh water was also highly valued by respondents in the interest component.

Fig. 3. Spider charts for the supply, demand and interest components for each ecosystem service across socio-economic units (SEU). Note that ES values of the supply component cannot be compared within each SEU due to their different measurement units, but it is possible to compare them across the different SEUs.


COMPONENTS OF THE ECOSYSTEM SERVICES
SUPPLY
DEMAND
INTEREST
SOCIO-ECONOMIC UNITS
SEU 1
SEU 2
SEU 3
SEU 4
AGR.
LIV.
FISH.
TI.
FW.
CSEQ
NUT.
EROS.
WAT.
HAB.
TOUR.
AESTH.
High value
Medium value
Low value
Cultural
Provisioning
Regulating
% of interest
Likert value
AGR = Food from agriculture
LIV = Food from livestock
FISH = Fishing
TI = Timber
FW = Fresh water
CSEQ = Carbon sequestration
NUT = Nutrient regulation
EROS = Erosion control
WAT = Water regulation and purification
HAB = Habitat for species
TOUR = Tourism and recreation
AESTH = Aesthetic enjoyment

3.2. Does the information provided by the different components of ES converge?

The PCA results showed that the supply, demand and interest components provide complementary information (Table 1). The first (F1) and second factor (F2) presented eigenvalues higher than 1, which accounted for 83% of the total variance. The first factor (F1; 50% of the total variance) was determined by the variables of the interest component (% of interest and Likert value), which were presented in the positive scores. The second factor (F2, 33% of variance) showed the contrast between supply and demand components; supply was represented in positive scores while demand was represented in negative scores. Results after Varimax rotation indicated that the first factor (D1) represented the interest component (comprised by the variables of % of interests and Likert value) and the second and third factors (D2 and D3) represented the supply and demand components, respectively (Table 1).

Table 1. Factor scores derived from the Principal Component Analysis (PCA) and after Varimax rotation. Values in bold correspond to the variables with the highest squared cosines.

Variables	Factor scores		Factor scores (Varimax rotation)		
	F1	F2	D1	D2	D3
Supply	-0.039	**0.824**	0.013	**0.985**	-0.169
Demand	0.206	**-0.791**	0.056	-0.170	**0.984**
Interest (% of interest)	**0.986**	0.129	**0.995**	0.030	0.022
Interest (Likert value)	**0.992**	0.068	**0.993**	-0.012	0.066
Eigenvalue	2.001	1.325			
Variance explained (%)	50.019	33.136			
Variance accumulated (%)	50.019	83.155			

The heat-map showed different patterns of mismatch among supply, demand and interest components, which were distinguished by five differentiated clusters of ES (Fig. 4). The first and second clusters, which consisted of provisioning services, were characterized principally by their high demand across SEUs, except for fishing in SEUs without coasts (i.e. the SEUs 1 and 3). At the same time, the first cluster revealed different levels of interest and supply. Patterns were divided into ES with high values of interest but potentially low supply (i.e. fresh water in the SEUs 1, 2, 3 and 4 and food from agriculture in the SEUs 2, 3 and 4) and those ES with low values of interest but presumably high supply (food from livestock in the SEU 2 and timber in the SEUs 3 and 4). In contrast, food from agriculture in the SEU 1 presented high values of interest and supply, while fishing in the SEU 2 showed medium interest and supply values. Cluster 2, in turn, represented those ES with lower values of interest (i.e. food from livestock in the SEUs 1 and 4, timber in the SEUs 1 and 2 and fishing).

The remaining clusters were characterized by their low demand. The third cluster was comprised by cultural ES and the regulating service of habitat for species. This cluster was represented by either ES with low values of interest and theoretically medium-high levels of supply (i.e. tourism and recreation in the SEUs 1, 2 and 4) or by ES with high values of interest and low values of supply (i.e. habitat for species). Supply and interest values of aesthetic enjoyment differed from SEU to SEU, with medium-high interest in the SEUs 3 and 4, and low supply in the SEU 3. Finally, the fourth and fifth clusters corresponded to the rest of the regulating services and represented seemingly high values of supply. The main difference between these clusters was related to level of interest. While cluster four represented regulating services with high values of interest (i.e. carbon sequestration and water regulation and purification), the fifth cluster represented regulating services with low values of interest (i.e. erosion control and nutrient regulation).

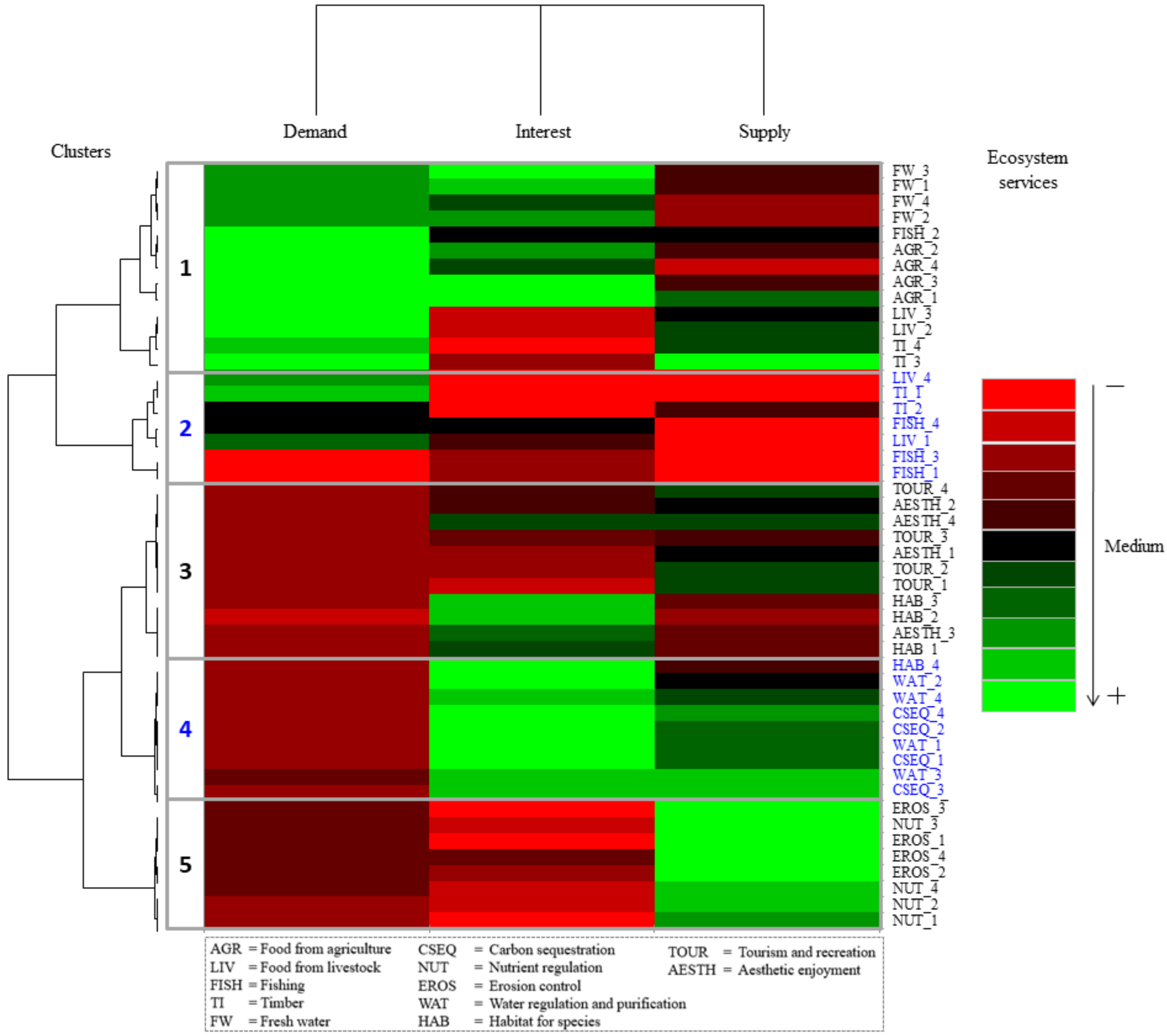


Fig. 4. Heat-map and hierarchical clustering of ecosystem services (ES) values according to supply, demand and interest components. Numbers at the end of ES abbreviations represent the socio-economic unit in which each ES is provided.

Thereby, mismatches might be found in cluster 1 between supply and demand-interest of fresh water and food from agriculture (except for the SEU 1), and interest and demand-supply of food from livestock in the SEUs 2 and 3 and timber in the SEUs 3 and 4. Cluster 2 displayed a presumable mismatch between interest-supply and demand of food from livestock in the SEUs 1 and 4 and timber in the SEUs 1 and 2. Likewise, cluster 3 presented probable mismatches between demand-interest and supply of tourism and recreation in the SEUs 1, 2 and 3, demand and interest-supply of aesthetic enjoyment in the SEU 4, and demand-supply and interest of habitat for species and aesthetic enjoyment in the SEU 3. Finally, clear mismatches were also found in clusters 4 and 5 between demand and interest-supply of carbon sequestration and water regulation and purification (except for water regulation and purification in the SEU 2) and demand-interest and supply of erosion control and nutrient regulation.

4. Discussion

4.1. Divergent but complementary information derived from the different ES components

Although former research has assessed the supply and demand components of ES (for a review, see Wei et al., 2017), to the best of our knowledge, this study is the first to conduct an empirical assessment of possible (mis)matches among the supply, demand and interest components. Our study strengthens the arguments of former calls to assess ES by considering their different components, i.e. supply, demand and interest (Martín-López et al., 2014; Geijzendorffer et al., 2015; Wei et al., 2017) because the various metrics used to assess each component provided complementary information (Martín-López et al., 2014; Castro et al., 2014; Langemeyer et al., 2015). Our results suggest that the assessment of ES through only one of these components would not adequately reflect the whole complexity of ES (Table 1; Fig 4). The supply component assessed by biophysical indicators and models captures the capacity of biophysical properties (in combination with human management actions) to provide ES (Geijzendorffer et al., 2015; Wei et al., 2017). This component thus represents the ecological value of ES, i.e. ecosystem functions, processes and components upon which ES delivery ultimately depends (de Groot et al., 2002; Gómez-Baggethun & Martín-López, 2015). The demand of ES contributes to assessment of human resource allocation for a particular ES (Geijzendorffer et al., 2015), which was measured in this study through the monetary values of ES. Finally, the interest component provides information about the wishes of stakeholders to preserve the ES that contribute to their personal wellbeing, and is often measured by so-called socio-cultural values (e.g. Oteros-Rozas et al., 2014; Schmidt et al., 2017). Therefore, the development of methodological approaches is imperative to allow the integration of supply, demand and interest components for a comprehensive assessment of the ES provided in a particular area. The methodological approach applied in this study represents a shift toward this type of comprehensive assessment through the integration of different valuation techniques.

Scientific literature is dominated by works that highlight the need for development of biophysical and monetary valuations (Maes et al., 2012; Abson et al., 2014; Nieto-Romero et al., 2014); it is noteworthy that the interest component of ES estimated through socio-cultural values is rarely addressed (Chan et al., 2012; Nieto-Romero et al., 2014). However, studies investigating the values related to the importance of ES for human well-being are gaining more attention and defenders of non-monetary valuation methods are becoming more frequent

(Martín-López et al., 2012; Scholte et al., 2015; García-Llorente et al., 2016). In this sense, our results show the importance of taking the interest component into consideration because it explained the majority of the data variance (Table 1). Even so, it is necessary to take into account that some ES like erosion control and nutrient regulation are almost imperceptible to people, so previous knowledge through explanation of concepts is necessary to arrive at conclusive outcomes.

Furthermore, most studies that have assessed the supply- and demand-sides of ES have been conducted at regional (Jie et al., 2015; Uthes & Matzdorf, 2016), national (Boithias et al., 2014; Tratalos et al., 2016) and continental spatial scales (Stürck et al., 2014; Breeze et al., 2014). Here, we provide evidence of divergent but complementary information, derived from the assessment of supply, demand and interest components on a local scale. We identified clusters or groups of ES according to the supply, demand and interest components, and found that the information obtained by assessing these three components was consistent across different spatial units with similar socio-economic characteristics and land uses (i.e. SEU) in the social-ecological system of the UBR for all regulating and cultural ES (Fig. 4). Identifying these clusters aids in the interpretation of the results and demonstrates that the mismatch patterns among supply, demand and interest components are more associated with the set of ES that were assessed than with the socio-economic characteristics and land uses of a particular social-ecological system.

Mismatches reflect differences in quality or quantity of ES components, so they may affect social well-being when the supply is not sufficient to satisfy demand or interest. Thus, assessing mismatches can provide relevant insights in the identification of potential conflicts and assist policy makers in developing alternatives that are consistent with public expectations and the capacity of ecosystems. In instances of non-compliance among ES components, we expected a mismatch to occur. As stated, mismatches can appear because of differences in quality or quantity, but we did not distinguish based on the cause of the difference; we only focused on analysis of whether mismatches were apparent among ES components.

With regard to quality, mismatches could be caused by management and increasing patterns of societal demand. For example, the supply of food from agriculture and livestock may be high but its quality (in terms of nutritional value) may be lower due to farming intensification and the use of chemical pesticides and fertilizers (Worthington, 2001). Similarly, the supply of carbon sequestration can be high in the UBR, but the management of the exotic plantations providing this service negatively impacts other ecological properties and services, such as erosion control and water regulation and purification (Rodríguez-Loinaz et al., 2013). Regarding cultural services, an abundant supply of tourism and recreation may exist, but the experience of recreational enjoyment might be jeopardized because of the high density of visitors. All in all, on the one hand, our results suggest that the interest component is not totally fulfilled when addressing the supply of fresh water and habitat for species across SEUs, food from agriculture in the SEUs 2, 3 and 4, water regulation and purification in the

SEU 2 and aesthetic enjoyment in the SEU 3 (Fig. 4). Indeed, during the summer, when rainfall declines significantly and the population in the UBR almost triples in size, the supply of water worsens and is amplified by the poor state of the aquifer (Bermejo et al., 2015). In addition, the sewage plant located in the SEU 2 (municipality of Gernika-Lumo) works inefficiently and is the main source of pollution of the estuary, which also affects some water used for bathing (AZTI-Tecnalia, 2016). With regard to habitat for species, approximately 70 species of flora and fauna are included in the Basque Catalogue of Threatened Species, out of which only 5 are protected through management plans in the UBR (Sistema de Información de la Naturaleza de Euskadi, 2016). Users in the UBR seem to be aware of the importance of biodiversity protection, and considering that we focused on a biosphere reserve, habitat for species should be a priority too. Likewise, in line with other studies in Biscay (Casado-Arzuaga et al., 2013), users demonstrate a desire to increase local food production from agriculture, and consequently, multifunctional landscapes. Finally, the reason for the low supply of aesthetic enjoyment in the SEU 3 could be its high density of pine plantations and timber provision. On the other hand, we found mismatches between the supply and the demand components with regard to provisioning services in general, and the demand and interest of carbon sequestration, water regulation and purification and habitat for species. Nonetheless, as we will explain later, we should exercise caution due to limitations of the use of different monetary techniques.

However, identifying high values of supply and low values of interest components may also be useful for land management. In this case, observed mismatches could indicate the necessity of redistribution of management efforts, such as those resulting from tourism and recreation to other ES such as water regulation and purification or carbon sequestration. Similarly, mismatches could also indicate lack of knowledge or visibility of some ES for people, namely erosion control and nutrient regulation (Lamarque et al., 2014; Partelow & Winkler, 2016).

4.2. Towards operationalizing an integrated assessment of ES

One of the main challenges for the operationalization of the integrated assessment of ES is the development of a joint methodological approach. This study presents a promising methodology, first developed by Martín-López et al. (2014), which enabled us to combine the different ES components and compare their values across different SEUs to allow for analysis of mismatches among the different components of ES.

Yet, our methodological approach presents some limitations that should be considered when interpreting the results. First, there is still no consensus on the definition and selection of the indicators that represent and quantify the ES and their components (Wolff et al., 2015; Heink et al., 2016; Wei et al., 2017). Regarding the supply component, selection of appropriate indicators and scales to measure ES is crucial. However, as is common in ES assessments, we used biophysical proxies due to lack of data and sometimes accuracy may be dubious. For example, nutrient regulation or maintenance of soil fertility was estimated by determining organic C in soil and did not take into account organic matter. For food from agriculture and livestock and fishing and timber, we used municipal limits as analysis-level, which can mask interactions among ES because of their larger scales (Xu et al., 2017). However, lack of consensus is especially remarkable with regard to the demand component, which was shown in this study to be biased towards the values estimated through market-based techniques. Consequently, the demand of regulating and cultural services, estimated by using contingent valuation, had negligible value compared to the marketed value of provisioning services. Nevertheless, regulating and cultural services were some of the most important for respondents, according to the interest component; paradoxically, they had the lowest monetary value. Therefore, considering that the interest component represents the variable that explained the highest variance in this study, we argue for the incorporation of multi-metric methods for developing an integrated assessment of ES that includes the supply, demand and interest components. Additionally, an integrated assessment may also diminish the limitations or superiority of a technique with respect to another technique, such as market-based valuation and WTP indicator measures.

Another key gap in the existing research pertains to development of methods to equalize the different units of supply, demand and interest to evaluate the self-sufficiency balance of society, therefore preventing potential conflicts of interests stemming from ES undersupply. On this point, the use of a heat-map provides an innovative approach for visualization of data and instantaneous conveyance of information so mismatch patterns among the supply, demand and interest components are easily identified but not quantified for each ES and SEU. However, our results should be carefully interpreted because despite the standardization of ES values, the original data was based on different units of measurement in supply, demand and interest. This has two main problems: (1) we compared data that were not originally comparable due to their different units of measurement and (2) the minimum and maximum values of ES could bias the results when values of ES are standardized.

Similarly, there is a need for further research on in the operationalization of ES assessment temporally and through consideration of different stakeholders (Geijzendorffer et al., 2015). The focus of our work was limited to the spatial approach of ES and distinguishing between different SEUs. However, the supply, demand and interest also depend on the temporal scale or season, as well as stakeholders or groups of beneficiaries. For example, in the area studied, tourism and recreation vary substantially throughout the year, and erosion control supply, which has very high values across the territory, may be non-existent when tree plantations are cut. Therefore, the demand and interest components may also change in circumstances in which the supply of an ES has deteriorated or is decreasing. Globalization and import/export policies also have an important impact on the provision of ES, and simultaneously affect the demand and interest components as well. Likewise, the demand and interest components are also dependent on the respondents. People’s choices are not only motivated by economic reasons (referring to the demand component), but also by socioeconomic characteristics and non-economic reasons such as ethic or individual relationship with nature (Chan et al., 2016). Previous studies found divergences in stakeholders’ preferences and willingness to pay according to their profile (e.g. Castro et al, 2014; Rodríguez-Ortega et al., 2016; Soy-Massoni et al., 2016; Nordén et al., 2017). Although we have not distinguished between groups of people, we have included different stakeholders, and our results suggest that age, origin and having children negatively affect the demand of ES (App. C Table C.2), so the interest component might also have been influenced as a socio-cultural valuation indicator.

5. Conclusions

Integrated assessment of ES is gaining increasing attention in scientific literature. The divergent information we obtained in our study through analysis of the supply, demand and interest components of ES underscores the necessity of combining the different dimensions of ES instead of assessing them separately. However, a comprehensive assessment of ES is still a challenge due to the lack of standardized methodological approaches.

Beyond some methodological caveats, this study contributes to the research on integrated assessment of ES and provides a methodology to analyse (mis)matches between supply, demand and interest of multiple ES across different SEUs. The identification of mismatches among ES components is important for the sustainable management of ES and conflict resolution. In the particular case of the UBR, we have found that patterns of mismatch are associated with the set of ES rather than differences in land uses and socio-economic characteristics of the social-ecological systems, as these patterns are consistent across the SEUs. We identified some potential mismatches between the supply and interest of food from agriculture, fresh water and habitat for species as well as the supply and demand of provisioning services. Also, mismatches appeared between the demand and interest in carbon sequestration, water regulation and purification and habitat for species, likely because market-based techniques hide the demand of non-provisioning services estimated by contingent valuation. Finally, potential mismatches were found between interest and supply of erosion control, nutrient regulation and tourism and recreation, which could provide insights regarding respondents’ lack of knowledge about the relevance of particular ES or even unequal distribution of management efforts.

References

Abson, D.J., von Wehrden, H., Baumgärtner, S., Fischer, J., Hanspach, J., Härdtle, W., t al., 2014. Ecosystem services as a boundary object for sustainability. Ecol. Econ. 103, 29-37.

Agencia Vasca del Agua, 2016. Red de seguimiento del estado de las aguas subterráneas. Informe 2015. [Spanish]

Aragão, A., Jacobs, S., Cliquet, A., 2016. What's law got to do with it? Why environmental justice is essential to ecosystem service valuation. Ecosyst. Serv. 22(B), 221-227.

Arbieu, U., Grünewald, C., Martín-López, B., Schleuning, M., Böhning-Gaese, K., 2017. Mismatches between supply and demand in wildlife tourism: Insights for assessing cultural ecosystem services. Ecol. Indic. 78, 282-291.

Atauri, J.A, de Pablo, C., de Agar, P., Schmitz, M.F., Pineda, F.D., 2004. Effects of management on understory diversity in the forest ecosystems of northern Spain. Environ. Manage. 34, 819-828.

AZTI-Tecnalia, 2016. Red de seguimiento del estado ecológico de las aguas de transición y costeras de la Comunidad Autónoma del País Vasco. Informe de resultados. Campaña 2015. [Spanish]

Bark, R.H., Colloff, M.J., MacDonald, D.H., Pollino, C.A., Jackson, S., Crossman, N.D., 2016. Integrated valuation of ecosystem services obtained from restoring water to the environment in a major regulated river basin. Ecosyst. Serv. 22(B), 381-391.

Basque Government, 2011a. Forest Inventory 2011. Department of Economic Development and Competitiveness.

Basque Government, 2011b. geoEuskadi. Available: www.geo.euskadi.eus/

Basque Government, 2017. Statistics. Department of Economic Development and Infrastructures. Available: www.euskadi.eus/gobierno-vasco/estadisticas-agricultura-pesca-politica-alimentaria/inicio/

Bateman, I.J., Carson, R.T., Day, B., Hanemann, W.M., Hanley, N., Hett, T., et al., 2002. Economic valuation with stated preference techniques: a manual. Edward Elgar, Cheltenham, UK.

Bennett, E.M., Cramer, W., Begossi, A., Cundill, G., Díaz, S., Egoh, B.N., et al., 2015. Linking biodiversity, ecosystem services, and human well-being: three challenges for designing research for sustainability. Curr. Opin. Environ. Sustain. 14, 76-85.

Bermejo, R., Hoyos, D., Lasagabaster, I., Pérez, R., 2015. Bases para una gestión sostenible del agua en Urdaibai en adecuación a la Directiva Marco del Agua. Un análisis económico, jurídico y ambiental. 132 pp. [Spanish]

Boithias, L., Acuna, V., Vergonos, L., Ziv, G., Marce, R., Sabater, S., 2014. Assessment of the water supply: demand ratios in a Mediterranean basin under different global change scenarios and mitigation alternatives. Sci. Total Environ. 470–471, 567–577.

Breeze, T.D., Vaissiere, B.E., Bommarco, R., Petanidou, T., Seraphides, N., Kozak, L., et al., 2014. Agricultural policies exacerbate honeybee pollination service supply-demand mismatches across Europe. PLoS ONE 9, e82996.

Burkhard, B., de Groot, R., Costanza, R., Seppelt, R., Jorgensen, S.E. Potschin, M., 2012a. Solutions for sustaining natural capital and ecosystem services. Ecol. Indic. 21, 1-6.

Burkhard, B., Kroll, F., Nedkov, S., Müller, F. 2012b. Mapping ecosystem service supply, demand and budgets. Ecol. Indic. 21, 1-6.

Cabral, P., Feger, C., Levrel, H., Chambolle, M., Basque, D., 2016. Assessing the impact of land-cover changes on ecosystem services: A first step toward integrative planning in Bordeaux, France. Ecosyst. Serv. 22(B), 318-327.

Calvet-Mir, L., Gómez-Baggethun, E., Reyes-García, V., 2012. Beyond food production: Ecosystem services provided by home gardens. A case study in Vall Fosca, Catalan Pyrenees, Northeastern Spain. Ecol. Econ. 74, 153-160.

Casado-Arzuaga, I., Madariaga, I., Onaindia, M., 2013. Perception, demand and user contribution to ecosystem services in the Bilbao Metropolitan Greenbelt. J. Environ. Manage. 129, 33-43.

Castillo-Eguskitza,N., Rescia, .J., Onaindia, M., 2017. Urdaibai Biosphere Reserve (Biscay, Spain): Conservation against development? Sci. Total Environ. 592, 124-133.

Castro, A.J., Verburg, P.H., Martín-López, B., García-Llorente, M., Cabello, J., Vaughn, C.C., López, E., 2014. Ecosystem service trade-offs from supply to social demand: a landscape-scale spatial analysis. Landsc. Urban Plan. 132, 102-110.

Chan, K.M.A., Satterfield, T., Goldstein, J., 2012. Rethinking ecosystem services to better address and navigate cultural values. Ecol. Econ. 74, 8-18.

Chan, K.M.A., Balvanera, P., Benessaiah, K., Chapman, M., Diaz, S., Gomez-Baggethun, E., et al., 2016. Why protect nature? Rethinking values and the environment. PNAS 113, 1462-1465.

Costello, A.B., Osborne, J.W., 2005. Best practices in exploratory factor analysis: four recommendations for getting the most from your analysis. Practical Assessment, Research & Evaluation 10, 1-9.

CPF. Centre de la Propietat Forestal., 2004. Annexe Indicadors dendrométrics En: Manual de redacción de plans tècnics de gestió i millota forestal (PTGMF) i plans simples de gestió forestal (PSGF). Instruccions de redacció i l’inventari forestal. Generalitat de Catalunya, Departament de Medi Ambient i Habitatge, Centre de la Propietat Forestal. Barcelona España. pp.211–314.

de Ayala, A., Hoyos, D., Mariel, P., 2015. Suitability of discrete choice experiments for landscape management under the European Landscape Convention. J. For. Econ. 21, 79-96.

de Groot, R.S., Wilson, M.A., Boumans, R.M.J., 2002. A typology for the classification, description and valuation of ecosystem functions, goods and services. Ecol. Econ. 41(3), 393-408.

Díaz, S., Demissew, S., Joly, C., Lonsdale, W.M., Larigauderie, A., 2015. A Rosetta Stone for nature's benefits to people. PLoS Biol. 13(1), e1002040.

ESRI, 2009. ArcGIS 9.3. Redlands. Environmental Systems Research Institute, California, USA.

European Commission, 2011. The EU Biodiversity Strategy to 2020.

EUSTAT, 2009. Agricultural census. [Online]. Available in: www.eustat.es

EUSTAT, 2017. Basque Institute of Statistics. [Online]. Available in: www.eustat.es

García-Llorente, M., Iniesta-Arandia, I., Willaarts, B.A., Harrison, P.A., Berry, P., del Mar Bayo, M., et al., 2015. Biophysical and sociocultural factors underlying spatial trade-offs of ecosystem services in semiarid watersheds. Ecol. Soc. 20(3):39.

García-Llorente, M., Castro, A., Quintas-Soriano, C., López, I., Castro, H., et al., 2016. The value of time in biological conservation and supplied services: A willingness to give up time exercise. J. Arid Environ. 124, 13-21.

García-Nieto, A.P., García-Llorente, M., Palomo, I., Quintas-Soriano, C., Montes, C., Martín-López, B., 2015. Collaborative mapping of ecosystem services: the role of stakeholders' profiles. Ecosyst. Serv. 13, 141-152.

Geijzendorffer, I.R., Martín-López, B., Roche, P.K., 2015. Improving the identification of mismatches in ecosystem services assessments. Ecol. Indic. 52, 320-331.

Gómez-Baggethun, E., de Groot, R., 2010. Natural capital and ecosystem services: The ecological foundation of human society. In: Hester, R.E & Harrison, R.M (eds) Ecosystem Services: Issues in Environmental Science and Technology. Cambridge: Royal Society of Chemistry, 118–145.

Gómez-Baggethun, E., Martín-López, B., Barton, D., Braat, L., Saarikoski, H., Kelemen, E., et al., 2014. EU FP7 OpenNESS Project Deliverable 4.1, State-of-the-art report on integrated valuation of ecosystem services. European Commission FP7.

Gómez-Baggethun, E., Martín-López, B., 2015. Ecological Economics perspectives on ecosystem services valuation. In: Martínez-Alier, J. & Muradian, R. (eds.). Handbook on Ecological Economics. Edward Elgar, pp. 260-282.

Haines-Young, R., Potschin, M., 2010. The links between biodiversity, ecosystem services and human well-being. In: Rafaelli, D., Frid, C. (Eds.), Ecosystem Ecology: A New Synthesis. BES

Ecological Reviews Series. University Press, Cambridge: Cambridge.

Heink, U., Hauck, J., Jax, K., Sukopp, U., 2016. Requirements for the selection of ecosystem service indicators – The case of MAES indicators. Ecol. Indic. 61, 18-26.

INE, 2007. Encuesta sobre la Estructura de las Explotaciones Agrícolas 2007.

IPCC, 2003. Good Practice Guidance for Land Use, Land-Use Change and Forestry. Ed J. Pennan et al. Institute for Global Environmental Strategies, Kanagawa.

Jacobs, S., Dendoncker, N., Martín-López, B., Barton, D.N., Gomez-Baggethun, E., Boeraeve, F., et al., 2016. A new valuation school: Integrating diverse values of nature in resource and land use decisions. Ecosyst. Serv. 22(B), 213-220.

Jie, X., Yu, X., Na, L., Hao, W., 2015. Spatial and temporal patterns of supply and demand balance of water supply services in the Dongjiang Lake Basin and its beneficiary areas. J. Resour. Ecol. 6, 386-396.

Jorgensen, B.S., Syme, G.J., Bishop, B.J. et al., 1999. Environmental and Resource Economics 14: 131.

Kaiser, H., 1958. The varimax criterion for analytic rotation in factor analysis. Psychometrika, 23(3), 187-200.

Lamarque, P., Meyfroidt, P., Nettier, B., Lavorel, S., 2014. How Ecosystem Services Knowledge and Values Influence Farmers' Decision-Making. PLoS ONE, 9(9), e107572.

Langemeyer, J., Baró, F., Roebeling, P., Gómez-Baggethun, E., 2015. Contrasting values of cultural ecosystem services in urban areas: The case of park Montjuïc in Barcelona. Ecosyst. Serv. 12, 178-186.

Legendre, P., 1993. Spatial Autocorrelation: Trouble or New Paradigm? Ecology 74, 1659-1673.

Likert, R., 1932. A technique for the measurement of attitudes. Arch. Psychol. 22(140), 1-55.MA, 2005. Ecosystems and Human Well-being: Synthesis. Island Press, Washington, DC.

Madrigal, A., Álvarez, J.G., Rodríguez, R., Rojo, A.(Eds.), 1999. Tablas de producción para los montes españoles. Fundación Conde del Valle de Salazar, Madrid, Spain.

Maes, J., 2010. Water Retention Index. European Commission, Joint Research Centre (JRC) [Dataset] PID: http://data.europa.eu/89h/06c3f085-c1e3-4228-949d-82a0899b8d7d

Maes, J., Egoh, B., Willemen, L., Liquete, C., Vihervaara, P., Schägner, J.P., et al., 2012. Mapping ecosystem services for policy support and decision making in the European Union. Ecosyst. Serv. 1(1), 31-39.

MAPAMA, 2015. National Spacial Data Infraestructure. NDSI. Available: http://www.magrama.gob.es/es/cartografia-y-sig/ide/descargas/agua/simpa.aspx

Martín-López, B., Montes, C., Benayas, J., 2007. The non-economic motives behind the willingness to pay for biodiversity conservation. Biol. Conserv. 139, 67-82.

Martín-López, B., Iniesta-Arandia, I., García-Llorente, M., Palomo, I., Casado-Arzuaga, I., García del Amo, D., et al., 2012. Uncovering ecosystem service bundles through social preferences. PLoS ONE 7(6), e38970.

Martín-López, B., Gómez-Baggethun, E., García-Llorente, M., Montes, C., 2014. Trade-offs across value-domains in ecosystem services assessment. Ecol. Indic. 37, 220-228.

Martín-López, B., Palomo, I., García-Llorente, M., Iniesta-Arandia, I., Castro, A.J., García Del Amo, D., et al., 2017. Delineating boundaries of social-ecological systems for landscape planning: A comprehensive spatial approach. Land Use Policy 66, 90-104.

Mateos, E., Edeso, J.M., Ormaetxea, L., 2017. Soil Erosion and Forests Biomass as Energy Resource in the Basin of the Oka River in Biscay, Northern Spain. Forests 8, 258.

Mitchell, R.C., Carson, R.T., 1989. Using surveys to value public goods. The Contingent Valuation Method. Resources for the Future, Washington, DC.

Montero, G., Ruiz-Peinado, R., Muñoz, M., 2005. Monografías INIA: Serie Tierras forestales (13). Producción de biomasa y fijación de CO2 por los bosques españoles. Ed. Instituto Nacional de Investigación y Tecnología Agraria y Alimentaria (INIA) y Ministerio de Educación y Ciencia, Madrid, Spain.

Moran, P.A., 1950. Notes on continuous stochastic phenomena. Biometrika 37,17-33.

Neiker-Ihobe, 2004. Estudio sobre la potencialidad de los suelos y la biomasa de zonas agrícolas, pascícolas y forestales de la CAPV como sumideros de carbono. Informe.

Nieto-Romero, M., Oteros-Rozas, E., González, J. Martín-López, B., 2014. Exploring the knowledge landscape of ecosystem services assessments in Mediterranean agroecosystems: insights for future research. Environ. Sci. Policy 37, 121-133.

Nordén, A., Coria, J., Jönsson, A.M., Lagergren, F., Lehsten, V., 2017. Divergence in stakeholders' preferences: Evidence from a choice experiment on forest landscapes preferences in Sweden. Ecol. Econ. 132, 179-195.

Onaindia, M., Fernández de Manuel, B., Madariaga, I., Rodríguez-Loinaz, G., 2013a. Co-benefits and trade-offs between biodiversity, carbon storage and water flow regulation. For. Ecol. Manage. 289, 1-9.

Onaindia, M., Ballesteros, F., Alonso, G., Monge-Ganuzas, M., Peña, L., 2013b. Participatory process to prioritize actions for a sustainable management in a biosphere reserve. Environ. Sci. Policy 33, 283-294.

Oteros-Rozas, E., Martín-López, B., González, J.A., Plieninger, T., López, C.A., Montes, C., 2014. Socio-cultural valuation of ecosystem services in a transhumance social-ecological network. Reg. Environ. Chang. 14, 1269-1289.

Palacios-Agundez, I., Onaindia, M., Barraqueta, P., Madariaga, I., 2015. Provisioning ecosystem services supply and demand: the role of landscape management to reinforce supply and promote synergies with other ecosystem services. Land Use Policy 47, 145-155.

Palomo, I., Martín-López, B., Zorrilla-Miras, P., García del Amo, D., Montes, C., 2013. Deliberative mapping of ecosystem services within and around Doñana National Park (SW Spain) in relation to land use change. Reg. Environ. Chang. 14, 237-251.

Partelow, S., Winkler, K.J., 2016. Interlinking ecosystem services and Ostrom’s framework through orientation in sustainability research. Ecol. Soc. 21(3):27.

Pascual, U., Balvanera, P., Díaz, S., Pataki, G., Roth, E., Stenseke, M., et al., 2017. Valuing nature’s contributions to people: the IPBES approach. Curr. Opin. Environ. Sustainability 26, 7-16.

Peña, L., Casado-Arzuaga, I., Onaindia, M., 2015. Mapping recreation supply and demand using an ecological and a social evaluation approach. Ecosyst. Serv. 13, 108-118.

Phelan, A., Jacobs, S., 2016. Facing the true cost of fracking; social externalities and the role of integrated valuation. Ecosyst. Serv. 22(B), 348-358.

Ressurreição, R., Gibbons, J., Kaiser, M., Dentinho, T.P., Zarzycki, T., Bentley, C., et al., 2012. Different cultures, different values: The role of cultural variation in public’s WTP for marine species conservation. Biol. Conserv. 145(1), 148-159.

Rodríguez-Loinaz, G., Amezaga, I., Onaindia, M., 2013. Use of native species to improve carbon sequestration and contribute towards solving the environmental problems of the timberlands in Biscay, northern Spain. J. Environ. Manage. 120, 18-26.

Rodríguez-Ortega, T., Bernués, A., Alfnes, F., 2016. Psychographic profile affects willingness to pay for ecosystem services provided by Mediterranean high nature value farmland. Ecol. Econ. 128, 232-245.

Rosa, J.C.S., Sánchez, L.E., 2016. Advances and challenges of incorporating ecosystem services into impact assessment. J. Environ. Manage. 180, 485-492.

Ruiz, J.M., 1999. Modelo distribuido para la evaluación de recursos hídricos. Monografías CEDEX M67.

Schmidt, K., Walz, A., Sachse, R., Martín-López, B., 2017. Testing socio-cultural valuation methods of ecosystem services to explain land use preferences. Ecosyst. Serv. 26, 270-288.

Scholte, S.S.K., van Teeffelen, A.J.A., Verburg, P.H., 2015. Integrating socio-cultural perspectives into ecosystem service valuation: A review of concepts and methods. Ecol. Econ. 114, 67-78.

Schröter, M., Albert, C., Marques, A., Tobon, W., Lavorel, S., Maes, J., et al., 2016. National Ecosystem Assessments in Europe: A Review. Bioscience, 66(10), 813-828.

Sharp, R., Tallis, H.T., Ricketts, T., Guerry, A.D., Wood, S.A., Chaplin-Kramer, R., et al., 2018. InVEST 2.6.0 User's Guide. The Natural Capital Project, Stanford University, University of Minnesota, The Nature Conservancy, and World Wildlife Fund.

Sistema de Información de la Naturaleza de Euskadi. 2016. [online] Available at: http://www.euskadi.eus/ [Accessed 2016].

Soy-Massoni, E., Langemeyer, J., Varga, D., Sáez, M., Pintó, J., 2016. The importance of ecosystem services in coastal agricultural landscapes: Case study from the Costa Brava, Catalonia. Ecosyst. Serv. 17, 43-52.

Stürck, J., Poortinga, A., Verburg, P.H., 2014. Mapping ecosystem services: The supply and demand of flood regulation services in Europe. Ecol. Indic. 38, 198-211.

TEEB, 2010. The Economics of Ecosystems and Biodiversity Ecological and Economic Foundations. Edited by Pushpam Kumar. Earthscan, London and Washington.

Tobin, J., 1958. Estimation of relationship for limited dependent variables. Econometrica 26, 24-36.

Torres, C., Faccioli, M., Riera Font, A., 2017. Waiting or acting now? The effect on willingness-to-pay of delivering inherent uncertainty information in choice experiments. Ecol. Econ. 131, 231-240.

Tratalos, J.A., Haines-Young, R., Potschin, M., Fish, R., Church, A., 2016. Cultural ecosystem services in the UK: lessons on designing indicators to inform management and policy. Ecol. Indic. 61, 63-73.

Udalmap, 2017. [online] Available at: www.eustat.eus/about/udalmap_c.html

Uthes, S., Matzdorf, B., 2016. Budgeting for government-financed PES: Does ecosystem service demand equal ecosystem service supply? Ecosyst. Serv. 17, 255-264.

Villamagna, Amy, M., Angermeier, Paul L., Bennett, Elena M., 2013. Capacity, pressure, demand, and flow: A conceptual framework for analyzing ecosystem service provision and delivery. Ecol. Complex. 15, 114-121.

Villegas-Palacio, C., Berrouet, L., López, C., Ruiz, A., Upegui, A., 2016. Lessons from the integrated valuation of ecosystem services in a developing country: Three case studies on ecological, socio-cultural and economic valuation. Ecosyst. Serv. 22(B), 297-308.

Ward, J., 1963. Hierarchical grouping to optimize an objective function. Journal of the American Statistical Association 58, 236-244.

Wei, H., Fan, W., Wang, X., Lu, N., Dong, X., Zhao, Y., et al., 2017. Integrating supply and social demand in ecosystem services assessment: A review. Ecosyst. Serv. 25, 15-27.

Wolff, S., Schulp, C., Verburg, P.H., 2015. Mapping ecosystem services demand: a review of current research and future perspectives. Ecol. Indic. 55, 159-171.

Worthington, V., 2001. Nutritional Quality of Organic Versus Conventional Fruits, Vegetables, and Grains. J. Altern. Complem. Med. 7(2), 161-173.

Xu, S., Liu, Y., Wang, X., Zhang, G., 2017. Scale effect on spatial patterns of ecosystem services and associations among them in semi-arid area: A case study in Ningxia Hui Autonomous Region, China. Sci. Total Environ. 598, 297-306.

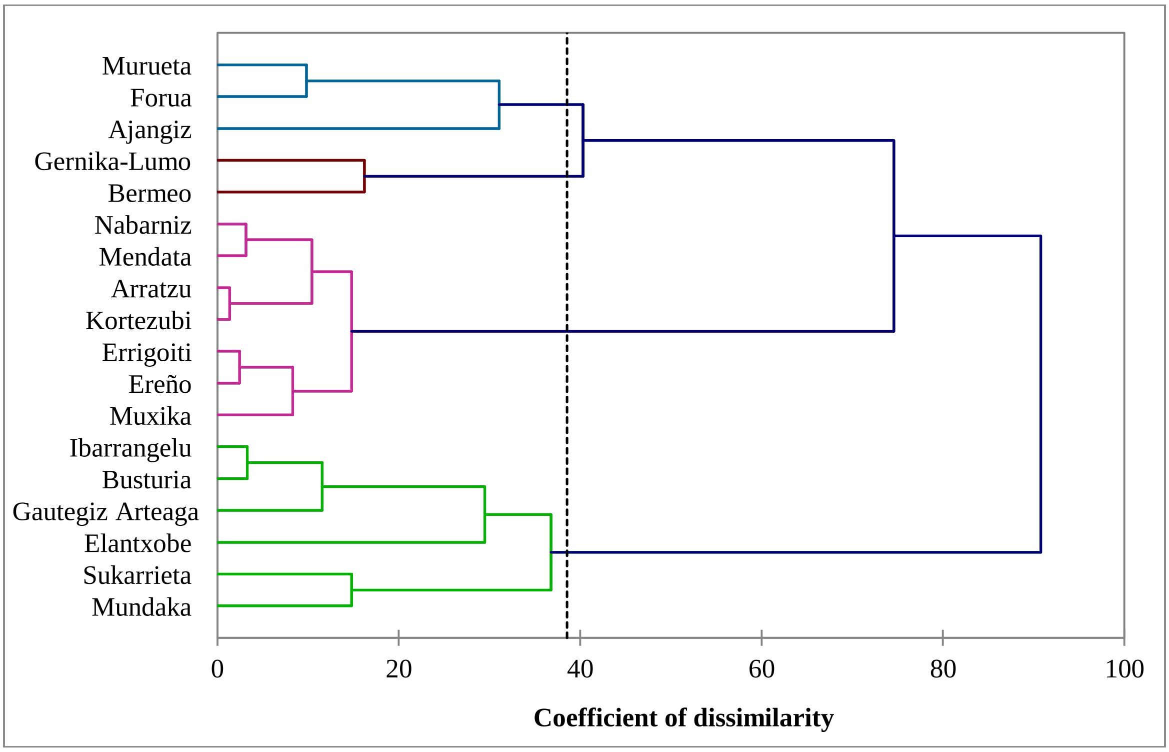
Appendix A. Socio-economic regionalization.

To identify socio-economic units with consistent socio-economic and cultural characteristics and land uses types (Martín-López et al., 2017), we carried out a PCA (Table A.1), previous standardization and ln(x+1) transformation of the data. For the analysis, we selected 26 descriptive variables at the municipal level (Table A.1.), including demographic (e.g. population density), economic (e.g. employment), cultural (e.g. population with higher education) and land uses variables (e.g. surface of pastures). The information was obtained from the Basque Institute of Statistics (EUSTAT, 2017) and Udalmap Municipal information system (Udalmap, 2017). Then, we performed a hierarchical cluster analysis to obtain similar groups of municipalities by using the PCA components with an eigenvalue higher than 1 (Kaiser criterion; Costello & Osborne, 2005) and the Euclidean distance and Ward's method as agglomerative hierarchical technique (Ward, 1963). As a result, a total of 4 SEU were obtained (Fig 1; Fig. A.1).

Table A.1. Factor scores of the descriptive variables derived from the PCA used to characterise the different socio-economic units.

Variables	Factor scores					
	F1	F2	F3	F4	F5	F6
Population density (inhabitants/km^2)	0.321	**0.665**	-0.434	-0.494	0.059	0.079
Population > 64 years (%)	**-0.562**	0.233	-0.481	0.164	-0.370	-0.314
Second home (%)	-0.462	**0.559**	0.279	0.447	-0.196	-0.221
Population with higher education (%)	0.306	0.409	**0.542**	0.355	-0.390	-0.054
Employment in the primary sector (% of occupied people)	-0.359	-0.412	**-0.622**	0.267	-0.025	0.264
Employment in the industry sector (% of occupied people)	**0.847**	0.032	-0.126	0.151	0.240	-0.249
Employment in the tertiary sector (% of occupied people)	0.455	0.442	-0.291	0.345	-0.443	0.252
Employment (% of active people)	**0.853**	0.006	-0.227	0.379	0.018	0.155
Gross Domestic Product (GDP) (€)	**0.801**	0.007	-0.223	0.503	0.144	0.094
Gross Value Added of the primary sector (%)	**-0.615**	-0.567	0.006	-0.141	0.080	0.292
Gross Value Added of the industry sector (%)	**0.672**	-0.210	-0.017	0.007	0.497	-0.385
Gross Value Added of the tertiary sector (%)	**-0.667**	0.402	-0.006	-0.413	-0.425	0.042
Foreign population (%)	0.306	0.362	-0.177	**-0.768**	-0.039	-0.185
Transport and communication infrastructures (%)	0.134	**0.700**	-0.417	-0.093	0.181	0.066
Waste production per inhabitant (kg/year)	-0.025	**0.812**	0.325	0.250	-0.152	-0.061
Water demand per inhabitant (l/day)	-0.007	-0.485	0.075	0.067	-0.268	**-0.761**
Conifer and eucalyptus plantations (%)	-0.183	**-0.702**	-0.481	0.096	-0.346	-0.083
Broadleaves (%)	-0.433	**0.534**	0.522	0.128	0.277	0.052
Meadows (%)	**0.799**	0.032	-0.035	-0.125	-0.109	0.018
Pastures (%)	-0.274	0.361	-0.350	0.202	0.387	-0.171
Scrublands (%)	-0.184	0.525	**-0.608**	0.189	0.147	0.011
Cultivated lands (%)	**0.665**	-0.260	0.253	-0.013	-0.278	0.114
Urban areas (%)	0.570	**0.676**	-0.147	-0.374	-0.177	-0.111
Coastal beach and dunes (%)	-0.409	**0.801**	-0.273	0.236	0.032	-0.018
Salt marshes (%)	0.248	0.271	**0.834**	-0.084	0.104	0.173
Nº of farms (% per total surface)	**0.806**	-0.178	-0.120	-0.096	-0.466	0.111
Eigenvalue	7.150	5.841	3.563	2.392	1.887	1.348
Variance explained (%)	27.500	22.465	13.704	9.202	7.259	5.184
Variance accumulated (%)	27.500	49.965	63.668	72.870	80.129	85.313

Fig. A.1. Hierarchical cluster analysis and socio-economic units obtained.



Appendix B. Indicators used for the assessment of the supply and demand components of ecosystem services.

Table B.1. Supply indicators and description of the variables.

Ecosystem services	Indicator	Equation	Variables	Format (Resolution_m)	Data sources
Provisioning					
Food from agriculture[a]	Yield rate of agricultural crops per surface (AG) (t/ha)	AG=AP/S	AP = Agricultural production for each type of crops (t) (2011-2015)	-	Basque Government, 2017;
			S = Total surface (ha)		EUSTAT, 2017
Food from livestock[b]	Livestock units per surface (LI) (units/ha)	LI=LU/S	LU = Livestock units (units)	-	EUSTAT, 2009
			S = Total surface (ha)		EUSTAT, 2017
Fishing	Inshore fishing (FI) (mt)	-	FI = Quantity of inshore fishing (mt) (2010-2015)	-	EUSTAT, 2017
Timber	Timber species' growth rate (TI) (m^3/ha)	TI=AIT/S	AIT = Annual increase of tree species (m^3)	-	Basque Government, 2011a;
			S = Surface occupied by each specie (ha)		EUSTAT, 2017
Fresh water	Runoff water (FW) (mm/ha)	FW=R–EV	R = Total annual rainfall (mm/ha) (SIMPA model)	Raster (125 x 125)	MAPAMA, 2015
			EV = Total annual evapotranspiration (mm/ha) (SIMPA model)	Raster (125 x 125)	MAPAMA, 2015; Sharp et al., 2018
Regulating					
Carbon sequestration	Total C storage (C) (tC/ha)	C=CS+CLB	CS = Stored C in soil (tC/ha)	Shape_1:25,000	Neiker-Ihobe, 2004
			CLB = Stored C in living biomass (tC/ha)	Shape_1:10,000	IPCC, 2013; Basque Government, 2011a; CPF, 2004; Madrigal et al., 1999; Montero et al., 2005
Nutrient regulation	Organic C in soil (N) (tC/ha)	-	N = Organic C in soil (tC/ha)	Shape_1:25,000	Neiker-Ihobe, 2004
Erosion control	Soil loss control (ER) (t/ha)	ER=PE–RE	PE = Potential laminar water erosion (RUSLE model) (t/ha)	Shape_1:25,000	Basque Government, 2011b
			RE = Real laminar water erosion (RUSLE model) (t/ha)	Shape_1:25,000	Basque Government, 2011b
Water regulation and purification	Water retention index (WRI)	-	WRI = f(retention in vegetation, soil and groundwater retention, slope and soil sealing) (ESTIMAP model)	Raster (100 x 100)	Maes, 2010
Habitat for species	Natural diversity index (HAB)	HAB=NPR+HQ+LP	NPR = Native plant richness	Shape_1:10,000	Onaindia et al., 2013a
			HQ = Habitat quality (successional level)	Shape_1:10,000	
			LP = Legal protection	Raster (2 x 2)	

Table B1 (continued).

Ecosystem services	Indicator	Equation	Variables	Format (Resolution_m)	Data sources
Cultural					
Tourism and recreation	Recreation index (TR)	TR=PR+CR	PR = Potential for recreation = f(naturalness index, legal protection, presence of water bodies and peaks) CR = Capacity for recreation = f(Accessibility, areas for recreation, tourist spots and birds observation points)	Shape_1:10,000	Peña et al., 2015
Aesthetic enjoyment	Landscape aesthetic index (AE)	AE=SP+T+LD+WB +LL-NE	SP = Perception of society T = Topography LD = Diversity of landscapes WB = Presence of water bodies LL = Influence of landscape landmark NE = negative elements	Shape_1:10,000	Peña et al., 2015

[a] Agricultural production of each municipality was estimated using available data from Biscay.

[b] Livestock units were calculated by applying a coefficient to each type of specie to allow incorporation of different species into a common unit (INE, 2007).

Table B.2. Demand indicators for the ecosystem services values estimated by market-based methods and descriptions of the variables.

Ecosystem services	Indicator	Equation		
Provisioning				
Food from agriculture	Agricultural production per inhabitant (AG) (€/inhab.)	AG=AV/PO	AV = Agricultural production (€)	EUSTAT, 2009
			PO = Population (inhabitants)	EUSTAT, 2017
Food from livestock	Livestock production per inhabitant (LI) (€/inhab.)	LI=SCxP/PO	SC = Average total weight of slaughtered cattle (2011-2015) (kg/year)	Request to the Basque Government
			P = Prices according to each specie (€/kg)	Basque Government, 2017
			PO = Population (inhabitants)	EUSTAT, 2017
Fishing	Inshore fishing (FI) (€/inhab.)	FI=FV/PO	FV = Value of inshore fishing according to species (2010-2015 years)	EUSTAT, 2017
			PO = Population (inhabitants)	
Timber[a]	Timber production per inhabitant (TI) (€/inhab.)	TI=WCxP/PO	WC = Authorized wood cuts (m^3) (2009 year)	EUSTAT, 2017
			P = Prices m^3 (2012-2016 years)	
			PO = Population (inhabitants)	
Fresh water	Water consumption per inhabitant (FW) (€/inhab.)	FW=WDxP	WD = Total water demand per year per inhabitant (m^3 $year^{-1}$ $inhabitant^{-1}$) (2011-2016 years)	Udalmap, 2017
			P = Supply prices according to the consumption (€)	Requested to Busturialdea Water Consortium

[a] Authorized wood cuts were estimated using the available data from Biscay. Only *P. radiata* and *Eucalyptus sp.* plantations were included.

Appendix C. Explanatory variables and results of the Tobit regression model.

Table C.1. Descriptive statistics of the explanatory variables used in the Tobit regression model. Ln(x+1) was applied for continuous variables.

Variables	Description	Mean	Std. dev.
WOMEN	Gender (female)	0.446	0.498
AGE	Age range (the midpoint was used): 1: 18-30; 2:31-45; 3: 46-60; 4: 61-75; 5: >76	44.020	14.341
EMP	Employed	0.748	0.435
PINCOME	Monthly income range (the midpoint was used): 1: 0 €; 2: 1-900 €; 3: 901-1.500 €; 4: 1.501-2.000 €; 5: 2.000-2.500 €; 6: > 2.500 €	1,316.0	707.836
ORIGIN	Origin: 1: Local; 2: Biscay; 3: The Basque Country; 4: Spain; 5: Foreign	2.158	1.342
CHILDREN	Children at home	0.401	0.491

Table C.2. Results of the Tobit regression model.

Variables	Coefficient		Std. error
Constant	3.605	*	2.097
GENDER	0.837	**	0.338
AGE	-1.862	***	0.605
EMP	0.911	*	0.505
PINCOME	0.420	**	0.178
ORIGIN	-0.234	*	0.127
CHILDREN	-0.850	**	0.363
σ	2.913	***	0.182
Log likelihood	-568.135		
WTP	Mean = 4.453; Std. dev. = 2.149		

Significance at the * = 10%, ** = 5% and *** = 1% levels.

Chapter 5

General discussion

"Look at the bark of a redwood, and you see moss.
If you peer beneath the bits and pieces of the moss, you'll see toads, small insects,
a whole host of life that prospers in that miniature environment.
A lumberman will look at a forest and see so many board feet of lumber.
I see a living city."

Sylvia Earle

5. General Discussion

5.1. Overview of the findings and scientific relevance

The main objective of the present thesis was to contribute to the assessment and valuation of ES in the SES of the UBR, with the aim of obtaining results that could be incorporated in decision-making process for sustainable landscape planning and management. The thesis has addressed the different questions formulated to achieve the main objective, and the results have highlighted the importance of the biosphere reserve for the conservation and development of the area, as well as, the necessity to incorporate all possible complexity by assessing the different dimensions of ES in order to inform appropriately.

5.1.1. Biosphere reserves: Conservation & Human well-being

Under the economic growth approach, PAs are often considered an obstacle for productive local activities owing to the restriction on the uses they usually impose. As a result, most of the PAs are mainly located in areas where land use changes are unlikely, such as high areas above 1,500 meters in the case of Spain (Europarc-España, 2017). Despite such tendency, protection figures including international, national and autonomous levels are many; however, biosphere reserves may be the one which best fix to SES and cultural landscapes like the one studied here.

Certainly, biosphere reserves integrate interdisciplinary approaches on the biophysical, monetary and cultural dimensions of ecosystems and promote the exchange of knowledge and social adaptability. They represent ‘science for sustainability support sites’, i.e., places for testing interdisciplinary approaches to understanding and managing changes and interactions between social and ecological systems, together with conflict prevention and management of biodiversity (UNESCO, 2017). In doing so, the three areas in which biosphere reserves are zoned (core, buffer and transition zone), allow a better interrelation of the PA in the territorial matrix by improving the ecological connectivity, and therefore, preventing a conservation *vs*. development model and contributing to the goal of social-ecological sustainability.

As regards the UBR, it seems that not only has it actually helped to nature conservation, but also to socioeconomic and cultural development (*Chapter 4.1*). Overall, the conservation of natural ecosystems and the status of the biosphere reserve have given local communities the opportunity to maintain their social welfare and to develop an economy based fundamentally on the tertiary sector but also on the primary sector and local industry. In fact, when comparing the non-protected region with the PA of the UBR, there were no significant differences for almost any variables. Only conifer plantations and scrublands, total population and employment in the primary sector presented significant differences along time. Specifically, even if the decrease of conifer plantations was fairly lower in the UBR, the general tendency showed better conservation features (native forest and marshland) and rural systems (forestry and other primary economic sector) in the UBR than the region outside the PA, while maintaining similar socioeconomic and cultural conditions. Besides, contrary to what happened in the non-PA, the production of the primary sector increased in the PA, being much higher, and employment in the industrial sector and the tertiary sector was maintained and increased, respectively, suggesting that the UBR encourages more diversity of uses and activities. Nevertheless, as indicated in the results, more effort is necessary to replace the conifer plantations, e.g. in those areas with high agrological capacity, and encourage sustainable forest management and local food production. So, rural life needs to be supported. After all, rural development should be viewed as the basis for any development strategy. Rural communities cannot be only considered as food or timber provider, but path for multifunctional landscapes where economic, socio-political, environmental, and cultural aspects of life are included and territorial cohesion promoted. Yet, forescast is not good. Although the population in the rural areas of the UBR has increased during this studied period (except for Elantxobe municipality), two municipalities (Bermeo and Gernika-Lumo) home to nearly 75% of the inhabitants of the UBR, and according to the latest UN (2017) projections, by 2050, 80-90% of the population will be living in cities and three-quarters are already living in urban areas in Europe.

5.1.2. Valuation of Ecosystem Services

Changes in ES influence all components of human well-being. Paradoxically, at the global level, declines in biodiversity, directly linked to ES (Balvanera et al., 2006; Harrison et al., 2014), have come together with gains in human well-being (MA, 2005), leading us to debate on how human well-being is being measured (Raudsepp-Hearne et al., 2010). GDP is usually used as an indicator of development, which is associated with human well-being, but it does not take into account the loss of welfare due to ecosystems' deterioration of biodiversity loss. Policy making has only been based on the attainment of the economic growth at the expense of large environmental and social costs, which are out of the calculation of traditional indicators of economic progress. Growth perspective exclusively focuses on the provisioning services and the cultural services like tourism and recreation, so that habitat for species and other regulating services are relegated to the PAs. Indeed, deficiencies in regulating and some cultural services are usually compensated by market mechanisms, making the maintenance of ES hard (e.g. chemicals and fertilizers substitute biological control and nutrient regulation services, dikes or dredging substitute erosion control service, or treatment plants take the place of water purification service).

This fact stimulated the call for new strategies with greater impact on decision making and economic arguments arose as a tool with which to push environmental problems up on political agenda. In this context, beyond some limitations, *Chapter 4.2* brought to light the economic impact of land use changes in the UBR. According to the results obtained with the benefit transfer method, the changes in land uses that have occurred during the last 44-year period have supposed a decrease of about 5% in the monetary value of ES. Provisioning services ESV was the most affected one due to the drastic reduction of the surface of croplands. Basically, pine and eucalyptus plantations took their place and timber extraction does not result such profitable as food production; in contrast, regulating services ESV increased and cultural services ESV remained roughly constant. So, we could say that losses were compensated by gains in the monetary value of other ES on behalf of landscape homogeneity and loss of multifunctionality. In addition, it is important to highlight that the monetary value did not change throughout time and in the case of pine and eucalyptus plantations every 30 and 10 years approximately the provision of regulating and cultural services is negatively impacted because of their management and clear cuts, and wood production is also reduced as plantations are cut and replanted. Thus, it might be obvious that the decrease in ESV could be even higher. Biophysical-monetary correspondence analysis suggested that the establishment of the biosphere reserve has contributed to its conservation goal, though, being the core area the one with the highest coupling between both valuations. Besides, similarities among zones revealed that, overall, the monetary value of ES is perceived as that based upon biophysical values across not only the core are, but also the buffer zone and the transition area.

But monetary values cannot be conceived as independent from the socio-cultural context due to their embeddedness in the social system. Hence, assuming that values are place-based and context specific, *Chapter 4.3* was useful to provide information that support management decisions since it analysed local population's preferences for changes in the level of supply of some provisioning, regulating and cultural ES related to different management scenarios. Understanding public preferences and WTP for ES and biodiversity conservation can be an effective strategy for delivering relevant information to decision makers in order to improve investments in nature conservation and land management policies. As far as the UBR, our results indicated that local population believes in the importance of investing in nature. People are willing to enhance the supply of different ES and go for another management strategy where functionality and regulating services are priority. Specifically, local population seems to be more concerned about ecosystems' health and landscape multifunctionality rather than recreation.

In this sense, the methodology used here to value ES and land uses in monetary terms, apart from helping in the achievement of desirable levels of ES supply according to the demands of society, could also be partially understood as an indicator of socio-cultural preferences instead of a market value *per se* (Chan et al., 2012). Actually, respondents' choices are usually influenced by non-economic factors related to socio-cultural values like ethical and moral motivations (Martín-López et al., 2007; Kumar & Kumar, 2008). But, even if it is famously acknowledged that stated preference survey methods (WTP and DCE methods) measure people's attitudes and preferences, one of the main criticism of these techniques is that they cannot capture the values of the whole population because they may restrict people with inability to pay due to income constrains or others. People with low financial power even depend on ES more than the rich, and therefore, they may result in a non-realistic measure for the demand. An example of that is examining the effect of ignoring or non-attendance to the price attribute on landscape preferences (van Zanten et al., 2016). According to this study, adding a price attribute to choice experiments substantially changed trade-offs and choices made by respondents. Likewise, these techniques, within the neoclassical economic paradigm, assume that individuals have rational preferences and try to maximize their profit on the basis of self-oriented motivations, so that other values like community ones and relational values are unlikely taken note of (Spash et al., 2009; Lo, 2014).

As a result, alternative valuation methods have been proposed and non-monetary techniques are gaining more and more visibility bringing to the table the multiple values of ES (Chan et al., 2012, 2016; Kenter et al., 2015). Willingness to give up time (WTT) and other approaches such as deliberative monetary methods have been proposed so as to overcome some limitations of the stated preference methods. WTT valuation method uses working hours to analyse social support for biodiversity conservation and ES delivery (García-Llorente et al., 2016), instead of monetary units as WTP or DCE. Since it is based on volunteering work, it is believed that respondents will behave on the basis of both self-oriented and others-oriented motivations (McDougle et al., 2015; Randle & Dolnicar, 2015); however, it also restricted the elderly and incapable people and other with time restrictions. Regarding deliberative or participatory monetary methods, they are considered to be more inclusive, allowing knowledge exchange and debate with locals and stakeholders; but group-based approaches also can make participants conform to social norms and hide their own opinion if valuation exercise is not proactively facilitated (Kenter et al., 2011).

Hence, all that is really clear is that every monetary valuation method present some advantages and drawbacks related to information and methodological misspecification, equity and problems with unfamiliarity, among others. Aware of these limitations and ambiguities, more likely in DCE valuation methods, our contribution to the literature is more focused on providing recommendations to better distribute budgets and minimize land use conflicts, rather than precise monetary values. Maintaining a PA is not cost-free, so our findings might be useful for policy makers to evaluate the suitability of investing more or less in one project or other. Moreover, informing about the potential monetary value of ES will hopefully inspire political will for conservation of environmental resources since it may dispel the belief that conservation is in conflict with economic objectives.

Nevertheless, worried about the the importance of value pluralism and the necessity to combine monetary valuation techniques with non-monetary or social valuation techniques, in *Chapter 4.4* we assessed whether the different metrics used to evaluate the commonly biophysical, monetary and socio-cultural value dimensions provide different information outputs in the UBR. Again, despite some limitations and chiefly non-adequacies in the monetary valuation of ES, we found that each dimension provided divergent information regarding their value and proposed a methodology to address mismatch patterns among the different components of ES, i.e. supply, demand and interest. Our findings strengthened arguments of former calls for integration of the biophysical, monetary and socio-cultural values if the whole complexity of ES is to be captured. In faith, the values obtained by economic approaches only partially reflect the concerns of the society and can be biased towards the information provided by markets (Martín-López et al., 2014). As expected, our study fulfilled what Simpson (2011) called a ‘paradox of valuation’, where the economic theory which predicts the high value of something on the basis of its scarcity/deterioration and its high demand/interest by society, is not taken place for all ES mainly due to market-based techniques' superiority over WTP method. In this regard, there can be no doubt that monetary valuation techniques used to value monetary value of ES need to be the same so as to avoid misunderstandings and ease comparison when interpreting the results.

5.2. TOWARDS A SUSTAINABLE SCENARIO: IMPLICATIONS FOR MANAGEMENT

Sustainability stems from the concept of sustainable development, which most widely is defined as the development that meets the needs of the present without compromising the ability of future generations to meet their own needs (WCED, 1987). It generally includes environmental, social and economic sustainability. Environmental sustainability refers to the maintenance of the natural capital; social sustainability acknowledges the importance of fostering relationships and cohesions between individuals based on a fair distribution of resources; and economic sustainability emphasizes a rational consumption of resources to create goods and services that add value to human lives. On the whole, the economy could be understood as a subset of society, which in turn is a subset of the environment. Therefore, in other words, sustainability involves the assessment of social relationships and interactions in living spaces in order to improve the degree of coexistence between groups of people.

5.2.1. Pragmatism and ecosystem services for sustainable development

Under global change scenario, the inclusion of sustainable development in political agendas has become a major aim, and the concept of ES comes out as a common mainstream for showing the links between ecosystems and society. The concept of ES has shifted our paradigm of how nature is important for human societies, in such a way that instead of viewing conservation of nature as something for which we have to sacrifice our well-being, now nature is perceived as natural capital, vital for society's well-being (Liu et al., 2010). In some way, ES concept has emerged as a new conservation paradigm in which conservation is no longer just focused on intrinsic approaches, because its importance in itself, but also its instrumental or utilitarian value, where ecosystems are directly linked to the generation of several contributions to the society. And here is where economic valuation plays a key role. In fact, even though ES concept was conceived as an interdisciplinary idea, which integrates social and natural sciences, economic valuation is dominant in the scientific literature (Bernués et al., 2014; Quintas-Soriano et al., 2016).

Within this context, ES have been a very powerful tool to ecologize economics by introducing ecological ideas to economic thinking and by making understand that ecosystems and biodiversity are not only a matter of ethics and aesthetics, but the very material foundations of human societies (Gómez-Baggethun & de Groot, 2010). Moreover, their economic valuation also calls attention to the contradiction of infinite growth in a finite world and underlines the environmental costs of nature degradation. Yet, the human population is increasingly disconnecting to nature, and at the same time, is more dependent than ever on ecosystems and the services they provide (Wiedmann et al., 2015).

According to our results, place-based monetary approaches suggest that two main management strategies ought to be adopted to enhance human well-being and increase sustainability: conservation and recovery of natural ecosystems and promotion of good agrarian practices. As demanded by the local population of the UBR, the improvement of the quality of water bodies shall be a priority and native forest and organic farming would need to increase their surface. From the landscape planning perspective, a suitable response option towards sustainability could be then to promote a shift from the current forest plantation monoculture landscape to a multifunctional traditional countryside mosaic landscape. The substitution of pine and eucalyptus monoculture plantations and their associated management by native forest would enhance the quality of water bodies to a degree by reducing clogging problems in rivers, soil and nutrient loss (Merino et al., 2004; Rodríguez-Loinaz et al., 2011; Garmendia et al., 2012), and contribute to the biodiversity protection, which was another important attribute in terms of monetary values for the local population. Similarly, the promotion of organic farming, and other sustainable arable land or good practices in agriculture, in general, would also lead to an increase in biodiversity, while gaining self-provisioning and reinforcing food security.

This need for recovering natural ecosystems and increasing organic farming has also been previously recognized as a fundamental element for the future landscape of our area (Onaindia et al., 2013; Rodríguez-Loinaz et al., 2011, 2013). Likewise, a socio-cultural valuation of ES in an area next to the UBR highlights users demand for local food provision (Casado-Arzuaga et al., 2013), and a participatory process developed from the regional scale of Biscay (Palacios-Agundez et al., 2013, 2014) identifies new landscape planning strategies principally based on changes in forest management and local organic production. It is important to point out that this local participatory process carried out by Palacios-Agundez et al. (2013, 2014) for landscape planning is having a policy impact thanks to the involvement of public administration technicians and policy makers, and is being included in the strategic policy plan for sustainability of the county. However, to accomplish the specific strategies and actions to be implemented by the government and public sector in the transition towards sustainability, usually incentives are needed.

5.2.2. Beyond money and self-oriented motivations: Value pluralism

The risk appears when tempting to believe in optimal solutions automatically provided by the markets. As suggested by Kallis et al. (2013), the question is not whether to reject money or not when valuing nature, but to think about when and how to value with money. If the goal is an egalitarian social-ecological transition, then, economic valuation is totally acceptable. However, four criteria should be satisfied (Kallis et al., 2013): environmental improvement; distributive justice and equality; maintenance of plural value-articulating institutions; and confronting commodification.

First and second criteria are clear. Environmental conditions at stake and social equalities must be improved and power redistributed. For example, economically weaker communities must be taken into account, and in case of an extra charge to ES users, monetary payment vehicle needs to be adapted to those people with lower income. As for the third criterion, other languages of valuation and complexity are claimed. Indeed, valuing nature is not only about putting a monetary value to it. The status of ES is influenced by both ecosystems and social systems, and therefore, pathways to sustainability require a valuation of the whole supply-demand framework (Griggs et al., 2013), including the supply, demand and interest components of ES. As Rockström (2015) stated, the number one economic threat to humanity is our inability to value nature, and beyond instrumental values, generally measured in monetary terms, plural values are gaining momentousness (Jacobs et al., 2016; Pascual et al., 2017; Arias-Arévalo et al., 2018). Following Einstein's dictum that "a problem cannot be solved by the same mindset that helped create it", if ES are playing a role in solving sustainability challenges, we cannot reduce the concept of ES to a unique metric nor methodology, but an integrated and holistic approach. Thus, to comprehend the complexity of ES and the SES they are embedded in, it is fundamental to assess the suppliers of services (ecosystems), as well as the beneficiaries or stakeholders and the diversity of the institutions or governance (social systems).

Furthermore, with regard to the fourth criterion, it is important to mention that economic valuation has often served, usually against the will of its promoters, as discursive framing and metrical technology for the commodification of ES (Robertson, 2006), which eventually degrades SES. According to Kallis et al. (2013), commodification is part of processes of capitalist development through accumulation by dispossession, i.e. enclosure of the commons (Harvey, 2007), accentuated under neo-liberalism. The result is the expansion of the commodity into previously non-marketed areas, leading to potentially counterproductive effects in the long term for biodiversity conservation and equity of access to ES (Gómez-Baggethun & Ruiz-Perez, 2011). So, judgement and awareness of the political-economic context within which economic valuation takes place is crucial, if we do not want to fall into what Gómez-Baggethun & Ruiz-Perez (2011) called the 'tragedy of well-intentioned valuation'. We have to demarcate the space for money and commodities in environmental policy, and then, decide which externalities we want to internalize in the market and which internalities externalize out of the market, as it was done before for instance with slavery (Gómez-Baggethun & Ruiz-Perez, 2011).

In conclusion, ethical, political, responsibility and other postures need to be considered when valuing ES and mastered holistically applying value pluralism where biophysical, monetary and socio-cultural values are seen primarily as complements and not as substitutes. But specially, political action is required to oppose undesirable commodification and make sure that plural values and institutions exist and proliferate (Kallis et al., 2013).

5.3. The challenge of integrating ecosystem services in decision making

Valuation of ES is widely recognized as an important step to support more sustainable management decisions, identify trade-offs and resolve potential conflict of interest between stakeholders (Farber et al., 2002; Costanza et al., 2011; Castro et al., 2014). Yet, many issues remain to be resolved to fully integrate ES value in decision making and their operationalization is still a challenge (Jax et al., 2018).

To start with, we have the necessity of collaboration and joint work among management technicians, policy makers, researches and other stakeholders. One can say that one's work may be useful for decision making, but if there is no implication and close interaction with stakeholders, hardly will political application exist (Burkhard et al., 2010). Many are the reasons which hinder the implementation of ES measures in policy and land management, but lack of communication and proper financing instruments are likely to be the most common ones (de Groot et al., 2010; Saarikoski et al., 2018).

Lack of communication might be the consequence of conceptual and methodological shortcomings. Certainly, although it may seem quite obvious, knowledge should be clearly communicated and ES language expanded beyond scientific literature to professional activities and general public. The management of ES requires considering every level of institutional diversity, starting from non-formal institutions or traditional knowledge (local scale) to legal and formal institutions such as laws and economic incentives (regional, national and global scale) (Gómez-Baggethun et al., 2013). That is, again a holistic approximation where biophysical, economic and socio-cultural aspects are considered is needed. Otherwise, if we do not incorporate socio-cultural values through non-formal institutions, we will find ourselves in a 'conservation against development' model, in which land use intensification or provisioning services' promotion is development, and regulating services' promotion is conservation (Folke, 2006; Martín-López et al., 2011); which, in turn leads us to provide monetary information so as to persuade decision makers about the profitability of conserving rather than degrading.

But to bring about a change in decision making, it is fundamental to embed ES values in formal institutions. In fact, even if local communities are the base of the pyramid, without formal institutional change, communities are likely to continue carrying on bad behaviors, harmful to society, like overfishing or high use of fossil fuels (Daily et al., 2009). Specifically, in Biscay, it is disconcerting the role of the Administration regarding the exotic plantations and their management. It is true that lately, sustainable forest management by forest certification (PEFC – Programme for the Endorsement of the Forest Certification) has been promoted and currently, 22% of the forest plantations in Biscay are certificated (OBSERVAPEFC; www.observapefc.es). However, even if the intentions seems to be on the right track, it must be highlighted that, contrary to the FSC – Forest Stewardship Council, which was the first forest certification in 1993 and promoted by conservationist NGOs, PEFC was promoted by companies of the timber industry, and therefore, environmental requirements are much lower than the ones suggested by the FSC. What is more, the Administration still continue favoring forest subsidies oriented to trees of the same age, planted and harvested simultaneously by clear cuts, and it seems not to be worried about the substitution of pine plantations by eucalyptus monocultures. The increase of eucalyptus plantations is the worst thing that could ever happen since the environmental problems would triple in the same period of time and the capacity for regeneration would be severely affected. But instead of setting an example, roughly 70% of forest area in Public Utility Woodlands is covered by pine and eucalyptus plantations and recently, it has also expressed its opposition to different measures proposed by a platform called *Kolore guztietako basoak* for the recovery of the native forest in Biscay (Kolore guztietako basoak; https://koloreguztietakobasoak.wordpress.com/), which basically asked for sustainable management of these forests and native forest plantation and conservation in public areas. But, we must point out that, better than nothing, some other measures have been accepted. Consequently, from now on, plantations with native species in Public Utility Woodlands will not be disposed in lines or grids, and by the end of 2018, for those private owners who decide to join the initiative, a new line of subside will be created, too.

Here, is where financing instruments, through the economic valuation of ES, usually take part to achieve which should be a more sustainable and long-term management of our natural resources and landscapes. These economic compensations are based on an opportunity cost principle, according to which the cost of a missed opportunity or the costs associated with forgone opportunities to convert land to profitable uses, ought to be compensated (Adams et al., 2010; Schmidt et al., 2014). In this sense, initiatives like Payment for Ecosystem Services (PES) are becoming increasingly popular as a way to incentivize conservation and sustainable resource management (van Noordwijk et al., 2012; Pascual et al., 2014; Ferguson et al., 2016). PES schemes are institutionalized payments which involve users of ES paying for actions that protect or reduce impacts on those services (Wunder et al., 2008). If these new financing approaches consider both biophysical and socioeconomic local conditions, they may enhance ecosystem management and contribute to the well-being of local communities (Wunder, 2013). Still, as it was mentioned before, this is something to think carefully not to fall into the ‘tragedy of well-intentioned valuation’. In fact, concerns related to these environmental incentive programs include (Chan et al., 2017a): new externalities, misplaced rights and responsibilities, burden of monitoring, motivational crowding out, equity, limited applicability, and top down prescription.

New externalities may be created for instance when referring to reforestation or afforestation programs, wherein exotic plantations of fast growing trees may be promoted on behalf of carbon sequestration (Alexander et al., 2011). Besides, PES could change our understanding of responsibility and provoke people to degrade unless they are paid (Gómez-Baggethun & Ruiz-Pérez, 2011; Solazzo et al., 2015), as well as destroy our intrinsic or altruistic motivations to conserve (Rode et al., 2015). Erroneously, all this may lead to cheats and to the idea that the polluter is paid. Moreover, and related to the previously commented distributive justice and equality, efficiency might exclude poorer (small landowners) and those who are already engaged in better practices (Pascual et al., 2014). Apart from that, the application of PES schemes usually is very limited to concrete cases where concrete beneficiaries pay concrete providers to promote conservation activities for a very concrete ES, without considering synergies and trade-offs (Rodríguez-Loinaz et al., 2018). Lastly, the last issue comes from the inflexibility of PES programs and non-invitation to participate, even if it is well-known that successful environmental policies towards sustainability require enhancing stewardship.

As Chan et al. (2017a) suggested, to contribute to sustainability, PES programs need to increase non-monetary motivations to participate and support stewardship. The program should act as a reward for leadership in land management and by offering only a co-pay, crowding out existing motivations for conservation could be avoided and responsibilities would be more evenly distributed (Chan et al., 2017b). Summing up, local knowledge and participation are essential. Again, it is necessary to emphasize the need for placing non-formal institutions, through their local knowledge, in the basis of any institutional pyramid, so that the sense of belonging and social participation are promoted, and ultimately, people and nature reconnected. But for real human-nature connections that may help transform society towards sustainability, we need to identify those leverage points (Abson et al., 2017; Ives et al., 2018), i.e. places in complex systems where a small shift can foster transformational system changes (Meadows, 1999), and interplay between formal and non-formal institutions is fundamental.

In the case in question, and in line with the proposal of Rodríguez-Loinaz et al. (2018) in Biscay, substituting exotic plantations by native forests and increasing the cover of organic farming could be the basis of our incentive mechanism. This change would address multiple ES, instead of thinking about the environment in terms of single issues. As commented before, it would improve the quality of water bodies, while enhancing biodiversity and most likely tourism and recreation due to aesthetic value increase. Timber market could also be successful because of its higher quality (Breukink et al., 2015) and clear cuts could be got past. What happens is that the low differences in subsidies between exotic plantations and native ones do not make economically beneficial betting on native ones taking into consideration their longer periods of time. Therefore, and considering that nowadays the timber sector is not profitable anymore because of globalisation and the reduction of the demand by the building sector (Rodriguez-Loinaz et al., 2018), as well as the damage caused by fungi in pine plantations, new scenarios have to be created, and due to the high private ownership in the UBR, PES seems to be the best option. These financing schemes have already been applied in many countries of the world and seek to be an alternative towards green growth in those places where the main asset is natural capital. It is argued that these incentives and friendly taxations may be more efficient than subsidies because they reward and promote sustainable practices, while subsidies do not necessarily contribute to the supply of ES.

To finance the extra cost for promotion of native forest, we believe that, little by little, the budget set aside for pine and eucalyptus plantations could be reallocated to native forest. So, at first, not to create so much conflicts, a little reduction in timber sector budget and increase in the promotion of native forest could be done, until eventually, the budget is totally reallocated. Those already planting native species, would also receive some extra money in the beginning for the services provided. Anyhow, forestry management must be changed to a sustainable one. Moreover, it cannot be acceptable that the Administration continue planting non-native species in Public Utility Woodlands. Thus, one option to prevent this could be to redistribute the budget to finance municipalities according to the cover of native forest in these areas, so that other municipalities might be encouraged to move sustainability into decision making. Similarly, the Administration should also implement some measures to support urban eco gardens in vacant or idle lands and in those areas with high agrological capacity, for the production of healthy and pesticide-free food, and other ES such as air regulation, habitat for species and recreation and environmental education. Here, Land Stewardship (LS) (www.landstewardship.eu) might be a good option too. It involves voluntary agreements of use transfer and/or purchase and sale between land owners or public institutions and NGOs to gain access to land management for conservation purposes. Currently, foundations like *Lurgaia Fundazioa* manage around 150 ha of land for native forest recovering in the UBR, and it is expected that its surface will increase (J. Hidalgo, personal communication, September 2018). But the Administration could also turn to NGOs to sign agreements with the private owners of these lands to support organic farming in exchange for technical advice and monitoring. Eventually, measures ought to be taken to involve local companies in conservation initiatives like PES to mitigate impacts and contribute to nature protection. All this could help to change the negative perception that some people may have about the forest sector or other industries and foster a transition to sustainability.

5.4. PERSPECTIVES FOR FURTHER RESEARCH

This research provides some insights for the implementation in landscape planning of ES assessment, but much more work is still needed to achieve a comprehensive integration of ES framework in the UBR. Basically, three important gaps to consider within this work might be the lack of temporal ES assessment and participatory processes, and the large unanswered questions regarding the incentive mechanism for its applicability in solution-oriented sustainability science.

Further research should be convenient to assess both spatial and temporal dimensions when valuing ES, not to misunderstand the values obtained. Biophysical, economic and socio-cultural valuation of ES is context dependent and varies according to the spatial and temporal scale, as well as stakeholders or groups of beneficiaries. The integration of these data would make it possible to incorporate planning and management decisions in ES assessment and therefore, reduce under/overestimations.

In addition, as previously discussed, participatory processes with local stakeholders, policy makers and management technicians of local and regional governments would facilitate a better understanding among the different parts and make feel stewardship, so that people's involvement would increase. In addition, considering the importance of complementing the different values of ES, further research which combines different techniques or valuations by mixing qualitative and quantitative methods is needed. To give an example, WTP, WTT and other ES valuation methods like preference rankings may be combined with a narrative valuation approach or deliberative methods. Actually, although in *Chapter 4.4.* we proposed a methodology that enable us to combine the different components of ES so as to compare their values, the next step would be to organize a kind of workshops to analyse the results obtained and reach a settlement.

Likewise, results in *Chapter 4.3* also give us information about the priorities of local population in the UBR, which may serve as a good starting point to establish environmental incentive programs. However, before implementing anything we should answer some questions that could be: Who should pay for these? Which should be the vehicle of payment and the distribution? How to involve beneficiaries into the payments and motivate providers by themselves? How can it be monitored? And again, a participatory process might be the key. Besides, understanding respondents' attitudes and motivations for paying for a hypothetical scenario may help managers and politicians decide more appropriate investment measures. Hence, another step in this research would be to study the interactions between socio-economic and other variables of interests and attributes variables such as cost. Moreover, we have already done almost 200 online questionnaires to citizens of the Basque Country and in the future, the idea would be to compare the results obtained with the local population and Basque citizens outside the UBR. Nonetheless, it is important to highlight that conflict resolution cannot begin with the application of monetary instruments, but the analysis of the problem or drivers of change, and usually, the way to solve these conflicts will be achieved by combining different instruments like a better legislation and PES. In this sense, studying motivations of those people who already are properly managing a common good may help to better implement these type of instruments, so that instead of paying for supplying a service, they are rewarded.

References

Abson, D.J., Fischer, J., Leventon, J., Newig, J., Schomerus, T., Vilsmaier, U., et al., 2017. Leverage points for sustainability transformation. Ambio 46(1), 30-39.

Adams, V.M., Pressey, R.L., Naidoo, R., 2010. Opportunity costs: Who really pays for conservation? Biol. Conserv. 143, 439-448.

Alexander, S., Nelson, C.R., Aronson, J., Lamb, D., Cliquet, A., Erwin, K.L., et al., 2011. Opportunities and Challenges for Ecological Restoration within REDD+. Restor. Ecol. 19, 683-689.

Arias-Arévalo, P., Gómez-Baggethun, E., Martín-López, B., Pérez-Rincón, M., 2018. Widening the evaluative space for ecosystem services: A taxonomy of plural values and valuation methods. Environ. Value 27(1), 29-53(25).

Balvanera, P., Pfisterer, A.B., Buchmann, N., He, J.-S., Nakashizuka, T., Raffaelli, D., Schmid, B., 2006. Quantifying the evidence for biodiversity effects on ecosystem functioning and services. Ecol. Lett. 9, 1146-1156.

Bernués, A., Rodríguez-Ortega, T., Ripoll-Bosch, R., Alfnes, F., 2014. Socio-Cultural and Economic Valuation of Ecosystem Services Provided by Mediterranean Mountain Agroecosystems. PLoS ONE 9(7): e102479.

Breukink, G., Levin, J., Mo, K., 2015. Profitability and Sustainability in Responsible Forestry: Economic Impacts of FSC Certification on Forest Operators. World Wide Fund for Nature, Gland, Switzerland.

Burkhard, B., Petrosillo, J., Costanza, R., 2010. Ecosystem services: bridging ecology, economy and social sciences. Ecol. Complex. 7, 257-259.

Burkhard, B., de Groot, R., Costanza, R., Seppelt, R., Jorgensen, S.E., Potschin, M., 2012. Solutions for sustaining natural capital and ecosystem services. Ecol. Indic. 21, 1-6.

Casado-Arzuaga, I., Madariaga, I., Onaindia, M., 2013. Perception, demand and user contribution to ecosystem services in the Bilbao Metropolitan Greenbelt. J. Environ. Manage. 129, 33-43.

Castro, A.J., Verburg, P.H., Martín-López, B., García-Llorente, M., Cabello, J., Vaughn, C.C., López, E., 2014. Ecosystem service trade-offs from supply to social demand: a landscape-scale spatial analysis. Landsc. Urban Plan. 132, 102-110.

Chan, K.M.A., Satterfield, T., Goldstein, J., 2012. Rethinking ecosystem services to better address and navigate cultural values. Ecol. Econ. 74, 8-18.

Chan, K.M.A., Balvanera, P., Benessaiah, K., Chapman, M., Diaz, S., Gomez-Baggethun, E., et al., 2016. Why protect nature? Rethinking values and the environment. PNAS 113, 1462-1465.

Chan, K.M.A., Anderson, E., Chapman, M., Jespersen, K., Olmsted, P., 2017a. Payments for ecosystem services: Rife with problems and potential—For transformation towards sustainability. Ecol. Econ. 140, 110-122.

Chan, K.M.A., Olmsted, P., Bennett, N., Klain, S.C., Williams, E.A., 2017b. Can Ecosystem Services Make Conservation Normal and Commonplace? In: Levin, P.S., Poe, M.R. (Eds.), Conservation for the Anthropocene Ocean, 225-252.

Costanza, R., Kubiszewski, I., Ervin, D., Bluffstone, R., Boyd, J., Brown, D., et al., 2011. Valuing ecological systems and services. F1000 Biology Reports 3, 14.

Daily, G., Polasky, S., Goldstein, J., Kareiva, P.M., Mooney, H., Pejchar, L. et al., 2009. Ecosystem Services in Decision Making: Time to Deliver. Front. Ecol. Environ. 7(1), 21-28.

de Groot, R.S., Alkemade, R., Braat, L., Hein, L., Willemen, L., 2010. Challenges in integrating the concept of ecosystem services and values in landscape planning, management and decision making. Ecol. Complex. 7(3), 260-272

Europarc-España. 2017. Anuario 2016 del estado de las áreas protegidas de España. Ed. Fundación Fernando González Bernáldez. Madrid.

Ferguson, I., Levetan, L., Crossman, N.D., Bennett, L.T., 2016. Financial Mechanisms to Improve the Supply of Ecosystem Services from Privately-Owned Australian Native Forests. Forests 7, 34.

Folke, C., 2006. The economic perspective: conservation against development versus conservation for development. Conserv. Biol. 20, 686-688.

García-Llorente, M., Castro, A. J., Quintas-Soriano, C., López, I., Castro, H., Montes, C., Martín-López, B., 2016. The value of time in biological conservation and supplied ecosystem services: A willingness to give up time exercise. J. Arid Environ. 124, 13-21.

Garmendia, E., Mariel, P., Tamayo, I., Aizpuru, I., Zabaleta, A., 2012. Assessing the effect of alternative land uses in the provision of water resources: evidence and policy implications from southern Europe. Land Use and Policy 29, 761-770.

Geijzendorffer, I.R., Cohen-Shacham, E., Cord, A.F., Cramer, W., Guerra, C., Martín-López, B., 2017. Ecosystem services in global sustainability policies. Environ. Sci. Policy 74, 40-48.

Gómez-Baggethun, E., de Groot, R., 2010. Natural capital and ecosystem services: The ecological foundation of human society. In: Hester, R.E & Harrison, R.M (eds) Ecosystem Services: Issues in Environmental Science and Technology. Cambridge: Royal Society of Chemistry, 118-145.

Gómez-Baggethun, E., Ruiz-Pérez, M., 2011. Economic valuation and the commodification of ecosystem services. Prog. Phys. Geog. 35(5), 613-628.

Gómez-Baggethun, E., Kelemen, E., Martín-López, B., Palomo, I., Montes, C., 2013. Scale Misfit in Ecosystem Service Governance as a Source of Environmental Conflict. Society & Natural Resources: An International Journal 26(10), 1202-1216.

Griggs, D., Stafford-Smith, M., Gaffney, O., Rockström, J., Öhman, M.C., Shyamsundar, P., et al., 2013. Policy: sustainable development goals for people and planet. Nature 495, 305-307.

Harrison, P.A., Berry, P.M., Simpson, G., Haslett, J.R., Blicharska, M., Bucur, M., et al., 2014. Linkages between biodiversity attributes and ecosystem services: A systematic review. Ecosyst. Serv. 9, 191-203.

Harvey, D., 2007. A brief history of neo-liberalism. Oxford University Press, Oxford.

Ives, C.D., Abson, D.J., von Wehrden, H., Dorninger, C., Klaniecki, K., Fischer, J., 2018. Reconnecting with nature for sustainability. Sustain. Sci. 13(5), 1389-1397.

Jacobs, S., Dendoncker, N., Martín-López, B., Barton, D.N., Gómez-Baggethun, E., Boeraeve, F., et al., 2016. A new valuation school: Integrating diverse values of nature in resource and land use decisions. Ecosyst. Serv. 22(B), 213-220.

Jax, K., Furman, E., Saarikoski, H., Barton, D.N., Delbaere, B., Dick, J., et al., 2018. Handling a messy world: Lessons learned when trying to make the ecosystem services concept operational. Ecosyst. Serv. 29(C), 415-427.

Kallis, G., Gómez-Baggethun, E., Zografos, C., 2013. To value or not to value? That is not the question. Ecol. Econ. 94, 97-105.

Kenter, J.O., Hyde, T., Christie, M. Fazey. I., 2011. The importance of deliberation in valuing ecosystem services in developing countries—Evidence from the Solomon Islands. Global Environ. Chang. 21(2), 505-521.

Kenter, J.O., O'Brien, L., Hockley, N., Ravenscroft, N., Fazey, I., Irvine, K.N., et al., 2015. What are shared and social values of ecosystems? Ecol. Econ. 111, 86-99.

Kumar, M., Kumar, P., 2008. Valuation of the ecosystem services: a psychocultural perspective. Ecol. Econ. 64, 808-819.

Liu, S., Costanza, R., Farber, S., Troy, A., 2010. Valuing ecosystem services. Theory, practice, and the need for a transdisciplinary synthesis. Ann. NY. Acad. Sci., 1185, 54-78.

Lo, A.J., 2014. More or less pluralistic? A typology of the remedial and alternative perspectives on monetary valuation of the environment. Environ. Value. 23, 253-274.

MA, 2005. Ecosystems and Human Well-being: Synthesis. Island Press, Washington, DC.

Martín-López, B., Montes, C., Benayas, J., 2007. Influence of user characteristics on valuation of ecosystem services in Doñana Natural Protected Area (south-west Spain). Environm. Conserv. 34(3), 215-224.

Martín-López, B., García-Llorente, M., Palomo, I., Montes, C., 2011. The conservation against development paradigm in protected areas: Valuation of ecosystem services in the Doñana social–ecological system (southwestern Spain). Ecol. Econ. 70, 1481-1491.

Martín-López, B., Gómez-Baggethun, E., García-Llorente, M., Montes, C., 2014. Trade-offs across value-domains in ecosystem services assessment. Ecol. Indic. 37, 220-228.

McDougle, L., Handy, F., Katz-Gerro, T., Greenspan, I., Lee, H.-Y., 2015. Factors predicting proclivity and intensity to volunteer for the environment in the US and South Korea. J. Environ. Plann. Man. 58(5):837-854.

Meadows, D., 1999. Leverage points: Places to intervene in a system. Hartland: The Sustainability Institute.

Merino, A., Fernández-López, A., Solla-Gullón, F., Edeso, J.M., 2004. Soil changes and tree growth in intensively managed Pinus radiata in northern Spain. For. Ecol. Manage. 196, 393-404.

Onaindia, M., Fernandez de Manuel, B., Madariaga, I., Rodriguez-Loinaz, G., 2013. Co-benefits and trade-offs between biodiversity, the carbon storage and water flow regulations. Forest Ecol. Manag. 289, 1-9.

Palacios-Agundez, I., Casado-Arzuaga, I., Madariaga, I., Onaindia, M., 2013. The relevance of local participatory scenario planning for ecosystem management policies in the Basque Country, northern Spain. Ecol. Soc. 18(3): 7.

Palacios-Agundez, I., Fernandez de Manuel, B., Rodriguez-Loinaz, G., Peña, L., Ametzaga-Arregi I., Alday, J.G., et al., 2014. Integrating stakeholders' demands and scientific knowledge for the inclusion of ecosystem services in landscape planning. Landscape Ecol.

Pascual, U., Phelps, J., Garmendia, E., Brown, K., Corbera, E., Martin, A., et al., 2014. Social Equity Matters in Payments for Ecosystem Services. BioScience 64(11), 1027-1036.

Pascual, U., Balvanera, P., Díaz, S., Pataki, G., Roth, E., Stenseke, M., et al., 2017. Valuing nature’s contributions to people: the IPBES approach. Curr. Opin. Environ. Sustainability 26, 7-16.

Randle, M., Dolnicar, S., 2015. The characteristics of potential environmental volunteers: implications for marketing communications. Australas. J. Env. Man. 22(3),329-339.

Robertson, M.M., 2006. The nature that capital can see: Science, state and market in the commodification of ecosystems services. Environ. Plann. D 24, 367-387.

Rode, J., Gómez-Baggethun, E., Torsten, K., 2015. Motivation crowding by economic incentives in conservation policy: A review of the empirical evidence. Ecol. Econ. 117, 270-282.

Rodríguez-Loinaz, G., Amezaga, I., Onaindia, M., 2013. Use of native species to improve carbon sequestration and contribute towards solving the environmental problems of the timberlands in Biscay, northern Spain. J. Environ. Manage. 120, 18-26.

Quintas-Soriano, C., Martín-López, B., Santos-Martín, F., Loureiro, M., Montes, C., Benayas, J., García-Llorente, M., 2016. Ecosystem services values in Spain: A meta-analysis. Environ. Sci. Policy 55(1), 186-195.

Raudsepp-Hearne, C., Peterson, G.D., Tengö, M., Bennett, E.M., Holland, T., Benessaiah, K., MacDonald, G.K., Pfeifer, L., 2010. Untangling the Environmentalist's Paradox: Why Is Human Well-being Increasing as Ecosystem Services Degrade? BioScience 60(8), 576-589.

Rockström, J., 2015. 5 reasons why the economy is failing the environment, and humanity. World Economic Forum Annual Meeting Article.

Rodríguez-Loinaz, G., Amezaga, I., Onaindia, M., 2011. Efficacy of management policies on protection and recovery of natural ecosystems in the Urdaibai Biosphere Reserve. Nat. Areas J. 31, 358-367.

Rodríguez-Loinaz, G., Peña, L., Palacios-Agundez, I., Ametzaga-Arregi, I., Onaindia, M., 2018. Identifying Green Infrastructure as a Basis for an Incentive Mechanism at the Municipality Level in Biscay (Basque Country). Forests 9, 22.

Saarikoski, H., Primmer, E., Saarela, S., Antunes, P., Aszalós, R., Baró, F., et al., 2018. Institutional challenges in putting ecosystem service knowledge in practice. Ecosyst. Serv. 29(C), 579-598.

Schmidt, J.P., Moore, R., Alber, M. 2014. Integrating ecosystem services and local government finances into land use planning: A case study from coastal Georgia. Landsc. Urban Plan. 122, 56-67.

Spash, C.L., Urama, K., Burton, R., Kenyon, W., Shannon, P., Hill, G., 2009. Motives behind willingness to pay for improving biodiversity in a water ecosystem: economics, ethics and social psychology. Ecol. Econ. 68(4), 955-964.

Simpson, R.D., 2011. The Ecosystem Service Framework: A Critical Assessment. Ecosystem Services Economics (ESE), working paper n◦ 5. UNEP.

Solazzo, A., Jones, A., Cooper, N., 2015. Revising payment for ecosystem services in the light of stewardship: the need for a legal framework. Sustain. For. 7(11), 15449-15463.

UN, 2017. Department of Economic and Social Affairs, Population Division. World Population Prospects: The 2017 Revision, Key Findings and Advance Tables. Working Paper No. ESA/P/WP/248.

UNESCO, 2017. [online] Available at: www.unesco.org/ [Accessed 2018].

van Noordwijk, M., Leimona, B., Jindal, R., Villamor, G.B., Vardhan, M., Namirembe, S., et al., 2012. Payments for Environmental Services: Evolution Toward Efficient and Fair Incentives for Multifunctional Landscapes. Annu. Rev. Env. Resour. 37(1), 389-420.

van Zanten, B.T., Koetse, M.J., Verburg, P.H., 2016. Economic valuation at all cost? The role of the price attribute in a landscape preference study. Ecosyst. Serv. 22(B), 289-296.

WCED, 1987. World Commission on Environment and Development. Report of the World Commission on Environment and Development. G. H. Brundtland, (Ed.). Oxford: Oxford University Press.

Wiedmann, T.O., Schandl, H., Lenzen, M., Moran, D., Suh, S., West, J., Kanemoto, K., 2015. The material footprint of nations. P. Natl. Acad. Sci. 112 (20), 6271-6276.

Wunder, S., Engel, S., Pagiola, S., 2008. Taking stock: a comparative analysis of payments for environmental services programs in developed and developing countries. Ecol. Econ. 65(4), 834-852.

Wunder, S., 2013. When payments for environmental services will work for conservation. Conserv. Lett. 6, 230-237.

Chapter 6

Conclusions

If life seems jolly rotten
There's something you've forgotten
And that's to laugh and smile and dance and sing.
When you're feeling in the dumps
Don't be silly chumps
Just purse your lips and whistle - that's the thing.

And... always look on the bright side of life...
Always look on the light side of life...

For life is quite absurd
And death's the final word
You must always face the curtain with a bow.
Forget about your sin - give the audience a grin
Enjoy it - it's your last chance anyhow.

So… always look on the bright side of death…
A-*Just before you draw your terminal breath…*

Monty Python
Monty Python Sings

6. CONCLUSIONS

This study explores the complex linkages between human and natural systems by assessing ES and their components, and provides guidance for sustainable planning and management in the UBR. Below, the main conclusions of the thesis:

1) The designation of the UBR does not influence the local population negatively but does safeguard nature conservation, which could have enhanced socioeconomic development.

2) The land uses changes occurred during the last 44-year period have not had such a big impact on the economic valuation of ES, but clearly have homogenised the territory with a subsequent loss of multifunctionality. However, biophysical-monetary correspondence analysis suggests that the establishment of the biosphere reserve has contributed to its conservation goal, being the core area the one with the highest coupling between both valuations.

3) Designing future management strategies consistent with public expectations requires understanding social perceptions and considering their interests. The DCE may provide us with useful information for designing alternative management plans by considering social preferences.

   On the whole, local population in the UBR is willing to move away from the status quo situation in order to introduce new alternative management scenarios. It seems that respondents give more importance to ecosystems' health rather than recreation, preferring multifunctional land uses with the highest delivery of ES. Specifically, respondents' primary concern was the improvement of the quality of water bodies followed by the increase of native forest surface area, organic farming and biodiversity protection, whereas the recreation attribute was the least important service.

4) The divergent information we obtained by analysing the supply, demand and interest components of ES underscores the necessity of combining the different dimensions of ES instead of assessing them separately.

   Limitations of monetary metrics (market-based *vs.* WTP) and the fact that the socio-cultural valuation through the interest component of ES explained the highest variance in this study, invite us to reconsider the valuation *per se* and argue for the incorporation of multi-metric methods for developing an integrated assessment of ES and go towards value pluralism.

5) Beyond some methodological caveats, we proposed an innovative methodology for the assessment of possible (mis)matches among the supply, demand and interest components of multiple ES across different SEUs.

   Assessing mismatches can provide relevant insights in the identification of potential conflicts and assist policy makers in developing alternatives that are consistent with public expectations and the capacity of ecosystems. In the particular case of the UBR, we found that patterns of mismatch are associated with the set of ES rather than differences in land uses and socio-economic characteristics of the SES, as these patterns are consistent across the SEUs.

6) A suitable response option towards sustainability could be to foster a shift from the current forest plantation monoculture landscape to a multifunctional traditional countryside mosaic landscape by recovering natural ecosystems and by promoting sustainable agricultural and forestry practices.

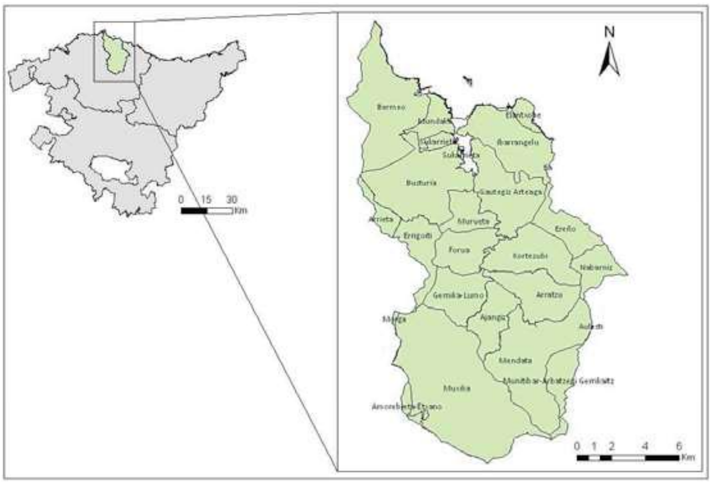
However, future research should be focused on participatory processes and on strengthening links between research and policy makers or management technicians and stakeholders to guarantee a successful implementation of sustainable management strategies.

QUESTIONNAIRE A

VALUATION OF DIFFERENT MANAGEMENT SCENARIOS IN THE URDAIBAI BIOSPHERE RESERVE

The University of the Basque Country UPV/EHU is conducting a study to analyse the opinion of the Basque population about the benefits that nature provides to humans.

The chosen space is the Urdaibai Biosphere Reserve, located in Busturialdea (Biscay, Spain), with an area of roughly 220 km^2 and 22 municipalities.



Have you ever visited the Urdaibai Biosphere Reserve? Yes ☐ No ☐

1. GENERAL CHARACTERISTICS:

Urdaibai was designed as a **Biosphere Reserve** in 1984 due to its natural and cultural value. Later, in 1993, it was added to the list of **Ramsar Wetlands** and European **Nature 2000 Network,** with 1 **Special Protection Area for Birds** and 3 **Special Areas of Conservation**.

1.1. Are you familiar with the "Biosphere Reserve" and/or "Nature 2000 network"? Yes ☐ No ☐

Next, we are going to describe the main characteristics of the Urdaibai Biosphere Reserve based on: 1) agricultural activity, 2) biodiversity (animals and plants), 3) quality of water bodies, 4) native forest and 5) recreation.

AGRICULTURAL ACTIVITY

Although the main economic source in the area was based on agriculture, it has lost its importance and only **3% of the territory are crops**. Currently, traditional farming (non-organic) predominates, but **organic farming is increasing, occupying nearly 0.5% of the territory**, i.e., one-sixth of the total agricultural area.

Agricultural activity in the area is organised into small crops, which has helped to shape the typical landscape of the Basque villages. In addition, the "***Alubias y Pimientos de Gernika***" quality label, together with the *txakoli* and other products, make the region a benchmark of high-quality agricultural products.


Cultivated lands


Plowing


Monday in Gernika


"Baserri" (traditional Basque house)

1.2. Do you live in a rural area? Yes □ No □

BIODIVERSITY (Animals and Plants)

The great variety of habitats in the area leads to an important biodiversity. In total, **more than 700 species of fauna and 800 species of flora** are counted. Specifically, the estuary constitutes an area of special interest because of its unique vegetation and for being a rest area for birds, both migratory and indigenous.


Basque armeria


Spoonbill


Tropical fern


European mink


Greater horseshoe bat


Dragonfly

1.3. Do you consider yourself fond of animals and plants? Yes □ No □

QUALITY OF WATER BODIES

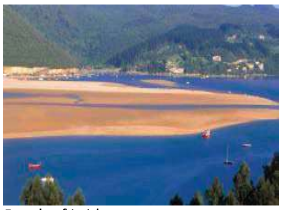
Four types of water bodies can be distinguished in Urdaibai: rivers, marshland, coastal waters and groundwaters.

The Water Framework Directive classifies the **global state of water bodies according to their chemical state and ecological state** as "good" or "worse than good". In Urdaibai **coastal waters and rivers have a "good" global state, except the Artigas river.** Meanwhile, groundwater, particularly **the aquifer of Gernika, and the marshland,** where there are several bathing areas such as the beach of Laidatxu and Sukarrieta, **have a "worse than good" global state**.

River

Superior estuary of the Oka river

Marshland



Beach of Laida

1.4. Do you think that the water quality of bath areas in Urdaibai is good? Yes □ No □

NATIVE FOREST

Native forest comprises trees like oaks, beeches and holm oaks. In Urdaibai the native forest is highly fragmented, in spite of its increasing surface area thanks to various protection measures. Approximately **17% of the territory** is occupied by native forest, highlighting the Cantabrian holm oak forest for being one of the most important coastal forests of the Autonomous Community of the Basque Country.

Among other benefits, they contribute to the formation and stabilization of soil, improve air quality and carbon sequestration, increase water availability, water quality and scenic beauty of the landscape, and they are natural habitats for a great variety of species.

Cantabrian holm oak forest

Beech forest

Oak forest

1.5. Do you consider native forests attractive? Yes □ No □

RECREATION

Urdaibai has an important **cultural, architectural and archaeological heritage**, highlighting due to its symbolic value the Tree of Gernika and the Assembly House. It has **around 150 km of paths and 24 recreational areas**, which together with the wide range of outdoor activities and tourist accommodations has meant a new appeal for the traditional summer tourism oriented to beaches.


Tree of Gernika


Path


Roman site in Forua


Vantage point in Ogoño


Canoeing


Birds observatory

1.6. Do you usually use paths and recreational areas of Urdaibai? Yes ☐ No ☐

2. ALTERNATIVES AND MANAGEMENT COSTS:

The management of Urdaibai is expensive and requires money. Annually, the Basque Government and other Basque entities allocate some money to conservation and enhancement of the territory. Nevertheless, this amount of money varies from year to year depending on the priorities.

Therefore, the authorities are considering protecting Urdaibai in a special way by **creating a Foundation linked to the United Nations Environment Programme** (UNEP). This Foundation would ensure different levels of conservation and environmental services depending on the money available.

Now, we will show you different future alternatives of management proposed in Urdaibai:

Organic farming

It is estimated that if there is no intervention, the area dedicated to organic farming will remain as usual, roughly 0.5% of the area of Urdaibai. Depending on the actions carried out, the area dedicated to **organic farming could be raised to 2% or 5% of the area of the territory**, by promoting good environmental practices and management (e.g. reducing or eliminating plowing to prevent soil loss, minimizing the use of chemical pesticides, mixing trees or shrubs and creating habitat for pollinators or other species), as well as initiatives such as urban gardens, which would also serve as a tool for environmental education.

No intervention	With intervention	
0.5%	**2%**	**5%**

2.1. Do you usually consume agricultural products with a quality label (*Eusko Label*, Ecological Agriculture...)? (1=not at all, 5=very much)

1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐

Biodiversity protection

It is estimated that if there is no intervention, the number of threatened species will remain as usual. Approximately, Urdaibai has 70 species of flora and fauna included in the Basque Catalogue of Threatened Species out of which 5 are protected through management plans. Depending on the actions carried out, the number of **endangered species protected** in the area **could increase** from 5 **to 15 or 25 species**.

No intervetion	With intervention	
5 **species protected**	**15** **species protected**	**25** **species protected**

2.2. How important is the flora and fauna to you? (1=not at all, 5=very much)

1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐

Quality of water bodies

It is estimated that if there is no intervention, the quality state of water bodies will remain as usual. Depending on the actions carried out, the quality of the **Artigas river, together with the marshland, could improve to a "good" state (BETTER)**, **or** it might even happen that the state of **all the rivers, the marshland and groundwater change to "good" (OPTIMUM)**.

No intervention	With intervention	
		
NO CHANGES	BETTER	OPTIMUM

2.3. How important is the state of the water bodies to you? (1=not at all, 5=very much)

1 □ 2 □ 3 □ 4 □ 5 □

Native forest

It is estimated that if there is no intervention, the surface area of native forest will remain as usual, approximately 17% of Urdaibai. Depending on the actions carried out, **the area occupied by native forest could increase to 30% or 40%**, always by the substitution of pine and eucalyptus plantations, which occupy more than the half of the territory.

No intervention	With intervention	
17% 	30% 	40% 

2.4. How important is the native forest to you? (1=not at all, 5=very much)

1 □ 2 □ 3 □ 4 □ 5 □

Recreation

It is estimated that if there is no intervention, paths and recreational areas will remain as usual. Depending on the actions carried out, they could present a **"BETTER" or "OPTIMUM" state of conservation**.

No intervention	**With intervention**	
NO CHANGES	**BETTER**	**OPTIMUM**

2.5. How important is recreation by use of paths and recreational areas to you? (1=not at all, 5=very much)

1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐

3. CHOICES ELECTION:

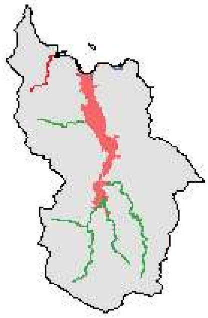
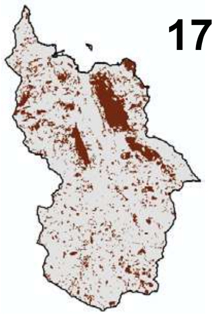
If the Foundation mentioned above was set up, it would be **funded by annual payments from all Basque citizens for 10 years.**

The money available to the Foundation **will depend on what the vast majority of respondents decide. If you deny paying, it would not be possible to carry out the proposed actions.**

3.1. Do you understand the aim and consequences of contributing economically or not? Yes ☐ No ☐

Now we will show you **different sets with several intervention options** (Current situation, Programme 1 or Programme 2). Please select the option where you best fit in for each choice set.

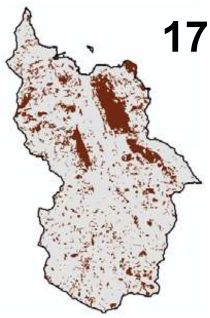
3.2. If you had to pay a certain amount of money to achieve the different levels of protection listed in this table, which choice would you prefer?[1]

BLOCK 1 - 1	Current situation	Programme 1	Programme 2
ORGANIC FARMING % of organic farming	**0.5%**	**0.5%**	**5%**
BIODIVERSITY PROTECTION Nº of species protected	**5** **species protected**	**15** **species protected**	**25** **species protected**
QUALITY OF WATER BODIES Global state of water bodies	 **NO CHANGES**	 **BETTER**	 **NO CHANGES**
NATIVE FOREST % of native forest	**17%** 	**40%** 	**30%** 
RECREATION State of conservation of paths and recreational areas	**NO CHANGES**	**OPTIMUM**	**NO CHANGES**
COST (€) Annual payment till 2026 (10 years)	 **0 €**	 **15 €**	 **30 €**

Chosen option: A ☐ B ☐ C ☐

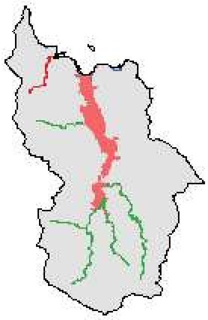
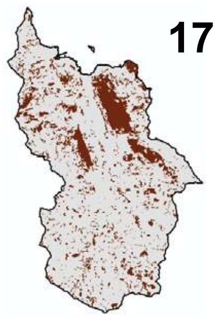
[1] If respondents choose Option A, ask 3.8; if not, continue with the next choice set.

3.3. And in this case, which choice would you prefer?

BLOCK 1 - 2	Current situation	Programme 1	Programme 2
ORGANIC FARMING % of organic farming	**0.5%**	**2%**	**5%**
BIODIVERSITY PROTECTION Nº of species protected	**5** **species protected**	**25** **species protected**	**5** **species protected**
QUALITY OF WATER BODIES Global state of water bodies	 **NO CHANGES**	 **OPTIMUM**	 **BETTER**
NATIVE FOREST % of native forest	**17%** 	**17%** 	**30%** 
RECREATION State of conservation of paths and recreational areas	**NO CHANGES**	**BETTER**	**NO CHANGES**
COST (€) Annual payment till 2026 (10 years)			

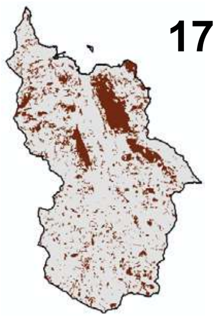
Chosen option: A ☐ B ☐ C ☐

3.4. And in this case, which choice would you prefer?

BLOCK 1 - 3	Current situation	Programme 1	Programme 2
ORGANIC FARMING % of organic farming	**0.5%**	**5%**	**0.5%**
BIODIVERSITY PROTECTION Nº of species protected	**5** **species protected**	**15** **species protected**	**5** **species protected**
QUALITY OF WATER BODIES Global state of water bodies	 **NO CHANGES**	 **BETTER**	 **NO CHANGES**
NATIVE FOREST % of native forest	**17%** 	**17%** 	**40%** 
RECREATION State of conservation of paths and recreational areas	**NO CHANGES**	**OPTIMUM**	**NO CHANGES**
COST (€) Annual payment till 2026 (10 years)			

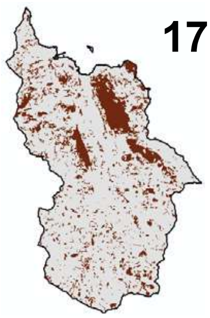
Chosen option: A ☐ B ☐ C ☐

3.5. And in this case, which choice would you prefer?

BLOCK 1 - 4	Current situation	Programme 1	Programme 2
ORGANIC FARMING % of organic farming	**0.5%**	**2%**	**0.5%**
BIODIVERSITY PROTECTION Nº of species protected	**5** **species protected**	**5** **species protected**	**15** **species protected**
QUALITY OF WATER BODIES Global state of water bodies	 **NO CHANGES**	 **BETTER**	 **NO CHANGES**
NATIVE FOREST % of native forest	**17%** 	**40%** 	**17%** 
RECREATION State of conservation of paths and recreational areas	**NO CHANGES**	**BETTER**	**OPTIMUM**
COST (€) Annual payment till 2026 (10 years)	**0 €**	**100 €**	**50 €**

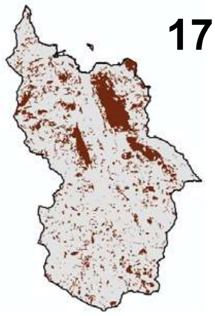
Chosen option: A ☐ B ☐ C ☐

3.6. And in this case, which choice would you prefer?

BLOCK 1 - 5	Current situation	Programme 1	Programme 2
ORGANIC FARMING % of organic farming	**0.5%**	**5%**	**0.5%**
BIODIVERSITY PROTECTION Nº of species protected	**5** **species protected**	**15** **species protected**	**25** **species protected**
QUALITY OF WATER BODIES Global state of water bodies	 **NO CHANGES**	 **OPTIMUM**	 **BETTER**
NATIVE FOREST % of native forest	**17%** 	**40%** 	**17%** 
RECREATION State of conservation of paths and recreational areas	**NO CHANGES**	**NO CHANGES**	**OPTIMUM**
COST (€) Annual payment till 2026 (10 years)			

Chosen option: A ☐ B ☐ C ☐

3.7. And in this case, which choice would you prefer?

BLOCK 1 - 6	Current situation	Programme 1	Programme 2
ORGANIC FARMING % of organic farming	**0.5%**	**0.5%**	**5%**
BIODIVERSITY PROTECTION Nº of species protected	**5** **species protected**	**25** **species protected**	**15** **species protected**
QUALITY OF WATER BODIES Global state of water bodies	 **NO CHANGES**	 **NO CHANGES**	 **OPTIMUM**
NATIVE FOREST % of native forest	**17%** 	**17%** 	**40%** 
RECREATION State of conservation of paths and recreational areas	**NO CHANGES**	**NO CHANGES**	**BETTER**
COST (€) Annual payment till 2026 (10 years)	**0 €**	**15 €**	**100 €**

Chosen option: A ☐ B ☐ C ☐

3.8. If you have chosen the option "Current Situation" (0 €/year payment), why did you choose this option?

- □ Alternatives are not attractive enough considering their cost
- □ Other

3.9. If you have answered "Others" in the previous question, why did you choose this option? Choose ONLY one option.

- □ I cannot afford to pay an extra fee on my taxes (*)[2]
- □ I think there are other priorities (employment, health, education ...) (*)
- □ There are other priority areas for me (*)
- □ I do not mind the state of the environment (*)
- □ I think that actually enough money is spent on environmental protection (*)
- □ I already pay enough taxes. An economic optimization is needed
- □ Only those who damage the environment should pay
- □ I do not rely on the government and that the proposals will be carried out
- □ I do not think the proposals will be successful
- □ It is my right to have a healthy environment

[2] (*) corresponds to real zero responds, whereas the rest are considered as protest.

3.10. How confident do you feel about this choice?

(very confident) 1 □ 2 □ 3 □ 4 □ 5 □ (not confident)

3.11. Assign a value to the level of difficulty when choosing an option

(very easy) 1 □ 2 □ 3 □ 4 □ 5 □ (very difficult)

3.12. When considering your choice, is there any attribute you have not taken into account?

□ Organic farming	□ Native forest
□ Biodiversity protection	□ Recreation
□ Quality of water bodies	□ Cost (€)

3.13. To what extent do you agree or disagree with the following statements?:

- The results of this survey will serve TO INFORM POLICY MAKERS about the different management choices for Urdaibai

  (totally disagree) 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ (totally agree)

- MY ANSWERS/CHOICES will influence the final policy outcome

  (totally disagree) 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ (totally agree)

- If a new management scenario is implemented, ALL BASQUES will have to pay the indicated amount

  (totally disagree) 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ (totally agree)

- If a new management scenario is implemented, I will have to pay the indicated amount

  (totally disagree) 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ (totally agree)

- The policy makers will choose a new management scenario which best suits PUBLIC PREFERENCES

  (totally disagree) 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ (totally agree)

3.14. Every action generates impacts. Could you tell me which are the consequences arising from an environmental problem that concern you most? (1 = not at all, 5 = very much)

"I am worried about the environmental impacts that have consequences on:"	1	2	3	4	5
– Plants					
– Animals					
– Birds					
– Aquatic life					
– Me					
– My health					
– My life-style					
– My future					
– People around me					
– Everybody					
– Children					
– Next generations					

4. SOCIOECONOMIC VARIABLES:

4.1. Gender: □ Male □ Female

4.2. Age: □ 18-30 □ 31-45 □ 46-60 □ 61-75 □ > 76

4.3. Birthplace:

□ Biscay □ Navarre
□ Gipuzkoa □ Rest of the State
□ Araba □ Abroad

4.4. Locality:

P. C.: ____________________ Municipality: ___________________

4.5. Relationship with the area (mark all the boxes you need)**:**

□ I live here □ Relatives
□ 2nd home □ Leisure time
□ Work / Study □ None

How often do you visit the Urdaibai Biosphere Reserve?

□ I live here □ Sometime during the year
□ Every week □ Less than once a year
□ Every month □ Never

Do you have any property in Urdaibai? Yes □ No □

□ Flat □ Farm
□ Single family house □ Forest land
□ Workplace

4.6. Employment status:

□ Student □ Employed part-time
□ Unemployed □ Employed full-time
□ Household chores □ Retired

4.7. Highest level of education:

□ Primary □ University
□ Secondary / High school □ None

4.8. Family structure:

Nº of adults (≥18 years): ___________ Nº of children (< 18 years): ___________

4.9. Do you collaborate economically with an environmental organisation? □ Yes □ No

4.10. Would you say that your cultural identity is Basque?

□ Less than average □ More or less as the average □ More than the average

4.11. Please indicate what your monthly income is (Remember that this survey is anonymous and the data are strictly confidential):

□ No income □ 1,501 – 2,000 €
□ < 450 € □ 2,001 – 2,500 €
□ 450 - 900 € □ > 2,501 €
□ 901 – 1,500 €

Thank you very much!

QUESTIONNAIRE B

ASSESSMENT OF ECOSYSTEM SERVICES IN THE URDAIBAI BIOSPHERE RESERVE (UBR)

(Short explanation about the UBR, municipalities included and its importance)

1. **Where do you live?** (P.C., Province)____

2. **Where are you coming from?** (Municipality, Province)____________________________

3. **How many people are travelling with you?**____________________________________

4. **How long are you staying in the UBR?** _______________________________________

5. **Is the visit to the UBR the main reason for your trip?**

   Yes ☐ No ☐ Among others ☐

   Please value these possible reasons from 1 to 5:

   Nature / Landscape ☐ Cultural value (museum visit, etc.) ☐

   Sport activities ☐ Rest / Spirituality ☐

   Picnic ☐

6. **Nº of different places you have visited in the UBR:** _________

7. **How many times have you visited (or how often have you visited) the UBR in the last year?** (12 months)____

8. **Select the amount of expenses you expect from your visit** (per person)**:**

Type of expenses	0 €	0-10 €	10-20 €	20-30 €	30-40 €	>40 € (How much?)
Accommodation						
Food and beverages						
Transportation (petrol, toll, flight...)						
Leisure (museums, sport, etc.)						
Purchases						
Others						

(Ecosystem services that the UBR provides and their explanation)

9. For you, which are the 5 most important ecosystem services offered by the UBR? And the 5 least important? Rank the most important ecosystem services from 1 to 5:

✓ **Provisioning services:**

Food from agriculture ☐

Food from livestock ☐

Fishing ☐

Timber (material) ☐

Fresh water ☐

☐

✓ **Regulating services:**

Carbon sequestration (*)
(climate change, sequestration of CO_2, and retention of pollution and dust) ☐

Nutrient regulation (*)
(soil fertility) ☐

Erosion control (*)
(soil loss prevention) ☐

Wind attenuation
(e.g. the dunes on the beach attenuate the wind) ☐

Water regulation and purification (*)
(water filtration and improvement of water quality) ☐

Pollination
(transfer of pollen for the production of seeds and fruits) ☐

Biological control
(control of pests and diseases by some animals) ☐

Habitat for species (*) ☐

✓ **Cultural services**

Tourism and recreation (*) ☐

Research ☐

Environmental education ☐

Aesthetic enjoyment (*)
(landscape and traditions) ☐

(Comment that ecosystem services contribute to human well-being, directly or indirectly, that they are not sufficiently valued, etc.)

10. Knowing that these ecosystem services contribute to human well-being, the authorities are considering protecting the UBR in a special way by creating a Basque Foundation which would ensure the provision of these regulating and cultural services marked with *. If this Foundation was set up, would you be willing to donate an annual voluntary amount of money so that these ecosystem services that the UBR provides could be preserved?"

☐ Yes, how much? ____ (€/year) (go to question 13)

☐ No. Why?[1] ____

____

____

11. If you could choose another payment vehicle, would you be willing to pay? How? Select only 1 option:

- Voluntary donation to an environmental association

Local	☐	State	☐
Province	☐	International	☐

How much?_________________________ (€/year)

- Payment of additional taxes incorporated to:

Town council	☐	Basque Government	☐
County council	☐	State	☐

How much?_________________________ (€/year)

- Allocate 0.7% of the income tax return ☐
  (take into account that the money would be allocated from other scopes)

- Voluntary work (e.g. nature conservation or restoration) ☐

  Hours/year ________________________________

- Others: ____ ☐

  How much?_________________________ (€/year)

[1] Write down only protest responses.

12. To what extent do you agree or disagree with the following statements? (1=totally disagree, 5=totally agree):

	1	2	3	4	5
I already pay enough taxes					
Nature conservation is responsibility of the State					
There are other priorities (employment, health, education…)					
I collaborate with other environmental/social organisations					
There are other priority areas for me					
I would like to see the contribution of the others and then decide					

13. How would you distribute that amount in % among those ecosystem services? (You can allocate 100% of the money to one service or distribute it among the different services):

Carbon sequestration	☐	Habitat for species	☐
Water regulation and purification	☐	Tourism and recreation	☐
Erosion control	☐	Aesthetic enjoyment	☐
Nutrient regulation	☐		

(Personal questions)

14. Gender: Male ☐ Female ☐ **15. Age:** _________

16. Job ____

17. Highest level of education:

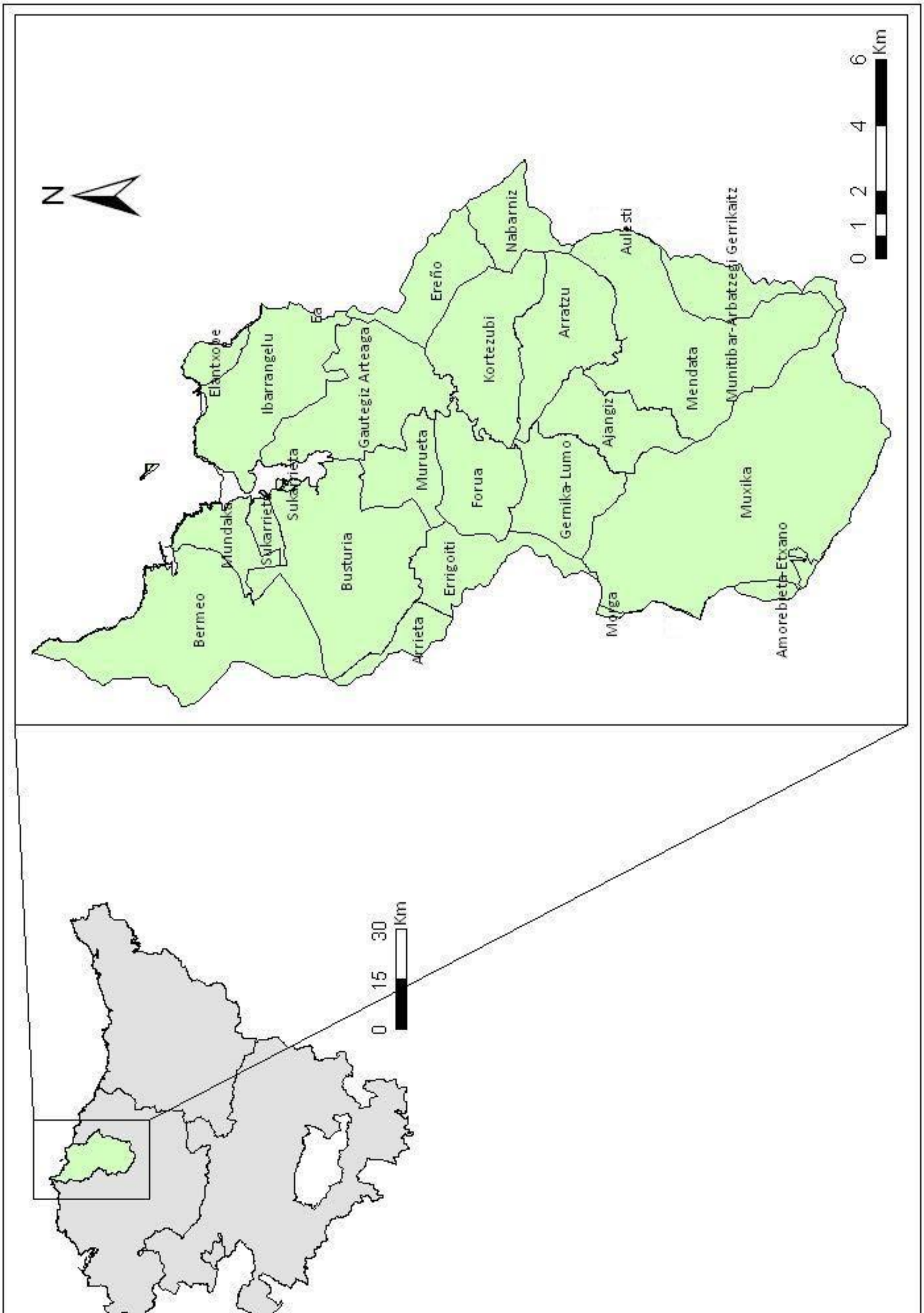
Primary	☐
Secondary / High school	☐
University	☐
None	☐

18. Please, indicate which your personal monthly income is (Remember that this survey is anonymous and the datum are strictly confidential):

< 900 €	☐	2.001 – 2.500 €	☐
901 – 1.500 €	☐	> 2.500 €	☐
1.501 – 2.000 €	☐		

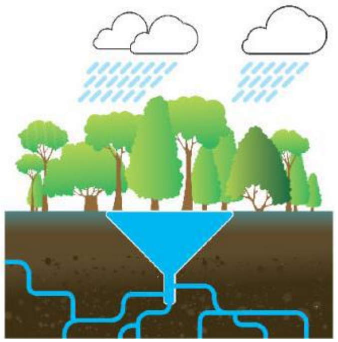
19. How many people are you living with at home?______________________________

Thank you very much for your help!


N
Bermeo
Mundaka
Sukarrieta
Busturia
Arrieta
Errigoiti
Murueta
Forua
Gautegiz Arteaga
Ibarrangelu
Elantxobe
Ea
Ereño
Kortezubi
Nabarniz
Arratzu
Aulesti
Gernika-Lumo
Ajangiz
Mendata
Munitibar-Arbatzegi Gerrikaitz
Muxika
Morga
Amorebieta-Etxano
0 1 2 4 6 Km
0 15 30 Km

Provisioning services:

Regulating services:



Habitat for species:






Cultural services:

ANNEX 1. METRICS

Castillo-Eguskitza, N., Rescia, A.J., Onaindia, M., 2017. Urdaibai Biosphere Reserve (Biscay, Spain): Conservation against development? *Science of the Total Environment* 592, 124-133. https://doi.org/10.1016/j.scitotenv.2017.03.076

Publisher: Elsevier

Subject area: Environmental Science

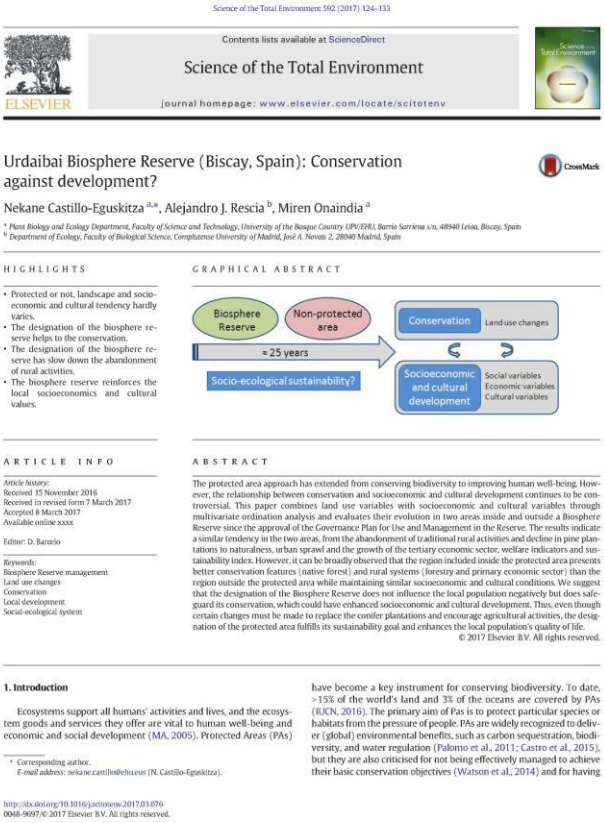
Impact factor 2017: 4.610

Ranking 2017: 27/241 (Q1)

5-year Impact Factor: 4.984

Source-Normalized Impact per Paper (SNIP): 1.65

SCImago Journal Rank (SJR): 1.546



Science of the Total Environment 592 (2017) 124–133

Contents lists available at ScienceDirect

Science of the Total Environment

journal homepage: www.elsevier.com/locate/scitotenv

Urdaibai Biosphere Reserve (Biscay, Spain): Conservation against development?

Nekane Castillo-Eguskitza [a,*], Alejandro J. Rescia [b], Miren Onaindia [a]

[a] Plant Biology and Ecology Department, Faculty of Science and Technology, University of the Basque Country UPV/EHU, Barrio Sarriena s/n, 48940 Leioa, Biscay, Spain
[b] Department of Ecology, Faculty of Biological Science, Complutense University of Madrid, José A. Novais 2, 28040 Madrid, Spain

HIGHLIGHTS

- Protected or not, landscape and socio-economic and cultural tendency hardly varies.
- The designation of the biosphere reserve helps to the conservation.
- The designation of the biosphere reserve has slow down the abandonment of rural activities.
- The biosphere reserve reinforces the local socioeconomics and cultural values.

GRAPHICAL ABSTRACT

ARTICLE INFO

Article history:
Received 15 November 2016
Received in revised form 7 March 2017
Accepted 8 March 2017
Available online xxxx

Editor: D. Barcelo

Keywords:
Biosphere Reserve management
Land use changes
Conservation
Local development
Social-ecological system

ABSTRACT

The protected area approach has extended from conserving biodiversity to improving human well-being. However, the relationship between conservation and socioeconomic and cultural development continues to be controversial. This paper combines land use variables with socioeconomic and cultural variables through multivariate ordination analysis and evaluates their evolution in two areas inside and outside a Biosphere Reserve since the approval of the Governance Plan for Use and Management in the Reserve. The results indicate a similar tendency in the two areas, from the abandonment of traditional rural activities and decline in pine plantations to naturalness, urban sprawl and the growth of the tertiary economic sector, welfare indicators and sustainability index. However, it can be broadly observed that the region included inside the protected area presents better conservation features (native forest) and rural systems (forestry and primary economic sector) than the region outside the protected area while maintaining similar socioeconomic and cultural conditions. We suggest that the designation of the Biosphere Reserve does not influence the local population negatively but does safeguard its conservation, which could have enhanced socioeconomic and cultural development. Thus, even though certain changes must be made to replace the conifer plantations and encourage agricultural activities, the designation of the protected area fulfills its sustainability goal and enhances the local population's quality of life.

1. Introduction

Ecosystems support all humans' activities and lives, and the ecosystem goods and services they offer are vital to human well-being and economic and social development (MA, 2005). Protected Areas (PAs) have become a key instrument for conserving biodiversity. To date, >15% of the world's land and 3% of the oceans are covered by PAs (IUCN, 2016). The primary aim of Pas is to protect particular species or habitats from the pressure of people. PAs are widely recognized to deliver (global) environmental benefits, such as carbon sequestration, biodiversity, and water regulation (Palomo et al., 2011; Castro et al., 2015), but they are also criticised for not being effectively managed to achieve their basic conservation objectives (Watson et al., 2014) and for having

* Corresponding author.
E-mail address: nekane.castillo@ehu.eus (N. Castillo-Eguskitza).

http://dx.doi.org/10.1016/j.scitotenv.2017.03.076
0048-9697/© 2017 Elsevier B.V. All rights reserved.

Castillo-Eguskitza, N., Onaindia, M., Martín-López, B., 2018. A comprehensive assessment of ecosystem services: Integrating supply, demand and interest in the Urdaibai Biosphere Reserve. *Ecological Indicators* 93, 1176-1189. https://doi.org/10.1016/j.ecolind.2018.06.004

Publisher: Elsevier

Subject area: Environmental Science

Impact factor 2017: 3.983

Ranking 2017: 48/241 (Q1)

5-year Impact Factor: 4.391

Source-Normalized Impact per Paper (SNIP): 1.643

SCImago Journal Rank (SJR): 1.406


Ecological Indicators 93 (2018) 1176–1189

Contents lists available at ScienceDirect

Ecological Indicators

journal homepage: www.elsevier.com/locate/ecolind

A comprehensive assessment of ecosystem services: Integrating supply, demand and interest in the Urdaibai Biosphere Reserve

Nekane Castillo-Eguskitza[a,*], Berta Martín-López[b], Miren Onaindia[a]

[a] Plant Biology and Ecology Department, Faculty of Science and Technology, University of the Basque Country UPV/EHU, Barrio Sarriena s/n, 48940 Leioa, Biscay, Spain

[b] Institute of Ethics and Transdisciplinary Sustainability Research (IETSR), University of Leuphana, Universitätsallee 1, C11.210e, 21335 Lüneburg, Germany

ARTICLE INFO

Keywords:
Integrated assessment
Operationalization
Mismatches
Urdaibai Biosphere Reserve

ABSTRACT

Integrated assessment of ecosystem services involves the recognition of value pluralism and the inclusion of the different components of ecosystem services, ranging from supply to social demand and interest. Supply refers to the capacity of ecosystems to provide services, while demand refers to the allocation of money or willingness to obtain a particular service and interest to the importance assigned to services. Yet, a comprehensive assessment of ecosystem services which integrates these three components is still unexplored. This paper proposes a methodological approach to examine (mis)matches, i.e. differences or similarities in quality or quantity, when analysing the supply, demand and interest components of ecosystem services. We assessed twelve ecosystem services in four different units socioeconomically and environmentally similar of the social-ecological system of the Urdaibai Biosphere Reserve in Northern Spain. Results showed that the different ecosystem services components provide divergent but complementary information regarding their value. We also found that the information obtained is consistent across different spatial units with similar socio-economic characteristics, suggesting that the mismatch patterns among ecosystem services components are more related to the set of ecosystem services assessed than the socio-economic characteristics and land uses of the area of study. Our findings strengthen arguments of former calls for integration of the biophysical, monetary and socio-cultural values addressed by the supply, demand and interest components of ecosystem services.

1. Introduction

Since the concept of ecosystem services (ES) first emerged in the 1990s, efforts to value and quantify them remain challenging because of the comprehensive nature of linking ecological and social systems (Haines-Young and Potschin, 2010). Despite the conceptual advances in assessing ES along the ecosystems-society continuum (e.g. Burkhard et al., 2012a; Bennett et al., 2015; Díaz et al., 2015; Geijzendorffer et al., 2015), the identification of suitable indicators and methods for measuring the different components of ES are still a matter of debate (Wolff et al. 2015; Wei et al. 2017). Recently, with the recognition of the existence of plural values of ES (Gómez-Baggethun and de Groot, 2010), international policy initiatives such as the European Biodiversity Strategy to 2020 (European Commission, 2011) and the Intergovernmental Platform for Biodiversity and Ecosystem Services (IPBES) have called for the integration of multiple values that represent the importance of ES (Díaz et al., 2015; Pascual et al., 2017). This call for the recognition of value pluralism in the assessment of ES has led to the emergence of a new school of valuation, in which multiple disciplines and methods are combined to comprehensively assess ES (Gómez-Baggethun and Martín-López, 2015; Jacobs et al., 2016).

An integrated assessment of ES requires combining different values (value pluralism), interdisciplinarity, use of plural methodologies (qualitative and quantitative) and different knowledge systems (scientific and local or traditional knowledge) (Gómez-Baggethun et al., 2014; Gómez-Baggethun and Martín-López, 2015). However, so many ES frameworks exist, including the Millennium Ecosystem Assessment (MA, 2005), the cascade model (Haines-Young and Potschin, 2010), the Economics of Ecosystems and Biodiversity (TEEB, 2010), ES capacity, pressure, demand, and flow framework (Villamagna et al., 2013) and supply-and-demand framework (Geijzendorffer et al., 2015). Thus, concepts concerning the different values and components of ES are confusing and inconsistent among scientists, as the use of different components of ES and different terminologies to refer to the same component is common. Here, we focus on the supply–demand framework developed by Geijzendorffer et al. (2015) since it includes a societal dimension by distinguishing between different interlinked components of supply and demand. These components of the

* Corresponding author.
E-mail address: nekane.castillo@ehu.eus (N. Castillo-Eguskitza).

https://doi.org/10.1016/j.ecolind.2018.06.004
Received 5 October 2017; Received in revised form 2 June 2018; Accepted 4 June 2018

ANNEX 2. FAVORABLE REPORTS OF EXTERNAL REVIEWERS

Prof. Dr. Berta Martín-López
Juniorprofessor for
Sustainability Science

Leuphana Universität Lüneburg

Institute for Ethics and
Transdisciplinary Sustainability
Research, Fakultät
Nachhaltigkeit

Scharnhorststraße 1
D-21335 Lüneburg

Fon 04131.677-1725
martinlo@leuphana.de

External Report of the PhD Thesis by Nekane Castillo-Eguskitza

Title: „Ecosystem services assessment in Urdaibai Biosphere Reserve social-ecological system: Insights into management strategies“

In this PhD thesis, Ms. Castillo-Eguskitza aims to assess and value the ecosystem services provided by the Urdabai Biosphere Reserve in order to contribute to the sustainable management of this social-ecological system. The topic is clearly of interest in current debates of plural valuation of ecosystem services and Ms. Castillo-Eguskitza has shown that she is capable of tackling this topic from an original perspective (or, in fact, from several perspectives) enriched by personal commitment and overcoming the typical limitations that may raise from interdisciplinary research conducted in case studies with local actors.

In this PhD dissertation, Ms. Castillo-Eguskitza applied an interdisciplinary framework by which value multiple provisioning, regulating and cultural ecosystem services using monetary, cultural and biophysical techniques. Despite she applies a plural valuation framework of ecosystem services, including their supply and demand, she mainly focuses on biophysical and monetary metrics by appraising the effects of land-use changes on ecosystem service provision and estimating the economic impact of these changes. More particularly, Ms. Castillo-Eguskitza applied a stated-preference valuation technique, i.e. choice experiment, to understand the social preferences towards different management options and the derived ecosystem services through eliciting people's willingness to pay to foster the abovementioned management options. In this sense, the current PhD entails a comprehensive and holistic exercise of assessing ecosystem services because it includes (1) different ecosystem service categories –i.e. provisioning, regulating and cultural-, (2) different dimensions of ecosystem services –i.e. supply, social interest and demand-, (3) different value-types –i.e. biophysical, social and economic- and the (4) heterogeneity of the social-ecological system. In addition, I do really appreciate the reflection made by Ms. Castillo-Eguskitza in most of the chapters about the methodological limitations, constrains and advantages of all the valuation methods applied. This reflection demonstrates that Ms. Castillo-Eguskitza is capable to practice self-reflectivity and reflect about the implications of the obtained results in a constructive manner.

The PhD dissertation is comprised by four scientific papers published or under revision in well-recognized journals on the field of ecosystem services research. Methodologically, the PhD thesis is very well conducted and applies several methods, including quantitative and qualitative. The application of different methods to elicit the values of ecosystem services is often obscured in ecosystem services research that often focuses solely on disciplinary-bounded approaches. In fact, this PhD dissertation is an exemplary research on integrated and plural valuation of ecosystem services. It does contribute to current scientific debates on integrated valuation and in doing so, it can advance the discussions around which value-types and valuation methods are more suitable to reveal the importance of different ecosystem services and ecosystem service dimensions, i.e. supply, interest and demand. In addition, the results of this PhD dissertation can potentially support decision-making at local scale and the science-policy interface at international level. In fact, this PhD dissertation can contribute to the existing debate on plural valuation of ecosystem services that is currently happening at science-policy interface, particularly at the International Platform of Biodiversity and Ecosystem Services (IPBES).

As a final note, the prose of the PhD dissertation is engaged and interesting. Its visual presentation has been carefully realized by Ms. Castillo-Eguskitza, with clear illustrations, diagrams and figures. In fact, the PhD dissertation is also aesthetically pleasant which helps to engage in its reading.

Overall, the thesis is an important contribution to the ecosystem services research and bode well for a line of research with much potential to be developed further. Furthermore, this PhD dissertation shows that Ms. Castillo-Eguskitza has the capacity to design and conduct interdisciplinary research, bringing (and 'bridging') knowledge from different disciplines under the umbrella of social-ecological systems.

In the light of my experience on ecosystem services research, I have no doubt that this PhD dissertation will contribute to the field in a remarkable manner.

Please do not hesitate in contacting me if you required any further information.

Yours faithfully,

Berta Martín-López
Lüneburg, 7th November 2018

Report on the thesis presented by Ms Nekane Castillo Eguskitza.

Ecosystem services assessment in Urdaibai Biosphere Reserve social-ecological system: Insights into management strategies. Thesis prepared at the Universidad del País Vasco.

The thesis presented by Ms Castillo Eguskitza consists of a text of 190 pages, two questionnaires and an annex. Supplementary material describes Questionnaires A) and B) aimed to local population and users of the biosphere reserve, which were considered in Chapters 4.3 and 4.4. In addition, Annex 1 includes the description of the published papers. The document is well presented and very well written. The bibliography is substantial, including important and updated references on the topic.

This work highlights the need to incorporate the ecosystem services framework in management strategies to better understand nature's value to society and better inform policy making. The main goal of this PhD thesis is to contribute to the knowledge in support of decision making for sustainability in the social-ecological system of the Urdaibai Biosphere Reserve by assessing and valuing ecosystem services. Its focus is on the valuation of ecosystems' services, considering them as the new paradigm for sustainable decision making.

I consider the theoretical framework of this thesis is original and it contributes with an interesting approach for the sustainability of this important biosphere reserve. The incorporation of the opinion of local communities and users of the reserve for making decisions in its management is also an issue to be highlighted in this thesis. I want also to underline the application of a multidisciplinary valuation approach, from the biophysical to the monetary and socio-cultural dimension, especially focused on the monetary dimension of ecosystem services. From this point of view, this thesis contributes with innovative approaches for the understanding of the socio-ecological systems.

The thesis is structured in four independent chapters: the first (*Chapter 4.1*) includes a general context of the biosphere reserve and explores if its designation was successfull in terms of sustainability goals and in increasing the quality of life of local communities. In the second one (*Chapter 4.2*) the main land use changes occurred in the study area in the last 44 years was analised and their economic impact was estimated. In *Chapter 4.3* the local population's preferences and their willingness to pay towards different management alternatives and related ecosystem services was studied. This approach was faced trying to relate the biophysical and monetary dimensions of the ecosystem services in order to build the conservation decision making. Finally, in *Chapter 4.4* a methodological approach to examine mismatches when analysing the different components of ecosystem services in four units which are different from a socioeconomical point of view but environmentally similar in the Urdaibai Biosphere Reserve were proposed.

This thesis contributes to the comprehension of the ecosystem services framework in order to uncover the links between ecosystems and human well - being. It involves environmental and socioeconomic and cultural information, together with an active role of stakeholders. Therefore, the information provided may be useful to take agreed decisions at local level and ease potential conflict resolutions and management for sustainability.

I consider the work carried out by Ms Nekane Castillo Eguskitza satisfies by far the requirements of a doctoral thesis. Its framework is clear, the employed methodology is suitable, and it brings original results as well as interesting conclusions and suggestions. As a conclusion of everything said, I consider Ms Castillo Eguskitza is in a position to defend her doctoral thesis.

Rubén Darío Quintana
Principal Researcher and Associated Professor
Director Instituto de Investigación e Ingeniería Ambiental (IIIA), Universidad Nacional de San Martín (UNSAM) and Consejo Nacional de Investigaciones Científicas y Técnicas (CONICET).

San Martín, November 12, 2018

Campus Miguelete – 4006 - 1500. 25 de Mayo y Francia: (1650) San Martín
Sede Paraná: 4372-3990 - Paraná 145 Piso 2º (1017) Ciudad de Bs. As

Universidad del País Vasco · Euskal Herriko Unibertsitatea

Ekosistemen zerbitzuen ebaluazioa Urdaibaiko Biosfera Erreserbako sistema sozial-ekologikoan:

Kudeaketa estrategietarako ezaguerak

Ecosystem services assessment in Urdaibai Biosphere Reserve social-ecological system:

Insights into management strategies

International PhD dissertation

Nekane Castillo Eguskitza

Zuzendariak:

Miren Onaindia Olalde
Alejandro J. Rescia Perazzo

2018

Azalaren akuarela: Maite Muro

Maketazioa eta beste akuarelak: Nekane Castillo Eguskitza

Ikerketa honek Eusko Jaurlaritzako Zientzia Politikarako Zuzendaritzako Hezkuntza, Hizkuntza Politika eta Kultura Saileko Doktoratu Aurreko Programako laguntza ekonomikoa (2015-2018) jaso du.

Eskerrak

Dicen que las palabras bonitas puede que no sean sinceras, mientras que las palabras sinceras no son bonitas… Son muchas las formas, y aunque las palabras no sean lo mío, no hace falta que diga quiénes sois aquellas personas importantes a las que agradezco y agradeceré siempre su apoyo. ¡Eskerrik asko familia y kuadrilla y demás!

Pero, sería de muy mal gusto no agradecer en esta breve etapa (o larga, depende cómo se mire) a varias personas sin las cuales no hubiera sido lo mismo. Por ello, no puede faltar un espacio en el que expresar mi agradecimiento a tod@s ellos:

Lehendabizi, beti nire buruan zaudelako, zu gogoratu nahi zaitut, amoma. Gurekin gerra ematen ez egon arren, oso pozik egongo zinela badakit. Zure indarra eta aurrera egiteko zure gogoagatik, ez zaitut inoiz ahaztuko.

Noski, Miren Onaindia, tesi honen zuzendaria, eta Alejandro Rescia, zuzendarikidea, eskertu beharrean nago nigan izandako konfiantzagatik eta etengabeko laguntzagatik. Mila esker Miren abentura txiki honetan nirekin nahasteagatik elkar ezagutzen ez bagenuen ere. Lehenengo egunean, nire asmoak kontatzeko aurkeztu natzaizuenean, dudarik gabe animatu eta babestu ninduzun eta. Zure bizitzeko moduagatik, zure betiereko irribarreagatik. Alejandro, muchas gracias porque, como bien sabes, si no llega a ser porque nos cruzamos en la Complutense, esto no habría salido adelante. Por tu paciencia y confianza, de nuevo, gracias.

Eskerrik beroenak Garapen Iraunkorra eta Ingurumen Hezkuntzari buruzko UPV/EHUko UNESCO Katedrari, eta nola ez, denbora guzti honetan nirekin egondako lankideei. Mila esker Jasone, Bea, Ibone eta Lorena zuen laguntza guztiagatik, ospakizunetarako zuen zaletasunagatik eta umore onagatik. Igone, zure prestutasunagatik eta elkarrekin pasatako momentu onengatik, eskerrik asko. Gloria, Izaskun, Leire, berdina diñotsuet. Tampoco podía faltar mi gran compañero Edu, el hombre de historias infinitas. Una no se aburre contigo. María, por tu motivación y buen rollo, por ese humor característico tuyo y gran apoyo.

No puedo olvidarme de ti, Berta, que me acogiste y me hiciste sentir como en casa. Por esas excursiones por el campo, alguna que otra *Dunkel*, por tu positividad y energía contagiosa. Por lo aprendido. Sólo tengo buenas palabras y agradecimientos.

Fernanda, the best flatmate I could ever have had. *Vielen Dank* for your friendliness, for making me love Lüneburg and its people, for those vegan barbeques and baths in the river. Paola, porque aunque breve, fue intenso y siempre sacaste un rato para reírnos. ¡Tenemos una visita pendiente! Jorge, siempre amable y dispuesto, alerta con tu vista de águila. Filipa, friend of trips and adventures. Esteban, Maria, for showing me the most hidden corners. Lara, Antje, for those afternoons trying to be a tightrope walker and those volleyball matches. To all of you, and some more, thank you very much! When I realized I had to come back home!

Claramente, debo agradecer también a David por introducirme en las técnicas de valoración económica y por su inestimable ayuda con los análisis y paciencia conmigo. Asimismo, no puedo más que dar las gracias a Marifé por aportar su experiencia, colaboración y hacerme bajar a la tierra.

Azkenik, tesi honen oinarri direlako eta haien laguntza barik hau guztia ez zatekeelako posible izango, esker onenak ikerketa honetan parte hartu duten eragile guztiei, bai inkestak gogo onez erantzuteagatik bai haien denbora eta ezagutza elkarbanatzeagatik. Batzuetan nekeza izan arren, ederto baten pasa dudalako eta oso ondo hartu nauzuelako beti.

Mila esker danori!

¡Muchísimas gracias a tod@s!

Thank you so much to everyone!

LABURPENA

Giza ongizatea ekosistemetan eta ekosistemen zerbitzuen eskaintza iraunkorrean oinarritzen da, eta aldi berean, giza ekintzek eta erabaki-hartzeek, (zuzeneko edo zeharkako) aldaketa-eragile ezberdinen bitartez, ekosistemetan eragina daukate. Biodibertsitatearen galerarekin lotutako ekosistemen zerbitzuen degradazioa giza ongizatea mehatxatzen ari da eta gure ekintza politikoak naturaren kudeaketa iraunkorrera orientatzea behar direnaren dudarik ez dago. Iraunkortasun-Zientziak, gizarte-natura elkarrekintzak aztertzen ditu sistema sozial-ekologikoetan, ekosistemen zerbitzuen kontzeptua kudeaketan integratuz. Beraz, ekosistemen zerbitzuak eta beren balorazioa, kontserbaziorako sustapenean eta erabaki-hartzean korronte nagusi bilakatu dira. Bereziki, ekosistemen zerbitzuen balorazio ekonomikoa, naturak duen diru-balioa, eta are gehiago, kontserbazioaren onura ekonomikoak komunikatzeko eta hautemateko tresna gisa babestua izan da zientzialari eta foro politikoetan.

Lan honek ekosistemen zerbitzuen esparrua kudeaketa estrategietan barneratzeko beharra azpimarratzen du, naturak gizartearentzat duen balioa hobeto ulertzeko eta erabaki-hartze politiketan hobeto informatzeko. Tesi honen helburu nagusia Urdaibaiko Biosfera Erreserbako sistema sozial-ekologikoan iraunkortasunerako erabaki-hartzean lagungarri izatea da, ekosistemen zerbitzuak ebaluatuz eta baloratuz. Helburu horri jarraiki, honako galdera hauei erantzutea bilatu genuen:

1) Zer nolako harremana dago kontserbazioa eta garapen sozioekonomiko eta kulturalaren artean Urdaibaiko Biosfera Erreserban?
2) Zein izan da lurzoru erabileren aldaketen eragin ekonomikoa Urdaibaiko Biosfera Erreserban azken 44 urteetan? Biosfera erreserbaren zonifikazioa ekosistemen zerbitzuen balio biofisiko eta monetarioekin egokitzen al da?
3) Urdaibaiko Biosfera Erreserbako biztanleria beste kudeaketa estrategia bat ezartzeko laguntzeko prest al dago? Zeintzuk dira lurzoru erabilera eta hauei lotutako ekosistemen zerbitzu ezberdinekiko gizarteak dituen lehentasunak?
4) Ekosistemen zerbitzuen osagai desberdinek antzeko informazioa ematen al dute? Nola identifika ditzakegu desadostasunak ekosistemen zerbitzuen ebaluazioan? Antzeko ezaugarri sozioekonomiko eta lurzoru erabilerak dauzkaten unitate ezberdinetan informazioa aldatzen al da?

Horretarako guztirako, diziplina anitzeko balorazio ikuspuntua aplikatu genuen, dimentsio biofisikotik, dimentsio monetario eta sozio-kulturaleraino; batez ere, ekosistemen zerbitzuen diru dimentsioan arreta jarriaz. Espresuki, ondorengoa egin genuen: 1) datu estatistikoen bilketa, natura-eremu babestuaren paisaia eta bilakaera sozioekonomiko eta kulturala alderatzeko; 2) ekosistemen zerbitzuen diru-balioaren transferentzia lurzoru erabilera bakoitzeko denboran zehar eta korrespondentzia biofisiko-monetarioaren azterketa; 3) hautaketa-esperimentuak (n=266 aurrez aurreko inkestak) tokiko biztanleriaren ordaintzeko borondatea estimatzeko; eta 4) ekosistemen zerbitzuen mapatzea eta tokiko eta kanpoko

biztanleriari zuzendutako aurrez aurreko galdetegiak (n=416), balorazio kontingentea delako ikuspuntu monetarioa eta interesen zerrendatzea bezalako ikuspuntu ez-monetarioak erabiliz. Datuen analisia ordenazio teknika multialdagaietan eta eredu ekonometrikoetan oinarritzen da nagusiki.

Emaitzen atala lau kapitulu enpiriko eta independenteetan banatzen da. *4.1. Kapitulua*k (**I Artikulua**) testuinguruan jartzen gaitu eta biosfera erreserbaren izendapenak iraunkortasunerako helburuak bete eta bertoko biztanleriaren bizi kalitatea hobe duen ala ez aztertzen du. Ondoren, ekosistemen zerbitzuak iraunkortasunerako erabakiak hartzeko paradigma berri gisa kontsideratuak izanik, hauen balorazioan zentratzen gara. Lehenik eta behin, *4.2. Kapitulua*n (**II Artikulua**), azken 44 urteotan Urdaibaiko Biosfera Erreserban gertatutako lurzoru erabileren aldaketa nagusiak aztertzen ditugu eta hauen inpaktu ekonomikoa estimatzen dugu literaturan oinarritutako balioak erabiliz. Ondoren, ekosistemen zerbitzuen dimentsio biofisikoa eta monetarioa lotzen saiatu ginen, kontserbazio erabaki-hartzean lagungarri izateko. Alabaina, gure ikerketa-arean ezaugarri sozioekonomiko eta kulturalak oso ezberdinak izango zirelakoan, eta ezagutza hutsune hori betetzeko, *4.3. Kapitulua*n (**III Artikulua**) hautaketa-esperimentu bat egiten dugu, tokiko biztanleriaren lehentasunak eta kudeaketa alternatiba desberdinekin erlazionaturiko ekosistemen zerbitzuekiko euren ordaintzeko borondatea aztertzearren. Azkenik, ekosistemen zerbitzuen multidimentsionalitatea ziurtzat hartuta, *4.4. Kapitulua*n (**IV Artikulua**), ekosistemen zerbitzuen osagai ezberdinen artean (eskaintza, eskaria eta interesa) desadostasunak aztertzeko metodologia bat proposatzen dugu sozioekonomikoki eta ingurumenaren aldetik antzekoak diren Urdaibaiko Biosfera Erreserbako lau unitate desberdinetan.

Gure emaitzek, biosfera erreserbaren izendapenak bertoko biztanlerian eragin negatiborik ez duela izan erakusten dute; aldiz, kontserbazioa bultzatu eta garapen sozioekonomiko eta kulturalaren hobekuntzan eragina izan zezakeela badirudi. Azken 44 urteotan gertaturiko lurzoru erabileren aldaketek ekosistemen zerbitzuen diru-balioan eragin handiegirik izan ez duten arren, bistan dago lurraldea homogeneizatu eta multifuntzionalitatea galtzea eragin dutela. Haatik, nukleoak balorazio biofisiko eta monetarioaren arteko akoplamendu altuena izateak, biosfera erreserba izendatzeak honen kontserbazioan lagundu izan duela adierazten du. Horrez gain, tokiko biztanleria kudeaketa plan berri bat finantzatzeko prest dago, non ur masen kalitatearen hobekuntzak lehentasuna duen, bertako basoaren eta nekazaritza ekologikoaren azaleren handitzearekin eta biodibertsitatea babestearekin batera. Azkenik, esan, ekosistemen zerbitzuen osagaiek balio informazio dibergentea baina osagarria ematen dutela, eskaintza, eskaria eta interes osagaien bitartez, hurrenez hurren, ekosistemen zerbitzuen balio biofisikoa, monetarioa eta sozio-kulturala integratzeko aurretiko deiak indartuz.

Laburbilduz, tesi hau ekosistemen zerbitzuen esparrua ulertzeko bidean jardun, ekosistemen eta giza ongizatearen arteko loturak argitzearren. Ingurumen eta informazio sozioekonomiko eta kulturala biltzen du, eta baita interesdunen eginkizun aktiboa suspertu ere. Hortaz, lortutako informazioa tokiko mailan erabaki adostuak hartzeko eta gatazka potentzialak konpontzeko eta iraunkortasunerako kudeaketa errazteko baliagarria izan daiteke.

AURKIBIDEA

IRUDIEN AURKIBIDEA

LABURDURAK ETA AKRONIMOAK

BPG	Barne Produktu Gordina
DB	Denbora sakrifikatzeko borondatea
EKZP	Erabilera eta Kudeaketa Zuzentzeko Plana
EZ	Ekosistemen zerbitzuak
EZB	Ekosistemen zerbitzuen diru-balioa
EZO	Ekosistemen zerbitzuen ordainketak
GIH	Garapen Iraunkorrerako Helburuak
GKE	Gobernuz Kanpoko Erakundea
HE	Hautaketa-Esperimentua
IGS	Informazio Geografikorako Sistema
LZ	Lurralde zaintza
NEB	Natura-Eremu Babestua
OB	Ordaintzeko borondatea
OT	Onuren transferentzia
SSE	Sistema sozial-ekologikoa
UBE	Urdaibaiko Biosfera Erreserba

1. Kapitulua

Sarrera

1. SARRERA

Argi dago naturaren eta gizakiaren arteko harremanak aldatu ez ezik, hauen arteko konexio falta gero eta handiagoa dela. Azken 60 urteotan, historia osoan zehar baino bizkorrago eta bortitzkiago aldatu dira ekosistemak Lurran (MA, 2005). Giza jarduerek eta lurzoru erabilera, ziklo biogeokimiko, klima aldaketa edo espezie inbaditzaileen sakabanaketa bezalako aldaketa-eragile nagusiek Ekosferaren funtzionamendua kaltetu dute (Rockström *et al.*, 2009; Steffen *et al.*, 2015). Eskala globalean antzematen den aldaketa funtzional honekin, komunitate zientifikoak antropozeno izeneko denbora geologiko berrian aurkitzen garela aldarrikatu du. Garai geologiko berri hau gizakion eraginpean dago, gure beharrak asetzeko nahita moldatua (Crutzen 2002).

Alabaina, ekosistemen parte gara gu eta *Laudato si'* entziklikak ere, bere hitzetan aldarrikatzen duenez, "natura ezin da gugandik bereizi edo bizilekutzat baino ez hartu. Naturan gaude, honen parte gara eta elkarrekiko elkarreragina dugu" (Frantzisko Aita Santua, 2015). Beraz, garapena eta aurrerakuntza, ekosistemek iraunkor izateko gaitasunarekin konektatu beharra dago berriro (Folke *et al.*, 2011).

1.1. EKOSISTEMEN ZERBITZUAK ETA GIZA ONGIZATEA

Gizateriaren erronka nagusiak natura babestea, kudeatzea eta errestauratzea dira, giza ongizatea iraunkorra izan dadin, naturarekin orekan (van Oudenhoven *et al.*, 2018). Iraunkortasunak ingurumena, ekonomia eta giza faktoreen arteko harreman interdependenteak ulertzea eta zaintzea dakar. Egun, ekosistemen dimentsio biofisikoa, monetarioa eta sozio-kulturala integratzen dituen eta onartuen dagoen kontzeptua ekosistemen zerbitzuen (EZ) esparrua da (Haines-Young & Potschin, 2010; Martín-López *et al.*, 2014).

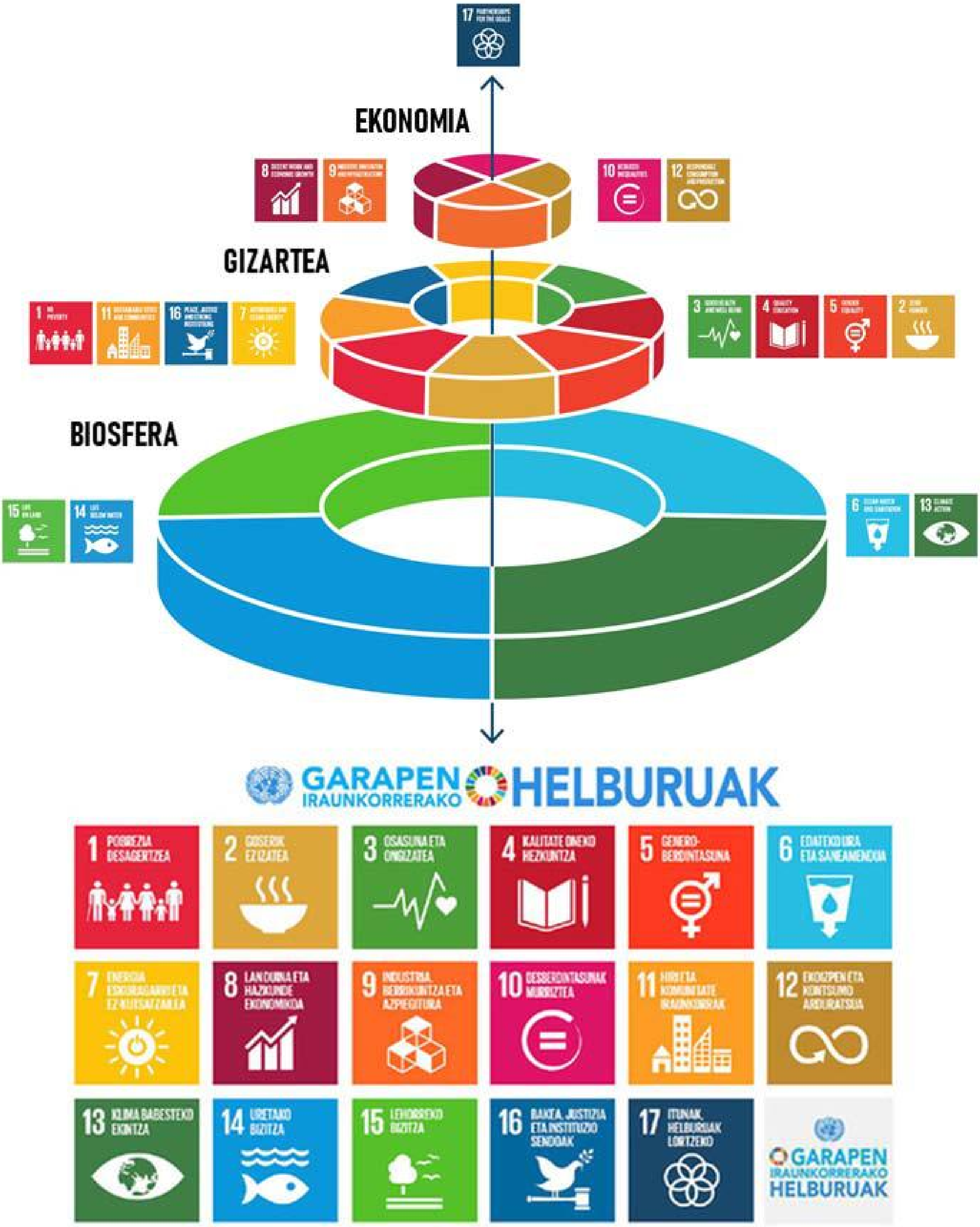
Ekosistemek gizakiei ematen dieten kontribuzioak bezala definituak (Pascual *et al.*, 2017), EZ hiru kategoriatan banatzen dira normalean (CICES, 2018) (1. irudia): 1) hornikuntza zerbitzuak, zeinek sistema bizietako nutrizio- eta nutrizionalak ez diren materialak, zera energetiko guztiak eta baliabide abiotikoak barne hartzen dituzten; 2) erregulazio eta mantenu zerbitzuak (hemendik aurrera, erregulazio zerbitzuak), hots, ekosistemen funtzionamendutik lortutako zeharkako kontribuzioak; eta 3) kultura zerbitzuak edo pertsonen egoera fisiko eta mentalean eragina duten ekosistemen (biotiko eta abiotikoa) baliabide ez-materialak.

1. ird. Ekosistemen zerbitzuen kategoriak eta adibide batzuk (Basque Government, 2014).

EZek ekosistemen eta giza ongizatearen arteko harremana ulertzen laguntzen dute; giza ongizatea bizitza on bat, askatasuna eta aukeratzeko ahalmena, osasuna, gizarte harreman onak eta segurtasun pertsonala izateko oinarrizko beharrak barne hartzen dituen egoera bezala ulertua (MA, 2005). Beste modu batera esanda, EZ ekosistemetan txertatzen dira, eta aldi berean, gizakiok ekosistemekin eta hauek eskaintzen dituzten zerbitzuekin gurutzatuta gaude, azken finean, gure etorkizunaren oinarri direnak. Besteak beste, elikagaiak eta ura bezalako oinarrizko baliabideak eskaintzen dizkigute, naturarekin dugun erlazioaren dimentsio espiritual, estetiko eta kulturalean ere eragina izateraino (Folke *et al*, 2016). EZ gizartea eta ekonomia oinarritzen diren zimendu dira, eta 2030 Agendaren Nazio Batuen Garapen Iraunkorrerako Helburuen (GIH) ideia nagusi.

GIHak 2016an jarri ziren abian eta 17 helburu eta 169 xede dauzkate. 2030. urterako, pobrezia eta gosetea desagerrarazteko, planeta hondamenetik babesteko, eta guztiontzako oparotasuna bermatzeko mundu-mailako tresna izan nahi dute (*Sustainable Development Knowledge Platform*; https://sustainabledevelopment.un.org/sdgs) (2. irudia). EZen eta GIHen arteko loturak argi daude: arestian esan bezala, ekosistemek elikagaiak, erregaiak eta aterpea bezalako EZ eskaintzen dituzte, pobrezia (GIH 1) eta gosetea (GIH 2) desagerrarazten lagunduz, eta eszenatoki ekonomiko berrien oinarri (GIH 8) izanez. Ekosistemen degradazioa gaixotasunen karga handiagoarekin (GIH 3) zuzenean loturik dago, eta honek, haurren hezkuntzan (GIH 4) ere eragina izan dezake eta genero desberdintasuna (GIH 5) areagotu, etxean lan egiteko behartuak ikusi baitezke edota besterik gabe, ura edo janaria biltzeko behar. Horrez gain, ur segurua (GIH 6) eskuratzeko muga bada. Gainera, lehengaien murriztea dakar, energia berriztagarri batzuen (GIH 7) edo azpiegitura berdeen garapenerako (GIH 9) beharrezkoak; zeinak aldi berean, hiri iraunkorrago (GIH 11) eta kontsumo-eredu iraunkorragoetara (GIH 12) aldatzeko ezinbestekoak diren. Naturaren babesak eta EZen eskaintza iraunkorrak eta bidezko eskuratzeak gizarte gatazkak prebenitu eta herrialdeen artean desberdintasunak (GIH 10) murrizten dituzte, gizarte baketsuak eta inklusiboak (GIH

16) sustatzen dituztelarik. Klima-aldaketa eta bere eraginari aurre egiteko (GIH 13), ur azpiko bizitza kontserbatzeko (GIH 14) eta lurra babesteko eta errestauratzeko (GIH 15) premiazko neurriak hartu beharra dago. Honek guztiak, lankidetza globala sendotzea eta gizartearen sektore askoren parte hartzea (GIH 17) behar du.



2. ird. Garapen Iraunkorrerako Helburuak eta hauen erlazioa: behekaldetik hasita, dimentsio biofisiko, sozial eta ekonomikoa. Iturria: *Stockholm Resilience Centre*; https://sustainabledevelopment.un.org/sdgs eta Euskal Herriko Unibertsitatea UPV/EHU web orritik egokitua.

1.1.1. Ekosistemen zerbitzuen balorazioa iraunkortasunera bideratutako erabakiak hartzeko

Erabaki-hartzeak hautatzea suposatzen du, eta ondorioz, baloratzea. Natura baloratzea garrantzia esleitzeko ideiarekin dator (Boeraeve *et al.*, 2015), eta erabaki hartzaileek ekosistemetan eta EZetan eragina duten ordezko kudeaketen eta giza ekintzen arteko tirabirak aztertzeko lagungarria da (MA, 2005).

Tirabira hauek kudeaketa aukerek EZ baten edo gutxi batzuen optimizazioa dakartzatenean agertzen dira, beste zerbitzu batzuen murrizpena edo okertzea ekarriz (Rodríguez *et al.*, 2006). Beraz, zenbait EZen, eskuarki, hornikuntza zerbitzuen eskaintza maximizatzeko asmoa duten, eta biztanleria gero eta handiago baten kontsumo eskakizunak betetzeko nahia duten ekosistemen kudeaketek, askotan EZen beherakada eragiten dute (Bennett *et al.*, 2009). Milurteko Ekosistemen Ebaluazioa delakoaren arabera (MA, 2005), EZen erdia baino gehiago degradatzen ari dira edo modu ez iraunkorrean erabiltzen dira. Erantzun gisa, mundu osoko gobernuek biodibertsitatearen galera eta honekin, EZen galera (Balvanera *et al.*, 2006; Harrison *et al.*, 2014) gelditzeko asmoarekin, nazioarteko akordioetan neurriak hartzeko hitza eman dute. Horretaz aparte, EZen kontzeptua erabiltzeko modukoa izateko eta erabaki-hartzean kontuan izan dadin, nazioarteko iniziatiba ezberdinak garatu dira, hala nola, Ekosistemen eta Biodibertsitatearen Ekonomia (TEEB siglak ingelesez) eta Biodibertsitatearen eta Ekosistemen Zerbitzuen inguruko Gobernu Arteko Plataforma (IPBES siglak ingelesez).

TEEB ekimena, porrot egin eta gainera, txarrera egin zuen (Butchart *et al.*, 2010) biodibertsitatearen gainbehera murrizteko 2010 Biodibertsitate Helburua lor zedin ebatzi zen. Izan ere, arrakasta eza honek erabaki-hartzean eta ekonomia arloan eragin handiago izango luketen estrategia berrien garapena bultzatu zuen, ingurumen arazoak agenda politikoan barneratuz. Aurretik, 2006an, Klima Aldaketaren Ekonomiari buruzko Stern txostenak (Stern, 2007) klima aldaketaren ondorioak arintzeko ekintza politiko erabakigarriak hartzeko beharra azpimarratu zuen, baldin eta Barne Produktu Gordin (BPG) globalaren %20a kolapsatuko ez bazen. Geroago, txosten honi jarraiki, TEEBak biodibertsitatearen galerak dakartzan kostuak nabarmendu zituen (TEEB, 2010). Europa mailan ere, Alderdien Biltzarrek 2020. urterako biodibertsitatearen balioak garapen plangintzan eta kontabilitate nazionalean txertatzea adostu zuten (Aichi Target 2).

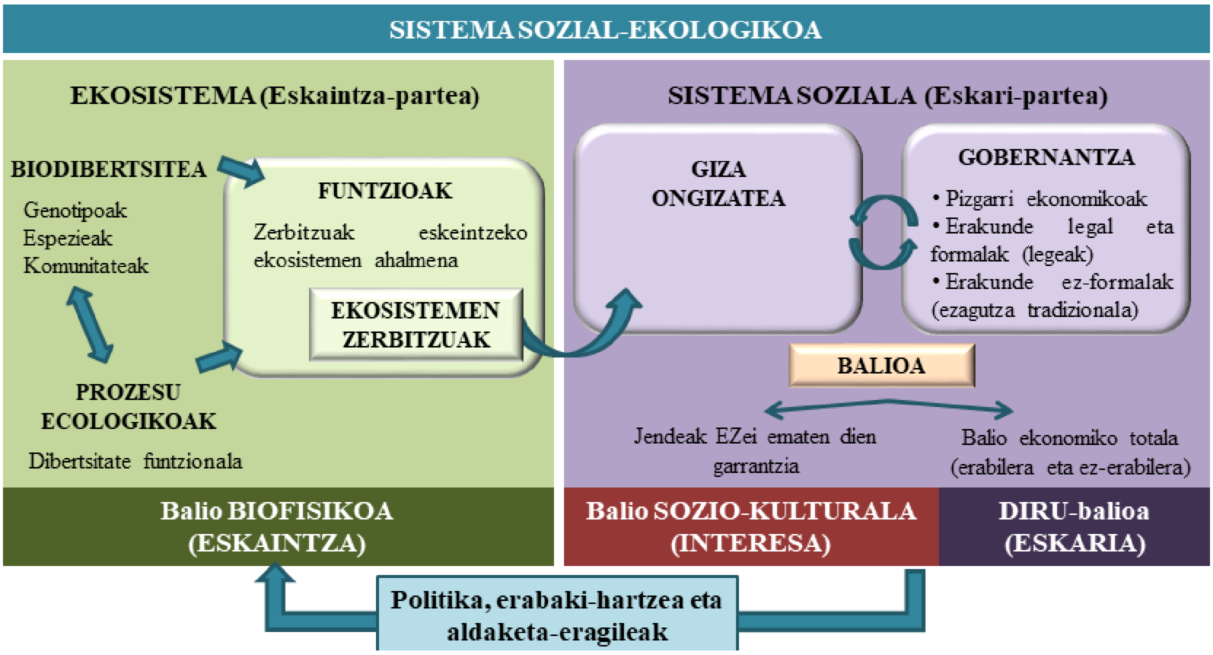
Berriki, 2012an, zientziaren bitartez politika hobeak, biodibertsitatearen kontserbazioa eta babesa, epe luzerako giza ongizatea eta garapen iraunkorra lortzeko ezagutza oinarriak indartzea helburu zuen IPBES delakoa ezarri zen (IPBES, 2018). Bai IPBESak eta bai ekonomian oinarri sendoagoa duen TEEBak, iraunkortasuna lortzeko balio aniztasuna eta gizakiok erabakiak hartzeko motibazio ugariak aintzat hartzen dituzte (TEEB, 2010; Pascual *et al.*, 2017).

Horrela, EZen balio aniztasuna modu zabalean onartua izan da ikerlarien artean eta EZen balio dimentsio ezberdinen integrazioa aldarrikatzen da (Gómez-Baggethun & de Groot, 2010; Díaz *et al.*, 2015; Jacobs *et al.*, 2016). EZen inguruko ekonomia ekologikoko literaturaren arabera, EZ hiru balio dimentsio nagusitan sailka daitezke: biofisikoa, monetarioa eta soziokulturala (Groot *et al.*, 2010; Castro *et al.*, 2014; Martín-López *et al.*, 2014).

Balio biofisikoa adierazle biofisikoekin edo *proxy*ekin neurtzen da eta ekosistemen egoera osasuntsua aztertzen du, interesdunek garatutako kudeaketa esku-hartzeen menpe dagoena (Geijzendorffer *et al.*, 2015). Diru-balioak EZ diru unitateetara bihurtzen dituzte, zerbitzu jakin bat izateko, erabiltzeko edo disfrutatzeko giza baliabideen egungo diru-kopurua (Geijzendorffer *et al.*, 2015) edo zerbitzu hori lortzeko borondatea (Wolff *et al.*, 2015; Wei *et al.*, 2017) estimatuz. Azkenik, balio sozio-kulturala, interesdunek eremu jakin batean euren ongizaterako EZei emandako garrantziarekin lotuta dago (Geijzendorffer *et al.*, 2015). Hauek guztiek, osagai ezberdinak sinbolizatzen dituzte eta Martín-López eta lagunek (2014) behin esan zutenez, balioak kalkulatzeko erabiltzen diren metodoek balioak eurak moldatu eta definitzen dituzte. Hortaz, erabakiak hartzen dituztenek lurraldea modu iraunkorrean kudeatzeko eta EZen eskaintza areagotzeko, EZen balio biofisiko, monetario eta sozio-kulturala ulertzea ezinbestekoa da.

Batez ere, Costanza eta lagunen (1997) artikulua argitaratu eta Milurteko Ekosistemen Ebaluazioa (MA, 2005) hasi zenetik, EZen ebaluazioaren inguruan interesak nabarmenki gora egin du. Hala ere, aurrerapen akademiko handia izan den arren, EZen balio pluralak integratzen dituen esparru zehatza garatzeko erronka pilo daude oraindik zientzialarien arteko desadostasunak eraginda. Ondorioz, EZen esparruak ugariak dira, besteak beste, Milurteko Ekosistemen Ebaluazioa (MA, 2005), turrusta eredua (Haines-Young & Potschin, 2010), Ekosistemen eta Biodibertsitatearen Ekonomia (TEEB, 2010), EZen gaitasuna, presioa, eskaria eta fluxuen esparrua (Villamagna *et al.*, 2013) edo eskaintza-eta-eskaria esparrua (Geijzendorffer *et al.*, 2015). Lan honetan, Geijzendorffer eta lagunek (2015) garatutako eskaintza-eskaria esparruan oinarrituko gara; izan ere, eskaintzatik eskarira doazen osagai desberdinak bereiztuz, h.d. eskaintza, eskaria eta interes osagaiak, dimentsio soziala ere barne hartzen dugu. Eskaintza-eskaria esparruaren osagai hauek inplizituki balio aniztasunaren irizpideetan sartzen dira, balio biofisiko, monetario eta soziokulturalak aztertzen baitituzte (Martín-López *et al.*, 2014; Geijzendorffer *et al.*, 2015) (3. irudia).

Honekin guztiarekin, EZen ebaluazioak ekosistemak eta sistema sozialak modu on batean kudeatzeko gure ezagutza hobe dezake, giza ongizatea hobetu eta gatazka potentzialak konpontzeko. Testuinguru honetan, EZ naturan oinarritutako soluzioen oinarri dira, gaur egun gero eta gehiago erabiltzen ari direnak, bai biodibertsitatearen kontserbazioa, klima aldaketaren egokitze eta baretze estrategietarako, bai garapen iraunkorrerako eztabaida politikoetan (Potschin *et al.*, 2016).

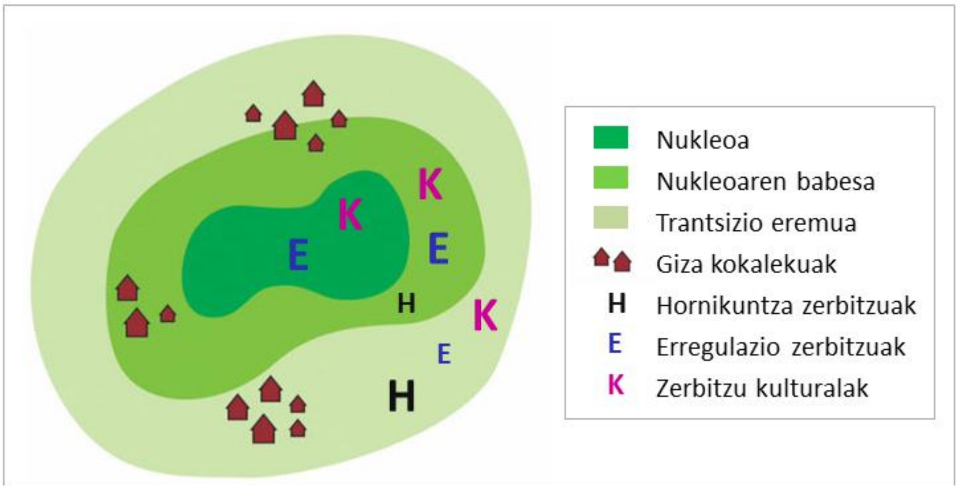


3. ird. Ekosistemen zerbitzuen integraziorako esparru metodologikoa, hornikuntzan (balioa biofisikoa - eskaintza) eta jendeak ematen dion garrantzian (balio sozio-kulturala - interesa) eta balio ekonomiko osoan (diru-balioa - eskaria) oinarritua (balio ezberdinen tamainak apropos daude dauden moduan). Mekanismo arautzaile gisa hartzen den gobernantzak, ekosistemen eta sistema sozialen arteko interfazeko hiru mailatan jarduten du: pizgarri ekonomikoak, erakunde legal eta formalak, eta erakunde ez-formalak. Martín-López *et al.* (2014) eta Gómez-Baggethun *et al.* (2013) artikuluetatik egokitua.

1.2. BIOSFERA ERRESERBAK: NATURA ETA GIZARTEA KONEKTATZEN

Kontserbazio plangintza natur-eremu babestuetan (NEB) askotan osagai biofisikoetan baino ez da zentratu; baina Petrosillo eta lagunek (2015) esan bezala, ez dago ez sistema sozialik naturarik gabe ez ekosistemarik jenderik gabe. Biosfera erreserbak garapen iraunkorrerako esperientzia-laborategi gisa konfiguratzen dira eta hori dela eta, natura eta gizartearen arteko elkarrekintzak ulertzeko diziplinarteko ikuspegiak probatzeko kontserbazio figura egokiak dira. UNESCOren *Man and Biosphere* Programaren barnean daude eta hauen helburu nagusia naturaren kontserbazioa honen erabilera iraunkorrarekin eta giza ongizatearekin bateratzea da, bertoko komunitateak kudeaketan parte hartzeko animatuz (UNESCO, 2018). GIHak ezartzeko eredu lagungarriak dira, beti ere, garapen iraunkorraren hiru dimentsioak kontuan hartzen baitituzte: hazkunde ekonomikoa, gizarte-inklusioa eta ingurumenaren babesa (UNESCO, 2018).

Erresilientzia sozial-ekologikoa sustatzeko, biosfera erreserbak hiru eremu ezberdinetan banatzen dira (4. irudia): nukleoa edo zorrozki babestutako eremua; *buffer* eremua, nukleoa inguratzen, eta ikerketa zientifikoa, segimendua, trebakuntza eta hezkuntza sendotu dezaketen giza jarduera ekologikoak baino ez onartzen dituena; eta trantsizio-eremua, non sozio-kulturalki eta ekologikoki iraunkorrak diren hazkuntza ekonomikoa eta giza garapena bultzatzen duten jardueren gehiengoa onartzen den.



4. ird. Biosfera erreserben zonifikazioa eta eremu bakoitzean ematen diren ekosistemen zerbitzuak (zenbat eta handiagoa ikurra, orduan eta eskaintza gehiago).

Biosfera erreserbak sistema sozial-ekologiko (SSE) iraunkorren adibide dira, h.d., denboran zehar itxura hartu duten ekosistemen eta giza jardueren arteko erlazioaren emaitza diren sistema adaptatzaile konplexuak (Liu *et al*., 2007). SSE hauen kontzeptu nagusiak ikuspegi sistemikoa, ezagutzaren ko-garapena, parte-hartze konpromisoa, segimendu-sistemak eta hezkuntza eta trebakuntza dira (Virapongse *et al*., 2016), eta hortaz, biosfera erreserben ingurumenaren kudeaketarako nahitaezkoak.

1.3. HIPOTESIAK ETA HELBURUAK

1.3.1. Hasierako hipotesia

NEBak biodibertsitatea eta EZ babesteko zentzu zabal horrekin, tokiko biztanleriaren garapenerako muga eta murrizketa inportante bezala antzeman dira historikoki (Pullin *et al*., 2013; Palomo *et al*., 2014). Landa eremuetan sarritan inposatuak izan ohi dira eta jarduera edo baliabide naturalen ustiapen-mota asko debekatu egiten dira normalean, pertsonak naturaz kanpo ateraz. Ideia honen aurka, biosfera erreserbek gizartea lurraldearen kudeaketaren parte izatera bultzatzen dute, modu honetan gatazka potentzialak ekidin eta garapen iraunkorra sustatzea posible eginez.

Beraz, kontserbazioa eta giza ongizatea biosfera erreserben xede nagusia izanik, hauen eraginkortasuna ebaluatzeak, lurzoruaren kudeaketan lagun dezake etorkizun batean. Alabaina, azken hamarkadetan gertatutako lurzoruaren erabileren aldaketak kontuan hartuta eta kontserbaziorako sentsibilizazioa sustatzeko helburuarekin, EZen balorazio ekonomikoak jarraitzaileak irabazi ditu, guztiok ulertzen dugun hizkuntza bezala saldua izanik. Honek, gizarteak EZei ematen dion garrantzia eta eszenatoki ezberdinekiko dituen lehentasunak aztertuta, erabaki-hartzean jarraibideak eman ditzake. Hala ere, diru-balio dimentsioak EZen osagai bakarra baino ez du sinbolizatzen. Ondorioz, EZen balio aniztasuna aintzatesten dugunez, aurre egin beharreko erronka nagusienetako bat EZen balio multidimentsionala integratzen duen ikuspegia garatzea da.

Funtsean, eta goikoei aurre eginez, hurrengo galderak erantzun nahi izan genituen:

1) Zer nolako harremana dago kontserbazioa eta garapen sozioekonomiko eta kulturalaren artean Urdaibaiko Biosfera Erreserban (UBE)?

2) Zein izan da lurzoru erabileren aldaketen eragin ekonomikoa UBEn azken 44 urteetan? Biosfera erreserbaren zonifikazioa EZen balio biofisiko eta monetarioekin egokitzen al da?

3) UBEko biztanleria beste kudeaketa estrategia bat ezartzeko laguntzeko prest al dago? Zeintzuk dira lurzoru erabilera eta hauei lotutako EZ ezberdinekiko gizarteak dituen lehentasunak?

4) EZen osagai desberdinek antzeko informazioa ematen al dute? Nola identifika ditzakegu desadostasunak EZen ebaluazioan? Antzeko ezaugarri sozioekonomiko eta lurzoru erabilerak dauzkaten unitate ezberdinetan informazioa aldatzen al da?

1.3.2. Helburu orokorrak eta zehatzak

Tesi honen helburu nagusia, EZen ebaluazioa eta balorazioa medio, UBEko SSEn iraunkortasunerako erabakiak hartzeko lagungarri izatea da.

Zehazki, honako hauek bilatzen ditugu:

1) UBEren eraginkortasuna eta garapen iraunkorra aztertzea.
2) Biosfera erreserba izendatu aurretik eta geroko kudeaketa erabakien ondorio ekonomikoak estimatzea literaturan oinarrituta, eta EZen balio biofisiko eta diru-balioaren arteko interdependentzia ikertu UBEko eremu ezberdinetan.

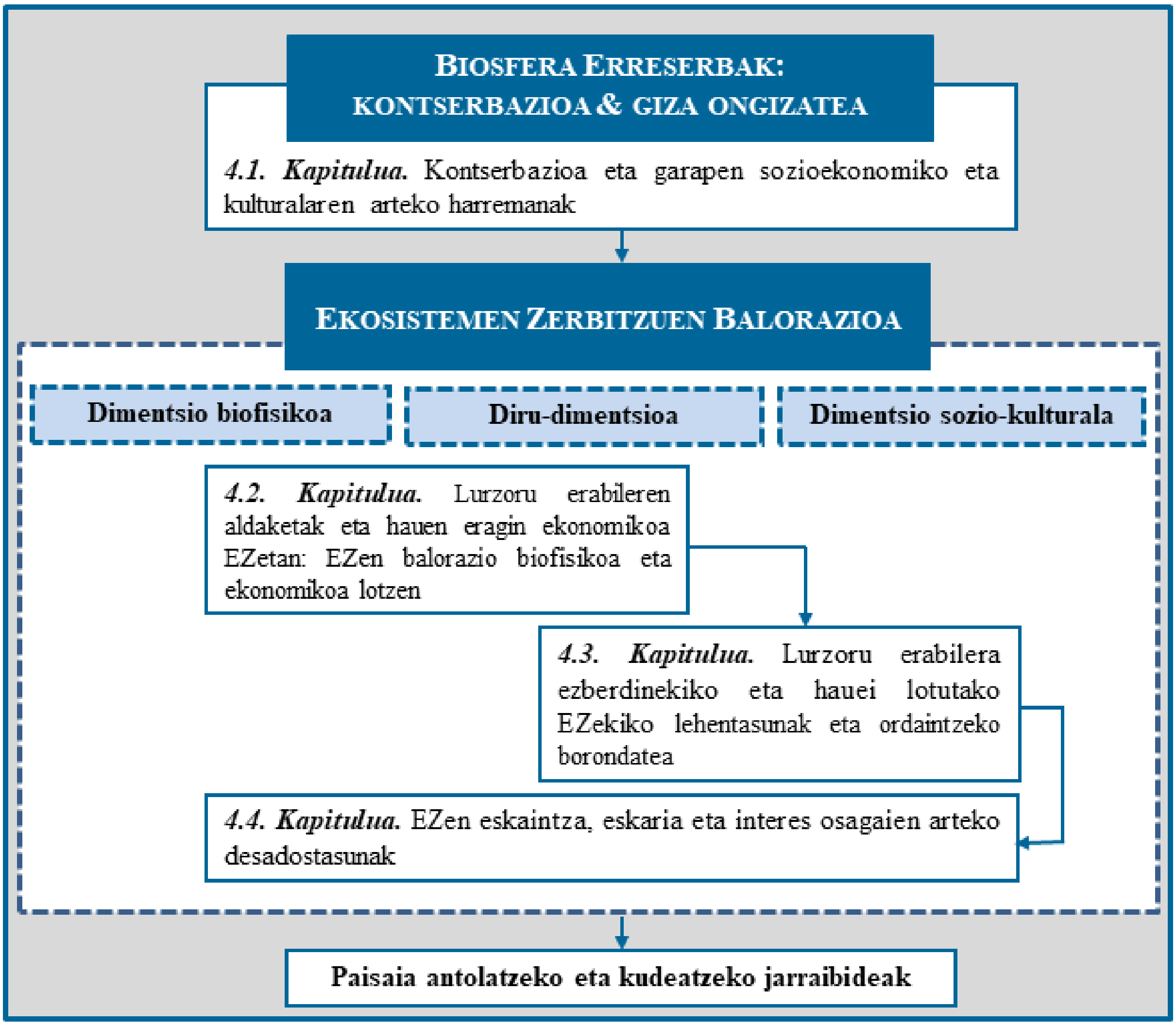
3) EZ ezberdinak kontuan hartzen dituzten hautaketa-esperimentu (HE) izeneko diru-teknika erabiltzea lurzoruaren erabilera desberdinekiko eta hauekin erlazionatutako EZekiko bertoko biztanleriak dituen lehentasunak eta ordaintzeko borondatea (OB) ikertzeko.

4) EZen balio biofisiko, monetario eta sozio-kulturalak balioetsi UBEko unitate sozio-ekonomiko ezberdinetan eta EZen eskaintza, eskaria eta interes osagaien arteko desadostasunak ikertu, sor daitezkeen gatazkak ekiditeko.

1.4. TESIAREN EGITURA

Doktorego-tesi hau elkarrekin loturik dauden, baina independenteak diren 4 argitalpenek osatzen dute (*4.1.*, *4.2.*, *4.3* eta *4.4. Kapituluak*). Sarrera orokor hau (*1. Kapitulua*), ikerketa-arearen deskribapena (*2. Kapitulua*) eta metodologia (*3. Kapitulua*), emaitzen atalaren (*4. Kapitulua*) aurretik doaz; aldiz, eztabaida orokorra (*5. Kapitulua*) eta ondorio nagusiak (*6.*

Kapitulua), atzetik. 5. irudiak lau emaitzen kapituluen laburpena eta hauen arteko harremana erakusten du.



5. ird. Doktorego-tesiaren emaitzen egitura eta haien arteko harremanak (EZ = Ekosistemen Zerbitzuak).

*4.1. Kapitulua*k (**Paper I.** *Urdaibai Biosphere Reserve (Biscay, Spain): Conservation against development?*) testuinguruan jartzen gaitu eta UBEren izendapenak iraunkortasunerako bere helburuak bete eta tokiko biztanleen bizi kalitatea hobetzen duen ala ez aztertzen du. Horretarako, biosfera erreserbaren Erabilera eta Kudeaketa Zuzentzeko Plana (EKZP) onartu zenetik, lurzoruaren erabileraren aldagai eta aldagai sozioekonomiko eta kulturalen eboluzioa aztertzen dugu biosfera erreserban bertan eta honetatik kanpo dagoen beste eskualde batean. Ondoren, EZ iraunkortasunerako erabaki-hartzean paradigma berri gisa aintzatetsiak izanik, hauen balorazioan jartzen dugu gure arreta. Lehenik eta behin, *4.2. Kapitulua*n (**Paper II.** *Linking biophysical and economic valuations of ecosystem services for a social–ecological approach to conservation planning: Application in a Biosphere Reserve (Biscay, Spain)*), azken 44 urteotan gertaturiko lurzoru erabileren aldaketa nagusiak aztertzen ditugu, eta beren inpaktu ekonomikoa estimatzen dugu, jadanik mundu osoan zehar existitzen diren onuren neurriak transferituz. Ondoren, EZen balorazio biofisiko eta ekonomikoaren arteko berdintasuna ikertzen dugu, biosfera erreserbako eremu ezberdinetan kontserbaziorako erabakiak eraikitzeko helburuarekin. Baina gure ikerketa-areako ezaugarri sozioekonomiko eta kulturalak desberdinak direnez ziurrenez, eta ezagutza hutsune hau betetzeko xedearekin, *4.3. Kapitulua*n (**Paper III**. *Economic valuation of ecosystem services: an application to Biosphere Reserve management*) HE bat burutu genuen, kudeaketa alternatiba desberdinekiko eta hauekin erlazionatutako EZekiko bertoko biztanleriak dituen lehentasunak eta OBa ikertzearren. Horretarako, eszenatoki ezberdinak planteatu genituen, non nekazal jarduera ekologikoaren azalerak gora egiten zuen, biodibertsitatearen babesa handiagoa zen, ur-masen kalitatea hobea zen, bertoko basoak gora egiten zuen eta aisirako baldintzak hobetzen ziren. Azkenik, EZen multidimentsionalitatea onartzen dugularik, *4.4. Kapitulua*n (**Paper IV.** *A comprehensive assessment of ecosystem services: integrating supply, demand and interest in the Urdaibai Biosphere Reserve*), EZen osagai ezberdinen artean (eskaintza, eskaria eta interesa) desadostasunak aztertzeko, h.d., kalitatean edo kantitatean desberdintasunak, metodologia bat proposatzen dugu sozioekonomikoki eta ingurumenaren aldetik antzekoak diren UBEko lau unitate desberdinetan. Horrela, dimentsio balio biofisiko, monetario eta sozio-kulturalaren arteko gatazka potentzialak aztertu ziren.

BIBLIOGRAFIA

Balvanera, P., Pfisterer, A.B., Buchmann, N., He, J.-S., Nakashizuka, T., Raffaelli, D., Schmid, B., 2006. Quantifying the evidence for biodiversity effects on ecosystem functioning and services. Ecol. Lett. 9, 1146-1156.

Basque Government, 2014. Department of Environment and Regional Planning. Ihitza 44 Driving the 21 school schedule. Ecosystems are our Natural Capital.

Bennett, E.M., Peterson, G.D., Gordon, L.J., 2009. Understanding relationships among multiple ecosystem services. Ecol. Lett. 12, 1394-1404.

Boeraeve, F., Dendoncker, N., Jacobs, S., Gómez-Baggethun, E., Dufrêne, M., 2015. How (not) to perform ecosystem service valuations: pricing gorillas in the mist. Biodivers. Conserv. 24(1), 187-197.

Butchart, S.H.M., Walpole, M., Collen, B., et al., 2010. Global biodiversity: Indicators of recent declines. Science 328, 1164-1168.

Castro, A.J., Verburg, P.H., Martín-López, B., García-Llorente, M., Cabello, J., Vaughn, C.C., López, E., 2014. Ecosystem service trade-offs from supply to social demand: a landscape-scale spatial analysis. Landsc. Urban Plan. 132, 102-110.

CICES. Common International Classification of Ecosystem Services., 2018. Available: www.cices.eu

Crutzen, P.J., 2002. Geology of mankind: The Anthropocene. Nature, 415:23.

De Groot, R.S., Alkemade, R., Braat, L. Hein, L., Willemen, L., 2010. Challenges in integrating the concept of ecosystem services and values in landscape planning, management and decision making. Ecol. Complex. 7(3), 260-272.

Díaz, S., Fargione, J., Chapin, F.S., Tilman, D., 2006. Biodiversity Loss Threatens Human Well-Being. PLoS Biol 4(8): e277.

Díaz, S., Demissew, S., Joly, C., Lonsdale, W.M., Larigauderie, A., 2015. A Rosetta Stone for nature's benefits to people. PLoS Biol. 13(1), e1002040.

Dominati, E., Patterson, M., Mackay, A., 2010. A framework for classifying and quantifying the natural capital and ecosystem services of soils. Ecol. Econ. 69(9), 1858-1868.

Folke, C., Jansson, Å., Rockström, J., Olsson, P., Carpenter, S. R., Chapin III, F. S., et al., 2011. Reconnecting to the Biosphere. Ambio, 40:719.

Folke, C., Biggs, R., Norström, A., Reyers, B., Rockström, J., 2016. Social-ecological resilience and biosphere-based sustainability science. Ecol. Soc. 21(3):41.

Geijzendorffer, I.R., Martín-López, B., Roche, P.K., 2015. Improving the identification of mismatches in ecosystem services assessments. Ecol. Indic. 52, 320-331.

Gómez-Baggethun, E., de Groot, R., 2010. Natural capital and ecosystem services: The ecological foundation of human society. In: Hester, R.E & Harrison, R.M (eds) Ecosystem Services: Issues in Environmental Science and Technology. Cambridge: Royal Society of Chemistry, 118–145.

Gómez-Baggethun, E., Kelemen, E., Martín-López, B., Palomo, I., Montes, C., 2013. Scale Misfit in Ecosystem Service Governance as a Source of Environmental Conflict. Society & Natural Resources: An International Journal 26(10), 1202-1216.

Gómez-Baggethun, E., Martín-López, B., 2015. Ecological Economics perspectives on ecosystem services valuation. In: Martínez-Alier, J. & Muradian, R. (eds.). Handbook on Ecological Economics. Edward Elgar, pp. 260-282.

Haines-Young, R., Potschin, M., 2010. The links between biodiversity, ecosystem services and human well-being. Ch. 6. In: Raffaelli, D. & Frid, C. (Eds.), Ecosystem Ecology: A New Synthesis. BES Ecological Reviews Series, CUP, Cambridge.

Harrison, P.A., Berry, P.M., Simpson, G., Haslett, J.R., Blicharska, M., Bucur, M., et al., 2014. Linkages between biodiversity attributes and ecosystem services: A systematic review. Ecosyst. Serv. 9, 191-203.

IPBES, 2018. Intergovernmental Platform for Biodiversity and Ecosystem Services. [Online] Available: www.ipbes.net/ [Accessed 2018].

Jacobs, S., Dendoncker, N., Martín-López, B., Barton, D.N., Gómez-Baggethun, E., Boeraeve, F., et al., 2016. A new valuation school: Integrating diverse values of nature in resource and land use decisions. Ecosyst. Serv. 22(B), 213-220.

Liu, J., Dietz, T., Carpenter, S.R., Folke, C., Alberti, M., Redman, C.L., et al., 2007. Coupled Human and Natural Systems. Ambio, 36(8), 639-649.

MA, 2005. Ecosystems and Human Well-being: Synthesis. Island Press, Washington, DC.

Martín-López, B., Gómez-Baggethun, E., García-Llorente, M., Montes, C., 2014. Trade-offs across value-domains in ecosystem services assessment. Ecol. Indic. 37, 220-228.

Palomo, I., Montes, C., Martín-López, B., González, J.A., García-Llorente, M., Alcorlo, P., García Mora, M.R., 2014. Incorporating the Social–Ecological Approach in Protected Areas in the Anthropocene. BioScience 64(3), 181-191.

Pascual, U., Balvanera, P., Díaz, S., Pataki, G., Roth, E., Stenseke, M., et al., 2017. Valuing nature's contributions to people: the IPBES approach. Curr. Opin. Environ. Sustainability 26, 7-16.

Petrosillo, I., Aretano, R., Zurlini, G., 2015. Socioecological systems. In: Reference Module in Earth Systems and Environmental Sciences, ed. S.A. Elias, pp. 1–7. Amsterdam, The Netherlands: Elsevier.

Pope Francis, 2015. Laudato Si': On Care for Our Common Home.

Potschin, M., Kretsch, C., Haines-Young, R., Furman, E., Berry, P., Baró, F., 2016.

Nature-based solutions. In: Potschin, M. and K. Jax (eds): OpenNESS Ecosystem Services Reference Book. EC FP7 Grant Agreement no. 308428. Available: www.openness-project.eu/library/reference-book

Pullin, A.S., Bangpan, M., Dalrymple, S., Dickson, K., Haddaway, N.R., Healey, J.R., et al., 2013. Human well-being impacts of terrestrial protected areas. Environ. Evid. 2:19.

Rockström, J., Steffen, W., Noone, K., Persson, Å., Chapin III, F. S., Lambin, E., et al., 2009. Planetary boundaries: exploring the safe operating space for humanity. Ecol. Soc. 14(2):32.

Rodríguez, J.P., Beard, T.D., Bennett, E.M., Cumming, G.S., Cork, S., Agard, J., Dobson, A.P., Peterson, G.D., 2006. Trade-offs across space, time, and ecosystem services. Ecol. Soc. 11(1): 28.

Steffen, W., Richardson, K., Rockström, J., Cornell, S.E., Fetzer, I., Bennett, E.M., et al., 2015. Planetary boundaries: Guiding human development on a changing planet. Science, 347:6223.

Stern, N., 2007. The Economics of Climate Change: The Stern Review. Cambridge University Press, Cambridge.

TEEB, 2010. The Economics of Ecosystems and Biodiversity Ecological and Economic Foundations. Edited by Pushpam Kumar. Earthscan, London and Washington.

UNESCO, 2018. [Online] Available: www.unesco.org/ [Accessed 2018].

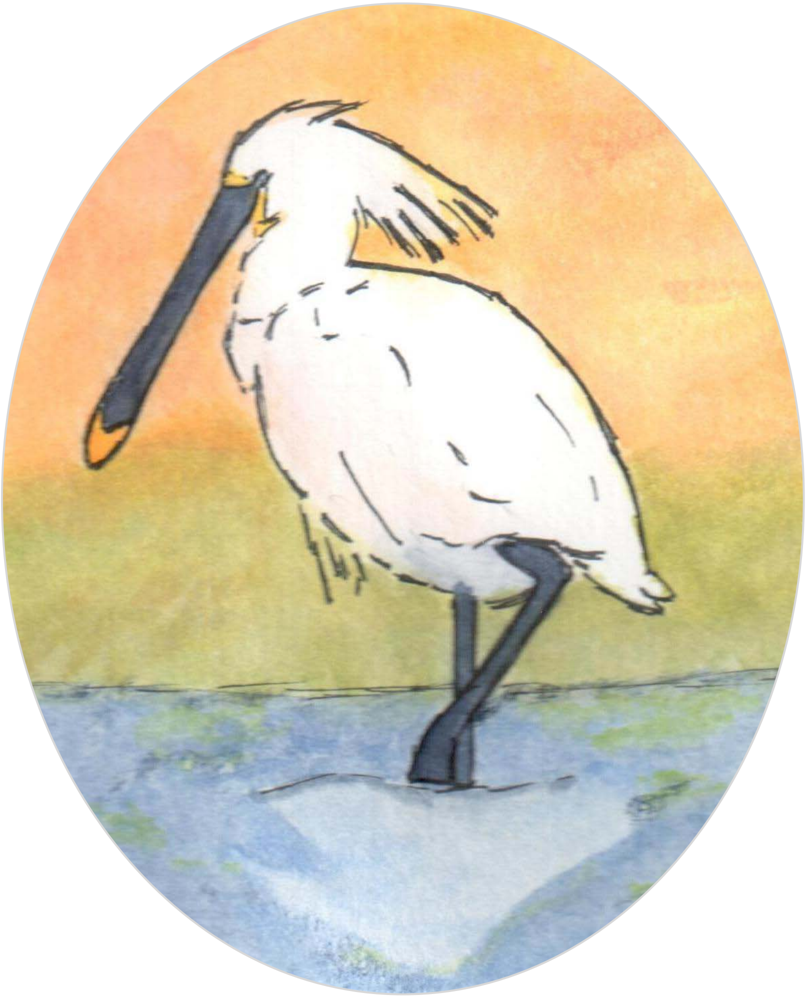
van Oudenhoven, A.P.E., Martín-López, B., Schröter, M., de Groot, R., 2018. Advancing science on the multiple connections between biodiversity, ecosystems and people, International Journal of Biodiversity Science, Ecosystem Services & Management, 14:1, 127-131.

Virapongse, A., Brooks, S., Covelli Metcalf, E., Zedalis, M., Gosz, J., Kliskey, A., Alessa, L., 2016. A social-ecological systems approach for environmental management. J. Environ. Manage. 178, 83-91.

Wei, H., Fan, W., Wang, X., Lu, N., Dong, X., Zhao, Y., Ya, X., Zhao, Y., 2017. Integrating supply and social demand in ecosystem services assessment: A review. Ecosyst. Serv. 25, 15-27.

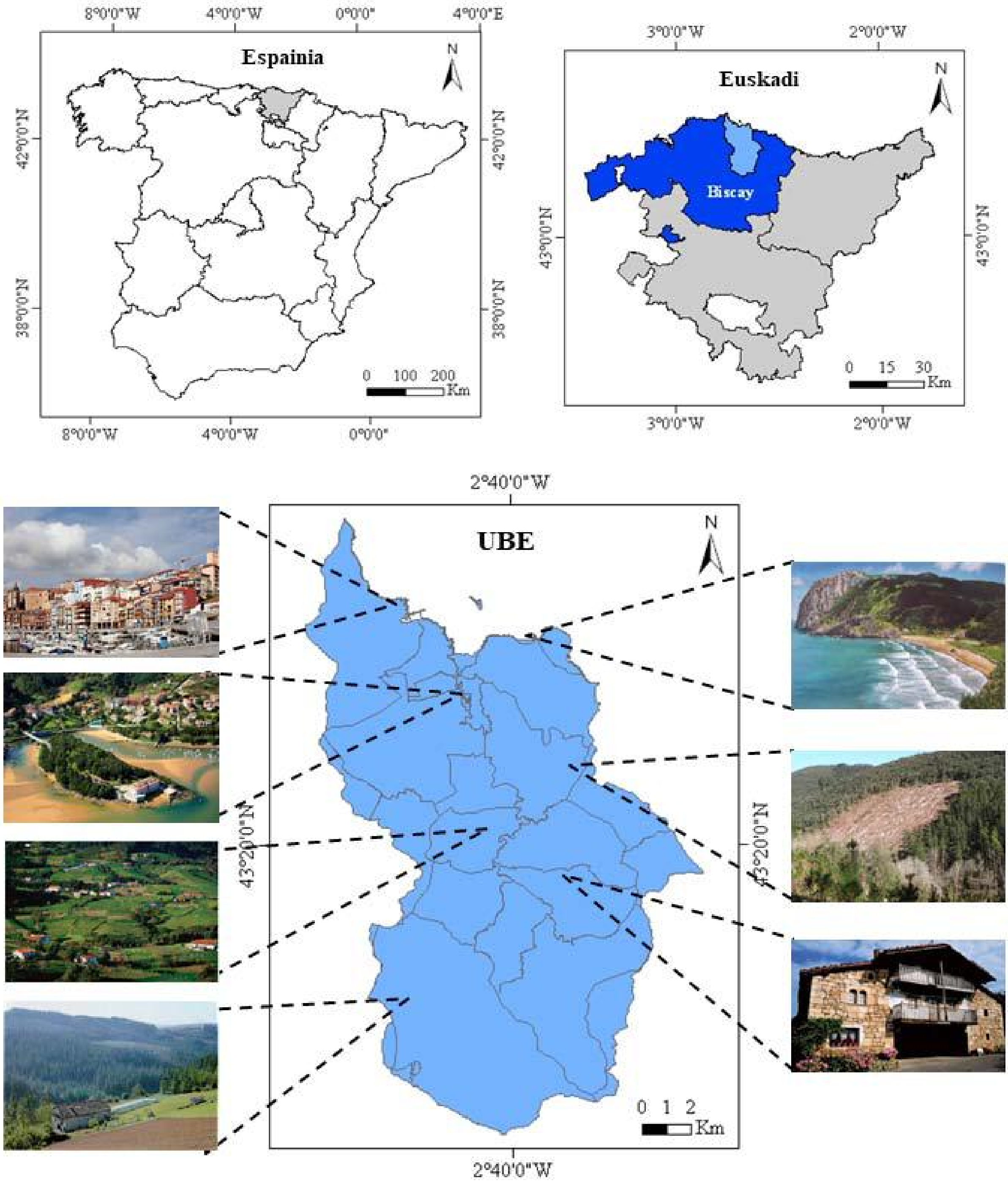
Wolff, S., Schulp, C., Verburg, P.H., 2015. Mapping ecosystem services demand: a review of current research and future perspectives. Ecol. Indic. 55, 159-171.

2. Kapitulua
Ikerketa-area



2. IKERKETA-AREA

Ikerketa UBEn kokatzen da, Espainiako iparraldean (Euskal Herria, Bizkaia) (43º 19 'N, 2º 40' W) (1. irudia). UBEk 220 km^2-ko azalera dauka gutxi gorabehera eta 22 udalerritan banatzen da, 45.000 biztanle ingururekin.



1. ird. Ikerketa-arearen kokapena eta gune ezberdinen ikuspegia.

UBEn bi area bereiz daitezke: hiri-eremua (Bermeo eta Gernika-Lumo udalerriak), non industri jarduera eta zerbitzu gehienak dauden eta biztanleen %75a inguru biltzen dituen; eta landa-eremua, populazio-dentsitate oso baxuarekin, batez ere basogintza eta nekazaritza eta abeltzaintzako sektorean oinarritzen dena, baina baita kostaldeko udako turismoan ere. Guztira, egungo datuen arabera, biztanle okupatuen %69ak hirugarren sektorean lan egiten du, %27ak industrian (eraikuntza barne) eta %3ak lehen sektorean (EUSTAT, 2016). Hirugarren sektoreak BPG osoaren %61a suposatzen du, industriak %26a eta lehen sektoreak %13a (EUSTAT, 2013). Hortaz, Bizkaia edota Euskal Herriarekin konparatuta, non lehen sektoreak ez duen BPGaren %1a gainditzen, UBEn lehen sektoreak garrantzi handia dauka; gertatzen dena da laborantza lurren azalera eta abeltzaintzako ustiategien kopurua behera doala apurka-apurka, eta arrantza sektoreak ere, lehen sektoreko garrantzitsuena alegia, berdela eta hegaluzea bezalako balio ekonomiko txikiko espezietara aldatuz doala.

1984. urtean UNESCOk biosfera erreserba deklaratu zuen Urdaibai bere balio natural eta kulturalagatik, eta geroago, 1993an, Ramsar Hezegunea listatuan eta Europar Batasuneko Natura 2000 Sarean barneratu zen. UBE sistema natural eta kultural askoren mosaikoa da, padurak, kostaldea eta baso kantauriarra nabarmentzen direlarik. Paisaia heterogeneo eta konplexua izateak (Rescia *et al.*, 1994), habitat aniztasun handia dakar eta fauna espezie desberdinentzako oso garrantzitsua da, bereziki hegazti migratzaileentzat. Guztira, 700 fauna espezie eta 800 flora espezie baino gehiago daude zenbatuta. Baina, horretaz aparte, UBEk Triasikotik (duela 251 milioi urte) Kuaternariora (duela 2,6 milioi urte) eta gaur egun arte doan geodibertsitate interesgarria badu ere.

Beste biosfera erreserbak bezala, UBEren funtzio nagusiak honakoak dira: kontserbazioa, garapen iraunkorra eta laguntza logistikoa ikerketa, prestakuntza eta komunikaziorako. Hiru helburu hauek 1993. urtean onartu ziren eta egun aztertzen ari den EKZPan biltzen dira (Eusko Jaurlaritza, 2004). Honek kudeaketa eta kontserbazioko jarraibideak ematen ditu eta espazio babestua biosfera erreserben zonifikazio klasikoan zatitzen du: a) zorrozki babestutako ekosistemak barne hartzen dituen erreserbaren nukleoa (kostaldeko ekosistemak, padurak, artadi kantauriarra eta arkeologia guneak); b) kostaldeko babes-eremuak, hariztia eta ibai-sarea barneratzen dituen eta kontserbazio helburuekin bat datozen jarduerak garatzen dituen nukleoaren babes eremua edo *buffer*-a; eta c) baso-eremuak, landa-herriak eta baserri sakabanatuetaz osatuta dagoen eta jarduera iraunkorrak sustatzen dituen trantsizio eremua.

Hala ere, SSE konplexua izanda, ingurua espazio babestua izendatzeak ez du gatazketatik libratu eta kontserbazio eta garapen ekonomikoaren elkarbizitzan aurkako interesak arruntak dira (Onaindia *et al.*, 2013a). Bizkaian gertatu den bezala, UBEko paisaia, antzinako nekazaritzak eta abeltzaintzak itxuratua, industrializazioa eta honi lotutako landa-uztearekin erabat eraldatu da. Izan ere, XX. mendearen erdialdean, bertoko basoaren deforestazioari eta landa-krisiari aurre egiteko, administrazioak landaketa exotikoak sustatu zituen (Madariaga *et al.*, 2011); eta hori dela eta, lurralde erdia baino gehiago *Pinus radiata* eta *Eucaliptus* sp. monolaborantzen menpe dago gaur egun, %17a eta %3a baino ez bertoko basoak eta labore-lurrak direlarik, hurrenez hurren. Hazkuntza azkarreko landaketa exotikoen ugaritzeak eta hauen kudeaketa modu zakarrek, ingurumen arazo ugari sortu dituzte, besteak beste, espezie aniztasunaren galera, gozamen estetiko eta kultur balioaren galtzea, lurzoruaren erosioa edota uraren kalitatea eta kantitatea okerrera egitea (Onaindia *et al.*, 2013b; Rodriguez-Loinaz *et al.*, 2013). Halaber, azken mendeko industri eta portuko jardueren eta hondakin-uren saneamendu ez eraginkorraren ondorioz, UBEn ur-masen kalitatea are gehiago txartu da. Honen emaitza, trantsizio-uren egoera global txarra (AZTI-Tecnalia, 2016) eta Gernikako akuiferoaren egoera kimiko txarra (Agencia Vasca del Agua, 2016) izan da. Beraz, iraunkortasunera bideratzeko eta paisaia iraunkorrak sortzeko erabakiak har daitezen planifikazio estrategikoa behar-beharrezkoa da.

BIBLIOGRAFIA

Agencia Vasca del Agua, 2016. Red de seguimiento del estado de las aguas subterráneas. Informe 2015. [Spanish]

AZTI-Tecnalia, 2016. Red de seguimiento del estado ecológico de las aguas de transición y costeras de la Comunidad Autónoma del País Vasco. Informe de resultados. Campaña 2015. [Spanish]

Basque Government, 2004. Governance Plan for Use and Management of Urdaibai Biosphere Reserve. Refunded text. Department of Land Management and Environment, Vitoria-Gasteiz. [Spanish]

EUSTAT., 2013. Basque Institute of Statistics. Gross value added (GVA) of the Basque Country by territorial scope, according to sectors of activity. Current prices (%). 2012. [Online]. Available: www.eustat.es

EUSTAT., 2016. Basque Institute of Statistics. Employed population aged 16 and over of the Basque Country by provinces according to economic sector. [Online]. Available: www.eustat.es

Madariaga, I., Arana, X., Casado-Arzuaga, I., Palacios-Agúndez, I., 2011. Servicios de los ecosistemas del paisaje cultural de Bizkaia. Perspectiva histórica de la actividad forestal y minera. Revista Forum de Sostenibilidad 4:33-46.

Onaindia, M., Ballesteros, F., Alonso, G., Monge-Ganuzas, M., Peña, L., 2013a. Participatory process to prioritize actions for a sustainable management in a biosphere reserve. Environ. Sci. Policy 33, 283-294.

Onaindia, M., Fernández de Manuel, B., Madariaga, I., Rodríguez-Loinaz, G., 2013b. Co-benefits and trade-offs between biodiversity, carbon storage and water flow regulation. For. Ecol. Manage. 289, 1-9.

Rescia, A.J., Schmitz, M.F., Martín de Agar, P., de Pablo, C.L., Atauri, J.A., Pineda, F.D., 1994. Influence of landscape complexity and land management on woody plant diversity in Northern Spain. J. Veg. Sci. 5, 505-516.

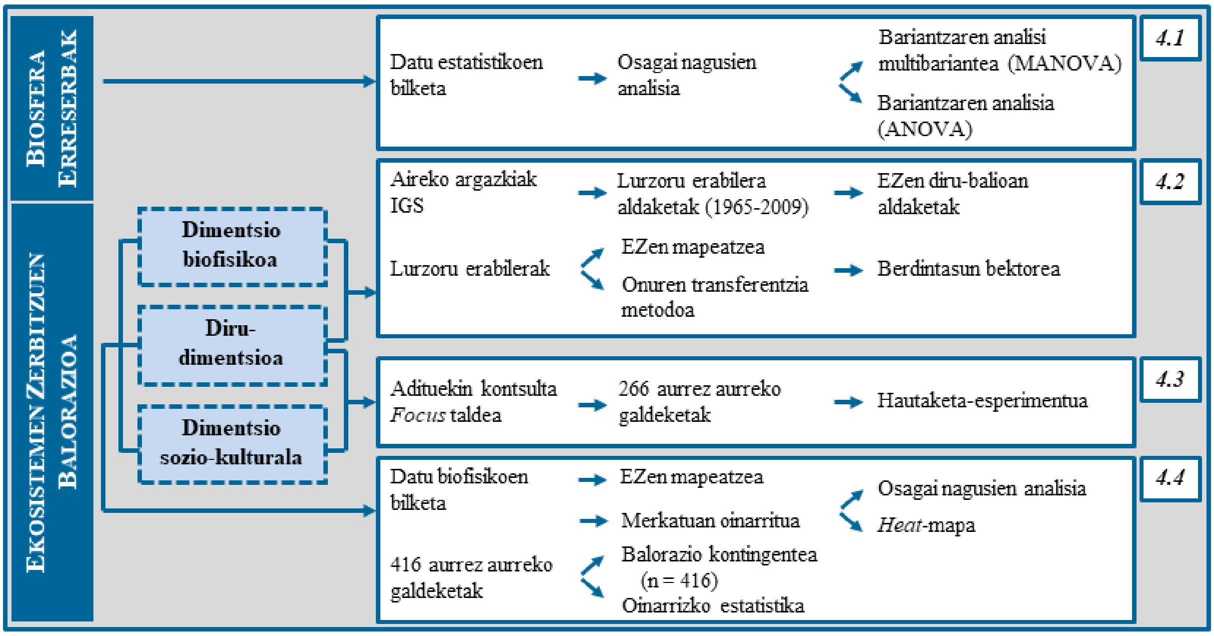
Rodríguez-Loinaz, G., Amezaga, I., Onaindia, M., 2013. Use of native species to improve carbon sequestration and contribute towards solving the environmental problems of the timberlands in Biscay, northern Spain. J. Environ. Manage. 120, 18-26.

3. Kapitulua

Metodologia

3. METODOLOGIA

Metodologia kapitulu honek tesian erabilitako metodoen ikuspegi orokorra aurkeztea du helburu (1. irudia). Emaitzen kapitulu bakoitzean erabilitako metodologia ezberdinen inguruan xehetasun gehiago ematen dira.



1. ird. Emaitzen kapitulu bakoitzean erabilitako metodologia orokorra eta balio-dimentsio desberdinak.

Alde batetik, ingurumen aldagaien eta aldagai sozioekonomiko eta kulturalen informazio estatistikoa ez ezik, aireko argazkiak ere biltzen ditugu ikerketa-arearen bilakaera aztertzeko. Bestalde, EZen hiru dimentsioak ebaluatzen ditugu, dimentsio biofisikotik, diru-dimentsio eta dimentsio sozio-kulturalaraino. Hala ere, azpimarratu beharra dago diru-dimentsioan oinarritu garela nagusiki. Izan ere, EZen dimentsio biofisikoa mapa biofisikoen bitartez ebaluatu egin da dagoeneko (Onaindia *et al.*, 2013a; Peña *et al.*, 2015), eta dimentsio sozio-kulturala ere parte-hartze prozesu ezberdinen bitartez aztertua izan da (Onaindia *et al.*, 2013b; Garmendia & Gamboa, 2012). Beraz, ikuspegi biofisikoak, monetarioak eta sozio-kulturalak aplikatu ditugu, moneta-teknikei arreta berezia eskainiz.

Balio biofisiko, diru-balio eta balio sozio-kulturalaren dimentsioak neurtzeko metodoak ugariak dira. Zehazki, honela baloratu genituen guk balio ezberdinak:

<u>Balio biofisikoa: Eskaintza osagaia</u>

Hurrengo EZen eskaintza analizatu genuen: hornikuntza zerbitzuak (nekazaritza, abeltzaintza, arrantza, egurra eta ur geza), erregulazio zerbitzuak (karbono biltegiratzea, erosio kontrola, uraren erregulazioa eta garbiketa, polinizazioa, habitata espezientzat) eta zerbitzu kulturalak (turismoa eta aisia, gozamen estetikoa) (*4.1.* eta *4.4. Kapituluak*). EZ hauek, kontserbazio plangintzan eta garapen sozioekonomikoan duten garrantzia eta datuen disponibilitatea kontuan hartuta aukeratu genituen. Arestian aipatu dugun bezala, EZen balorazio biofisiko gehiena dagoeneko egina zegoen, eta hortaz, datu horiek, adierazleak eta erabilitako metodoak oinarritzat hartu genituen.

Diru-balioa: Eskari osagaia

Diru-teknika ezberdinak erabiliz, EZ mota eta kudeaketa eszenatoki desberdinen diru-balioa estimatzen dugu. Lehenik, onuren transferentzia (OT) metodoa aplikatu genuen (*4.1. Kapitulua*). Metodo honek aurretik antzeko testuinguru batean pareko ondasun eta zerbitzuen datuak erabilita, EZen diru-balioak eratortzea ahalbidetzen du (Liu *et al.*, 2010). Ondoren, merkatuen zuzeneko balorazioa eta adierazitako lehentasunen metodoak erabili genituen hornikuntza zerbitzu eta erregulazio eta kultura zerbitzuen diru-balioa kalkulatzeko, hurrenez hurren (*4.3.* eta *4.4. Kapitulua*k).

Lehentasunen metodoak inkesten bitartez EZen merkatu hipotetikoa simulatzen du (Pascual *et al.*, 2010). Bi teknika mota dira nagusi: balorazio kontingentea eta HE. Balorazio kontingenteak inkestatuak naturaren babesarako borondatez ordaindu nahi duen diruaren araberako EZen estimazio ekonomikoa egiten du (Mitchell & Carson, 1989). HEetan, berriz, baloratu beharreko zerbitzuen atributu partekatuak dituzten ≥ 2 politika-eszenatoki aurkezten dira, beti ere atributu-maila ezberdinekin (jendeak zerbitzu horretarako ordaindu beharko lukeen atributuetako bat dirua izanik). Horrela, norbanakoek aukera bat egiten dutenean, politika ezberdinak deskribatzen dituzten atributuen mailen eta hauei lotutako gastuen artean tirabiran aritzen dira (Bernués *et al.*, 2014). Bi metodoak erabilgarritasun-aldaketaren kontzeptuan oinarritzen dira. Honek zerbitzu baten kantitatea edo kalitatea handitzea edo murriztearen ondorioz gertatutako giza ongizatearen aldaketa moneta unitateetan neurtzen du.

*4.3. Kapitulua*n, bertoko biztanleei zuzendutako 266 aurrez aurreko galdeketa (Material gehigarria Galdeketa A) burutu genituen eta kudeaketa eszenatoki ezberdinekiko haien lehentasunak aztertu genituen, Logit modelo mixtoa erabiliz. Gainera, *4.4. Kapitulua*n, bertoko biztanleei eta bisitariei zuzendutako 416 aurrez aurreko galdeketa (Material gehigarria Galdeketa B) burutu genituen eta EZ desberdinei lotutako diru-balioa kalkulatu, Tobit erregresio eredua erabiliz.

Balio sozio-kulturala: Interes osagaia

EZen diru-balioa estimatzeko erabili genituen 416 aurrez aurreko galdeketak (Material gehigarria Galdeketa B) erabilita, *4.4. Kapitulua*n EZen inportantzia sozio-kulturala aztertu genuen. Hasteko, EZ bakoitzari buruzko azalpen labur bat emanda, inkestatuek EZen esanahia ondo ulertzen zutela bermatu genuen. Jarraiki, haien ongizaterako garrantzia gehien duten bost zerbitzuak aukeratzeko eta mailakatzeko agindu genien. Interes osagai hau, Geijzendorffer eta lagunek (2015) adierazi zuten bezala, lehentasun bako zerbitzuen desira-zerrendak izan ohi da.

BIBLIOGRAFIA

Bernués, A., Rodríguez-Ortega, T., Ripoll-Bosch, R., Alfnes, F., 2014. Socio-Cultural and Economic Valuation of Ecosystem Services Provided by Mediterranean Mountain Agroecosystems. PLoS ONE 9(7): e102479.

Garmendia, E., Gamboa, G., 2012. Weighting social preferences in participatory multi-criteria evaluations: A case study on sustainable natural resource management. Ecol. Econ. 84, 110-120.

Geijzendorffer, I.R., Martín-López, B., Roche, P.K., 2015. Improving the identification of mismatches in ecosystem services assessments. Ecol. Indic. 52, 320-331.

Liu, S., Costanza, R., Troy, A., D'Aagostino, J.D., Mates, W., 2010. Valuing New Jersey's ecosystem services and natural capital: A spatially explicit benefit transfer approach. Environ. Manage. 45, 1271-1285.

Mitchell, R.C., Carson, R.T., 1989. Using surveys to value public goods. The Contingent Valuation Method. Resources for the Future, Washington, DC.

Onaindia, M., Fernández de Manuel, B., Madariaga, I., Rodríguez-Loinaz, G., 2013a. Co-benefits and trade-offs between biodiversity, carbon storage and water flow regulation. For. Ecol. Manage. 289, 1-9.

Onaindia, M., Ballesteros, F., Alonso, G., Monge-Ganuzas, M., Peña, L., 2013b. Participatory process to prioritize actions for a sustainable management in a biosphere reserve. Environ. Sci. Policy 33, 283-294.

Pascual, U., Muradian, R., Brander, L., Gómez-Baggethun, E., Martín-López, B., Verma, M., et al., 2010. The Economics of Valuing Ecosystem Services and Biodiversity. In: Kumar, P. (Ed.), The Economics of Ecosystems and Biodiversity Ecological and Economic Foundations, Earthscan, London, pp. 183-256.

Peña, L., Casado-Arzuaga, I., Onaindia, M., 2015. Mapping recreation supply and demand using an ecological and a social evaluation approach. Ecosyst. Serv. 13, 108-118.

4. Kapitulua

Emaitzak

Urdaibaiko Biosfera Erreserba (Bizkaia, Espainia): Kontserbazioa *versus* garapena?

Nekane Castillo-Eguskitza, Alejandro J. Rescia, Miren Onaindia

Laburpena

Natura-eremu babestuen ikuspegia biodibertsitatea kontserbatzetik giza ongizatea hobetzera pasa da. Hala ere, kontserbazioa eta garapen sozioekonomiko eta kulturaren arteko erlazioa polemikoa izaten jarraitzen du. Artikulu honek lurzoru erabileraren aldagaiak eta aldagai sozioekonomiko eta kulturalak konbinatzen ditu aldagai anitzeko ordenamendu analisiak erabiliz, eta hauen eboluzioa aztertzen du bi eremu ezberdinetan, biosfera erreserban bertan eta kanpoan, Biosfera Erreserbaren Erabilera eta Kudeaketa Zuzentzeko Plana onartu zenetik. Emaitzek antzeko joera erakusten dute bi zonaldeetan, non ohiko landa-jarduerak bertan behera utzi eta pinu-landaketek behera egiten duten nolabait naturaltasunari, hiri hedapenari eta hirugarren sektore ekonomikoko, ongizate-adierazleen eta iraunkortasun-indizeen hazkundeari paso emanez. Alabaina, natura-eremu babestuan dagoen eskualdeak, kanpoan dagoen eskualdearekin alderatuta, kontserbazio ezaugarri (bertoko basoa eta marisma) eta landa sistema (basogintza eta lehen sektore ekonomikoa) hobeak aurkezten dituela ikus daiteke oro har, pareko baldintza sozioekonomiko eta kulturalak mantentzen direlarik. Biosfera erreserbaren izendapenak tokiko biztanlerian eragin negatiborik ez ezik, kontserbazioa bermatzen duelakoan gaude, zeinak aldi berean garapen sozioekonomikoa eta kulturala hobe izan zezakeen. Hortaz, koniferoen landaketak ordezkatzeko eta nekazaritza-jarduerak sustatzeko zenbait aldaketa egin behar diren arren, natura-eremu babestuaren izendapenak iraunkortasuna bilatu eta tokiko biztanleriaren bizi-kalitatea hobetzen duela ematen du.

Gako-hitzak:

Biosfera erreserben kudeaketa; lurzoru erabileren aldaketak; kontserbazioa; tokiko garapena; sistema sozial-ekologikoa

Ekosistemen zerbitzuen balorazio biofisikoa eta ekonomikoa lotzen kontserbazio-plangintzan ikuspegi sozial-ekologikoa izateko: Ezarpena biosfera erreserba batean (Bizkaia, Espainia).

Nekane Castillo-Eguskitza, María F. Schmitz, Miren Onaindia, Alejandro J. Rescia

Laburpena

Azken hamarkadetan pinu eta eukalipto landaketen azaleraren handitzearekin batera Urdaibaiko Biosfera Erreserbako sistema sozial-ekologikoan gertaturiko lurzoru erabileren aldaketek kontserbazioa eta garapen ekonomikoaren arteko gatazka ekarri dute. Aldaketa hauek ekosistemen zerbitzuetan duten eragin ekonomikoa kuantifikatzea lagungarri izan daiteke politika-arduradunei aholkuak emateko eta paisaiaren iraunkortasuna hobetzeko. Hala ere, kudeaketa iraunkorra bermatu nahi bada, sistema sozial-ekologikoen alderdi biofisikoa eta soziala lotzea funtsezkoa da. Ikerketa honetan, lehendabizi, lurzoru erabileren aldaketak aztertzen ditugu denboran zehar eta ekosistemen zerbitzuen diru-balioa estimatzen dugu jadanik existitzen den literaturan oinarrituz. Ondoren, ekosistemen zerbitzuen diru-balioa balio biofisikoarekin lotzen dugu biosfera erreserbaren zonifikazioa kontuan hartuta. Emaitzek erakusten dutenez, lurzoru erabileren aldaketek ekosistemen zerbitzuen diru-balioan eragin handiegirik izan ez duten arren, bistan dago lurraldea homogeneizatu eta multifuntzionalitatea galtzea eragin dutela. Alabaina, ekosistemen zerbitzuen balio biofisiko eta diru-balioaren arteko berdintasun analisiaren arabera, biosfera erreserba izendatzeak honen kontserbazioan lagundu izan du, nukleoak bi balorazioen arteko akoplamendu altuena duelarik. Erabilitako prozedura hau plangintza espaziala optimizatzeko eta inguruaren garapen iraunkorrerako politika zehatzak edo kontserbazio estrategiak ezartzeko eta natura-eremu babestuen eraginkortasuna aztertzeko baliagarria da.

Gako-hitzak:

Sistema sozial-ekologikoa; ekosistemen zerbitzuak; lurzoru erabileren aldaketak; balorazio ekonomikoa; natura-eremu babestuen kudeaketa; aklopamendua

Ekosistemen zerbitzuen balorazio ekonomikoa: Biosfera erreserba baten kudeaketarako aplikazioa

Nekane Castillo-Eguskitza, David Hoyos, Miren Onaindia, Mikolaj Czajkowski

Laburpena

Ekosistemen zerbitzuen balorazio ekonomikoa kontserbazioa eta lurzoruaren kudeaketa iraunkorra sustatzeko tresna baliotsu bezala azaltzen da. Hemen, hautaketa-esperimentua erabiltzen dugu Urdaibaiko Biosfera Erreserban hornikuntza, erregulazio eta kultura ekosistemen zerbitzuekiko lehentasunak eta hauek babesteko ordaintzeko borondatea ikertzearren. Kontuan izandako zerbitzuen artean uraren kalitatearen kontrola, nekazaritza, bertoko basoaren babesa, biodibertsitatea eta aisia aurkitzen dira. Lehentasunak aztertzeko eta eszenatoki desberdinetarako ordaintzeko borondate (OB) ongizate neurri marjinalak estimatzeko, korrelazioak onartzen dituen ausazko parametro modeloa erabili genuen OB espazioan. Lortutako emaitzek erakusten dutenez, bertoko biztanleriak ekosistemen egoera osasuntsua eta paisaia multifuntzional eta iraunkorra lehenesten du eta honen hobekuntzarako kudeaketa plan berri bat finantzatzeko prest dago. Ekosistemen zerbitzu guztien artean aisia izan zen gutxien baloratu zena, eta ondorioz, esan genezake inkestatuek funtzionaltasuna eta erregulazio zerbitzuak gehiago baloratzen dituztela. Gure emaitzak giza ongizatea erdiesteko eta lurzoru erabilera gatazkak txikiagotzeko helburuarekin kontserbazio eta kudeaketa politikak informatzeko baliagarriak izan daitezke.

Gako-hitzak:

Ekosistemen zerbitzuak; hautaketa-esperimentua; gizarte lehentasunak; balorazio ekonomikoa; Urdaibaiko Biosfera Erreserba

Ekosistemen zerbitzuen ebaluazio sakona: Eskaintza, eskaria eta interesa integratzen Urdaibaiko Biosfera Erreserban

Nekane Castillo-Eguskitza, Berta Martín-López, Miren Onaindia

Laburpena

Ekosistemen zerbitzuen balorazio integratuak balio aniztasuna eta eskaintzatik eskari eta interes sozialera doazen ekosistemen zerbitzuen osagai ezberdinen onarpena dakar. Eskaintza, ekosistemek zerbitzuak eskaintzeko duten kapazitatearekin lotzen da; aldiz, eskariak, zerbitzu jakin bat izateko bideratzen den diru-kopurua edo nahia adierazten du, eta interesak zerbitzuei emandako garrantzia. Hala ere, ekosistemen zerbitzuen hiru osagai hauek aztertzen dituen balorazio integratua aztertu barik dago oraindik. Artikulu honek ekosistemen zerbitzuen eskaintza, eskaria eta interes osagaien arteko desadostasunak, hots, ezberdintasunak edota berdintasunak kalitate edo kantitatean, aztertzeko ikuspuntu metodologikoa proposatzen du. Horretarako, hamabi ekosistemen zerbitzu aztertzen ditugu sozioekonomikoki eta lur erabilerari dagokionez antzekoak diren Urdaibaiko Biosfera Erreserbako (Espainiako iparraldea) lau unitate ezberdinetan. Emaitzek ekosistemen zerbitzuen osagai ezberdinek balio informazio desberdina, baina osagarria, ematen dutela erakutsi zuten. Gainera, unitate sozioekonomiko ezberdinen arteko informazioa berdina dela ikusi genuen, eta hortaz, ekosistemen zerbitzuen osagaien arteko desadostasun patroia, ikerketa-arearen ezaugarri sozioekonomiko eta lur erabilerak baino, ekosistemen zerbitzuen multzoarekin erlazionatuta dagoela ondorioztatzen da. Honek guztiak, ekosistemen zerbitzuen eskaintza, eskaria eta interes osagaien bidez jorratzen diren balio biofisiko, diru-balio eta balio sozio-kulturalaren integrazioaren aldeko deiak indartzen ditu.

Gako-hitzak:

Ebaluazio integratua; praktikan jartzea; desadostasunak; Urdaibaiko Biosfera Erreserba

5. Kapitulua
Eztabaida orokorra

5. EZTABAIDA OROKORRA

5.1. EMAITZEN LABURPENA ETA EGOKITASUN ZIENTIFIKOA

Tesi honen helburu nagusia UBEko SSEren EZen ebaluazio eta balorazioa aberastea izan da, beti ere paisaiaren antolamendu eta kudeaketa iraunkorrerako erabaki-hartze prozesuan lagungarri diren emaitzak lortzeko xedearekin. Tesiak, formulatutako galdera ezberdinak aztertu ditu helburu nagusia erdiesteko. Lortutako emaitzek, eremuaren kontserbazio eta garapenerako biosfera erreserbaren garrantzia ez ezik, behar bezala informatzeko konplexutasun posible guztia kontuan hartzeko beharra nabarmentzen dute ere, EZen dimentsio desberdinak ebaluatuz.

5.1.1. Biosfera erreserbak: Kontserbazioa & Giza ongizatea

Hazkunde ekonomikoaren ikuspegitik, NEBak jarduera produktibo ezberdinak aurrera eramateko oztopo bezala ikusi ohi dira, inposatzen dituzten murrizketak direla eta. Horrela, NEBa gehienak lurzoru erabilerak nekez aldatuko diren eremuetan kokatzen dira batez ere, esate baterako, Espainia kasu, 1.500 metro baino goragoko espazioetan (Europarc-España, 2017). Baina joera hori izanda ere, nazioarte, estatu eta autonomi mailan babes irudiak asko dira; hala ere, izan liteke biosfera erreserbak hemen ikertutako SSE eta paisaia kulturaletara ondoen egokitzen direnak izatea.

Biosfera erreserbek ekosistemen dimentsio biofisiko, monetario eta kulturalak integratu eta jakintza trukea eta gizarte egokitzea sustatzen dituzte. 'Iraunkortasunerako zientzia' adierazle dira, hau da, diziplina anitzeko ikuspegien azterketarako lekuak dira, sistema sozial eta ekologikoen arteko aldaketak eta elkarreraginak ulertzeko eta kudeatzeko, eta gatazkak prebenitzeko eta biodibertsitatea kudeatzeko (UNESCO, 2017). Biosfera erreserbak osatzen dituzten hiru eremuek (nukleoa, nukleoaren babesa eta trantsizio eremua) konektibitate ekologikoa hobetzen dute eta lurralde matrizean harremana hobea izatea dakarte, nolabait kontserbazioa *vs.* garapenaren eredua saihestuz eta iraunkortasun sozial-ekologikoaren helburuan lagunduz.

UBEri dagokionez, badirudi honek naturaren kontserbazioaz aparte, garapen sozioekonomiko eta kulturalean eragina izan duela (*4.1. Kapitulua*). Oro har, ekosistema naturalen kontserbazioak eta biosfera erreserba izendatzeak, bertoko komunitateei euren giza ongizatea mantentzeko eta bereziki hirugarren sektorean, baina baita lehen sektorean eta industrian, oinarritutako ekonomia garatzeko aukera eman die. Izan ere, babesik gabeko eskualdea eta UBE NEBa alderatzean ez dira diferentzia esanguratsurik aurkitu gehiengo aldagaietan. Bakarrik koniferoen landaketek eta sastrakadiek, biztanleriak eta enpleguak lehen sektorean izan dituzte ezberdintasun esanguratsuak denboran zehar. Hain zuzen ere, koniferoen landaketen beherakada UBEn, NEBetik kanpo dagoen eskualdean baino pixkat txikiagoa izan arren, joera orokorrak kontserbazio ezaugarri (bertoko basoa eta marisma) eta landa sistema (basogintza eta sektore ekonomikoa) hobeak aurkezten ditu UBEn, pareko baldintza sozioekonomiko eta kulturalak mantentzen direlarik. Gainera, NEBetik kanpo dagoen eskualdean ez bezala, UBEn lehen sektorearen ekoizpena handitu egin zen, askoz ere handiagoa izanik, eta industria eta hirugarren sektoreko enplegua mantendu eta handitu ziren, hurrenez hurren. Honek guztiak UBEk lurzoru erabilera eta jarduera aniztasuna sustatzen dituela iradokitzen du. Dena dela, emaitzetan adierazi den moduan, koniferoen landaketak ordezkatzeko ahalegina beharrezkoa da, adibidez ahalmen agrologiko handiko eremu horietan. Halaber, baso kudeaketa iraunkorra eta tokiko elikagaien ekoizpena ere bultzatu beharra dago. Beraz, landa bizitza suspertzea ezinbestekoa da. Azken finean, landa-garapena edozein garapen estrategiarako oinarri izan beharko litzateke. Landa-komunitateak ezin dira elikagai edo egur hornitzaile bezala soilik ikusi, baizik eta ekonomia, soziopolitika, ingurumen eta kultur alderdiak barne hartzen duten eta lurralde kohesioa sustatzen duten paisaia multifuntzionalak lortzeko bide bezala. Hala ere, iragarpena ez da ona. UBEko landa eremuetan biztanleriak gora egin duen arren denboraldi honetan (Elantxoben izan ezik), bi udalerrik bakarrik (Bermeo eta Gernika-Lumo), UBEko biztanleriaren %75a inguru batzen dute, eta azken Nazio Batuko proiekzioen (2017) arabera, 2050. urterako, biztanleriaren %80-90a hirietan biziko da eta dagoeneko hiru laurden Europako hirietan bizi dira.

5.1.2. Ekosistemen Zerbitzuen Balorazioa

EZetan ematen diren aldaketek giza ongizatean eragina daukate. Paradoxikoki, mundu mailan, EZekin zuzenean lotuta dagoen biodibertsitatearen (Balvanera *et al*., 2006; Harrison *et al*., 2014), gainbeherak, giza ongizatean irabaziak ekarri ditu (MA, 2005). Honek, giza ongizatea neurtzeko modua dudatan jartzen du (Raudsepp-Hearne *et al*., 2010). BPGa garapenaren adierazle gisa erabili ohi da, giza ongizatearekin lotzen dena; baina honek ez du biodibertsitatearen galeraren ekosistemen hondatzearen ondorioz ematen den giza ongizatearen galera kontuan hartzen. Politika, garapen ekonomikoaren adierazle tradizionaletatik at dauden ingurumen eta gizarte kalteen kontura, hazkunde ekonomikoan baino ez da oinarritu. Hazkunde ikuspegi honek hornikuntza eta turismoa eta aisialdia bezalako kultur zerbitzuetan bakarrik jartzen du arreta, espezieentzako habitata eta gainerako erregulazio zerbitzuak NEBetara alboratuz. Izan ere, erregulazio zerbitzu eta zerbitzu kulturalen gabeziak merkatu mekanismoekin konpentsatzen dira normalean, EZen maintenua zailduz (e.b. produktu kimikoek eta ongarriek kontrol biologikoa eta nutrienteen erregulatzeko zerbitzuak ordezkatzen dituzte, dikeak edo dragaketak erosio kontrolerako erabiltzen dira, eta araztegiek ur arazketa zerbitzua ordezkatzen dute).

Honek guztiak, erabaki-hartzean eragin handiagoa izan dezaketen estrategiak bilatzera eraman gaitu eta argumentu ekonomikoak ingurumen arazoek agenda politikoan leku bat izan dezaten tresna bilakatu dira. Testuinguru honetan, zenbait mugen haraindian, *4.2. Kapitulua*k lurzoru erabileren aldaketen inpaktu ekonomikoa argitara dakar. OT metodoa erabilita lortutako emaitzen arabera, UBEn azken 44 urteetan gertatutako lurzoru erabileren aldaketek EZen diru-balioan %5eko galera suposatu dute gutxi gorabehera. Hornikuntza zerbitzuen EZBa izan zen kaltetuena labore-lurren azaleraren murrizketa zorrotzagatik. Funtsean, pinu eta eukaliptoen landaketek labore-lurren lekua hartu zuten eta egurra ez zen elikagaien ekoizpena bezain errentagarria izan; aitzitik, erregulazio zerbitzuen EZBak gora egin zuen eta zerbitzu kulturalen EZBa hortxe-hortxe mantendu zen. Hortaz, esan genezake, galerak beste EZ batzuen diru irabaziekin konpentsatu zirela, paisaiaren homogeneitatea eta multifuntzionaltasunaren izenean. Horrez gain, garrantzitsua da azpimarratzea diru-balioa ez zela denboran zehar aldatu eta pinu eta eukaliptoen landaketen kasuan, 30 eta 10 bat urteren buruan, hurrenez hurren, erregulazio zerbitzuen eta zerbitzu kulturalen eskaintza lazki kaltetu egiten dela hauen kudeaketa eta matarrasen ondorioz, eta egur ekoizpenak ere behera egiten duela moztearekin eta birlandatzearekin batera. Horrela, begi-bistakoa da EZBaren murrizketa are handiagoa izan zitekeela. EZen balio biofisiko eta diru-balioaren arteko berdintasun analisiaren arabera, ordea, biosfera erreserba izendatzeak honen kontserbazioan lagundu izan du, nukleoak bi balorazioen arteko akoplamendu altuena duelarik. Gainera, zonen arteko antzekotasunak agerian uzten duenez, oro har, nukleoan ez ezik, nukleoaren babes eremuan eta trantsizio eremuan ere, EZen diru-balioa, balio biofisikoan oinarritutakoaren gisa hautematen da.

Baina diru-balioak ez dira independenteak testuinguru sozio-kulturalarekiko, sistema sozialean erabat txertatuta baitaude. Beraz, balioak tokian tokikoak direla eta testuinguru zehatzak dituztela onartuta, *4.3. Kapitulua* kudeaketa erabakiak adosteko informazioa emateko baliagarria izan zen, kudeaketa eszenatoki ezberdinekin erlazionatutako EZen eskaintzan aldaketa desberdinekiko tokiko biztanleriaren lehentasunak aztertu baitziren. Giza lehentasunen eta EZ eta biodibertsitatea kontserbatzeko OBaren ulermenak, naturaren kontserbazioan inbertsioak eta lurralde kudeaketarako politikak hobetzeko estrategia eraginkorrak erabakitzen lagun dezake. UBEri dagokionez, gure emaitzek tokiko biztanleriak naturan inbertitzearen inportantzian sinisten dutela erakutsi zuten. Jendea EZ desberdinen eskaintza hobetzeko eta funtzionaltasuna eta erregulazio zerbitzuak lehenesten dituen beste kudeaketa estrategia bat bilatzeko prest dagoela ematen du. Zehazki, tokiko biztanleria ekosistemen osasunean eta paisaiaren multifuntzionalitatean kezkatuta dagoela dirudi.

Zentzu honetan, EZ eta lurzoru erabilerak diru-baliotan baloratzeko erabilitako metodologia honek, gizartearen eskarien araberako EZen eskaintza maila desiragarriak lortzen laguntzeaz aparte, lehentasun sozio-kulturalen adierazletzat har genezake, berez merkatu balioa izan ordez (Chan *et al.*, 2012). Egia esan, inkestatuek egindako hautaketek etika eta morala bezalako balio sozio-kulturalei loturiko faktore ez-ekonomikoen eragina izan ohi dute (adb. Martín-López *et al.*, 2007; Kumar & Kumar, 2008). Baina, nahiz eta adierazitako lehentasunen inkesten metodoek (OBa eta HE metodoak) pertsonen jarrerak eta lehentasunak neurtzen dituztela ondo jakin, teknika hauen kritikarik nagusienetako bat biztanle guztien balioak atzemateko ezintasuna da. Besteak beste, diru-sarrera faltagatik edo, jendea kanpo utz dezakete, eta kontuan hartzen badugu finantza-botere txikia duten pertsonek aberatsek baino menpekotasun handiagoa dutela EZetan, eskariaren neurri ez errealista izan daitezke. Horren adibide bat paisaiaren lehentasunetan prezioaren atributua alde batera uztearen edo ez uztearen eragina aztertzea da (van Zanten *et al*., 2016). Ikerketa honen arabera, HEetan prezio atributu bat gehituz gero, inkestatuen tirabirak eta aukerak nabarmen aldatzen dira. Era berean, teknika hauek, neoklasikoko paradigma ekonomikoaren barnean, gizabanakoek lehentasun arrazionalak dituztela eta norberaren motibazioetan oinarrituta beren irabaziak maximizatzen ahalegintzen direla uste dute, komunitate eta balio erlazionalak bezalakoak nekez kontuan hartuta (Spash *et al*., 2009; Lo, 2014).

Horrela, balorazio metodo alternatiboak proposatu dira eta teknika ez-monetarioak gero eta ospe handiagoa irabazten ari dira, EZen balio anitzak mahai gainean jarriz (Chan *et al*., 2012, 2016; Kenter *et al*., 2015). Denbora sakrifikatzeko borondatea (DB) eta deliberazio metodo monetarioak bezalako ikuspegiak proposatu dira lehentasunen metodoen mugak gainditzeko. DBak, OBaren eta HEen diru-unitatearen ordez, lan orduak erabiltzen ditu biodibertsitatearen kontserbazioa eta EZen eskaintza sustatzeko gizarteak duen nahia aztertzeko (García-Llorente *et al*., 2016). Boluntariotza lanetan oinarritzen denez, inkestatuek norberaren eta norberarenak ez diren motibazioen arabera jokatuko dutela uste da (McDougle *et al*., 2015; Randle & Dolnicar, 2015); hala ere, adinduak eta pertsona ezgaituak eta denbora mugak dituzten pertsonak ere kanpo uzten ditu. Bestetik, deliberazio edo parte-hartze diru metodoei dagokienez, inklusiboagoak direla uste da, ezagutza trukea eta eztabaidatzea dakartzate eta; baina taldean oinarritutako planteamenduek ere, parte hartzaileak arau sozialekin bat etortzea eta euren iritzia ezkutatzea ekar dezakete, balorazio ariketa proaktiboki errazten ez bada (Kenter *et al*., 2011).

Hortaz, argi dagoen bakarra balorazio ekonomiko metodo bakoitzak abantaila eta desabantaila batzuk dituztela da, bai informazio eta metodologia espezifikazio ezagatik, bai ekitate eta ezagutza faltagatik, besteak beste. HE balorazio metodoetan bereziki ematen diren muga eta anbiguotasun horiek jakitun, gure ekarpenak literaturari, diru-balio zehatzak ematea baino, aurrekontuak hobeto banatzeko eta lurzoruaren erabileren gatazkak minimizatzeko gomendioak ematean enfokatuta daude. NEBak mantentzea ez da doakoa. Hori dela eta, gure emaitzak baliagarriak izan daitezke politika-arduradunek proiektu batean edo bestean, gehiago edo gutxiago, inbertitzeko egokitasuna aztertzeko. Gainera, EZen diru-balio potentzialari buruz informatzeak, ingurumen baliabideen kontserbaziorako borondate politikoa bultza dezake, kontserbazioa helburu ekonomikoekin gatazkan dagoenaren sinesmena deseginez.

Hala eta guztiz ere, balio aniztasunaren garrantziaz eta balorazio teknika monetarioak metodo ez-monetarioekin edota gizarte balorazio teknikekin konbinatzeko beharraz kezkatuta, *4.4. Kapitulua*n balio dimentsio biofisiko, monetario eta sozio-kulturala ebaluatzeko erabiltzen diren neurri ezberdinek UBEn pareko informazio edo ez ematen duten ikertu genuen. Berriz ere, EZen balorazio ekonomikoan muga batzuk eta ez-egokitasunak izan arren, dimentsio bakoitzak elkarrengandik urruntzen zen balio informazioa ematen zuela aurkitu genuen eta EZen osagaien arteko, h.d. eskaintza, eskaria eta interesa, desadostasunak analizatzen laguntzen duen metodologia proposatu genuen. Gure emaitzek, balio biofisikoa, diru-balioa eta balio sozio-kulturala integratzeko egungo deien argumentuak indartzen dituzte, EZen konplexutasun osoa barneratuko bada. Izan ere, ikuspuntu ekonomikoaren bitartez lortutako balioek gizartearen kezkak partzialki baino ez dituzte islatzen eta merkatuek emandako informazioaren alde jo dezakete (Martín-López *et al*., 2014). Espero bezala, gure ikerketak Simpsonek (2011) 'balorazio paradoxa' bezala deitu zuena konplitzen du. Bere hitzetan, teoria ekonomikoak gabezia/hondamena eta gizartearen eskaria/interes handiaren arabera iragartzen du zerbaiten balio altua; alabaina, OBa metodoekin alderatuta, merkatuan oinarritutako tekniken nagusitasuna dela eta, balioak ez datoz bat EZ guztientzako. Beraz, ez dago inolako dudarik EZen diru-balioa baloratzeko erabiltzen diren teknika monetarioak berdinak izan behar direla gaizki ulertuak saihesteko eta konparazioak errazteko emaitzak interpretatzerako orduan.

5.2. ESZENATOKI IRAUNKOR BATERANTZ: KUDEAKETARAKO INPLIKAZIOAK

Iraunkortasuna garapen iraunkorraren kontzeptuarekin batera sortua da, honela definitzen dena: gaur egungo beharrak asetzen dituen garapena etorkizuneko belaunaldiek euren beharrak asetzeko gaitasuna arriskuan jarri gabe (WCED, 1987). Honek ingurumen, gizarte eta ekonomia iraunkortasuna barne hartzen ditu, oro har. Ingurumen iraunkortasunak kapital naturalarekin du zerikusia; gizarte iraunkortasunak, baliabideen bidezko banaketa oinarritzat hartuta, norbanakoen artean harremanak eta kohesioak sustatzea aldarrikatzen du; eta ekonomia iraunkortasunak baliabideen kontsumo arrazionala edo orekatua azpimarratzen du, gizakion bizitza balioesten duten ondasunak eta zerbitzuak sortzeko. Orokorrean, ekonomia gizartearen azpitalde bat bezala kontsidera dezakegu, zeina aldi berean, ingurumenaren azpitalde bat dena. Orduan, beste modu batean esanda, iraunkortasunak gizarte harreman eta elkarrekintzak aztertzen ditu, pertsonen arteko elkarbizitza maila hobetzeko.

5.2.1. Pragmatismoa eta ekosistemen zerbitzuak garapen iraunkorrerako

Aldaketa globala diogun honetan, agenda politikoetan garapen iraunkorra barneratzea helburu nagusi bilakatu da eta EZen kontzeptua ekosistemen eta gizartearen arteko loturak erakusteko korronte bihurtu da. EZen kontzeptuak naturak gizartean duen paperaren gure paradigma aldatu du eta egun, naturaren kontserbazioa kapital naturala bezala hautematen da, gure ongizaterako nahitaezkoa, eta ez sakrifikatu beharreko zerbait bezala (Liu *et al*., 2010). Nolabait esateko, EZen kontzeptua kontserbazio paradigma berri bat bezala agertu da, non kontserbazioa ez den ikuspuntu intrintsekoetan soilik oinarritzen, bere garrantzi propioagatik, baina baita balio instrumentaletan ere, non ekosistemak gizartearentzako onuragarriak diren ekarpenekin lotuta dauden. Eta non eta hemen, balorazio ekonomikoak funtsezko zeregina betetzen duen. Izan ere, nahiz eta EZen kontzeptua diziplinarteko ideia moduan sortu bazen ere, zientzia sozialak eta naturalak integratzen dituena, balorazio ekonomikoa gailendu egiten da literatura zientifikoan (Bernués *et al*., 2014; Quintas-Soriano *et al*., 2016).

Beraz, EZ ekonomia ekologizatzeko tresna indartsua izan dira; ideia ekologikoak pentsamendu ekonomikora ailegatzea ahalbidetu dute eta ekosistemak eta biodibertsitatea etika eta estetika kontua ez ezik, gizarteen oinarri sendoak direla ulertarazten lagundu dute ere (Gómez- Baggethun & de Groot, 2010). Gainera, balorazio ekonomikoak finitua den munduan hazkunde infinitua izatearen kontraesana eta naturaren degradazioaren ingurumen kostuak azpimarratu ditu. Halere, biztanleria naturarekin gero eta deskonektatuago dago eta, aldi berean, ekosistema eta hauek eskaintzen dituzten zerbitzuekiko menpekotasuna gero eta handiagoa da (Wiedmann *et al*., 2015).

Gure emaitzek erakusten dutenez, gizakion ongizatea hobetzeko eta iraunkortasuna areagotzeko, tokiko ikuspuntu monetarioak bi kudeaketa estrategia nagusi jarraitu beharko lituzke: ekosistema naturalen kontserbazioa eta berreskurapena, eta nekazaritza-praktika onen sustatzea. UBEko biztanleek eskatzen duten moduan, ur masen kalitatea hobetzea lehentasuna izan beharko litzateke eta bertako basoaren eta nekazaritza ekologikoaren azalerak gora egin beharko luke. Paisaiaren plangintzaren ikuspegitik, gaur egungo baso landaketa monokultiboa iraunkortasunerako egokiagoa den landa mosaiko multifuntzionalera pasa liteke. Pinu eta eukalipto monokultibo landaketak eta hauei loturiko kudeaketa bertako basoarekin ordezkatzeak, ur masen kalitatea hobetuko luke nola edo hala, ibaiak lohiz betetzea murriztuz, lurzoruan eta nutrienteen galera gutxituz (Merino *et al*., 2004; Rodríguez-Loinaz *et al*., 2011; Garmendia *et al*., 2012), eta biodibertsitatea babestuz, zeina bertoko biztanleriarentzako ere atributu inportantea izan zen diru-baliotan. Era berean, nekazaritza ekologikoaren sustapenak, labore lur iraunkorrak edo nekazaritza praktika onek, oro har, biodibertsitatea areagotuko lukete eta elikadura segurtasuna bermatu eta sendotu.

Ekosistema naturalak berreskuratzeko eta nekazaritza ekologikoa areagotzeko behar hau, aurretiaz ere, gure etorkizuneko paisaiaren funtsezko elementu kontsideratu zen (Onaindia *et al*., 2013; Rodríguez-Loinaz *et al*., 2011, 2013). Halaber, UBEtik gertu dagoen EZen balorazio sozio-kulturalak (Casado-Arzuaga *et al*., 2013) azpimarratzen duenez, erabiltzaileek tokiko elikagaien eskaintza eskatzen dute; eta Bizkaiko eskualde-mailan garatutako parte-hartze prozesu batek (Palacios-Agundez *et al*., 2013; 2014) paisaiaren plangintza estrategia berriak identifikatzen ditu, batez ere, basoen kudeaketaren aldaketan eta tokiko ekoizpen ekologikoan oinarritzen direnak. Garrantzitsua da aipatzea Palacios-Agundez eta lagunek (2013, 2014) paisaiaren plangintzarako burututako tokiko parte-hartze prozesu hauek, administrazio publikoetako teknikarien eta politika-arduradunen partaidetzari esker, Bizkaiko iraunkortasunerako politika plan estrategikoan kontuan hartzen ari direla. Dena dela, gobernuak eta sektore publikoak iraunkortasunerako trantsizioan garatu beharreko estrategia eta ekintza zehatzak betetzeko, normalean pizgarriak behar dira.

5.2.2. Dirua eta norberaren motibazio propioetatik haratago: balio aniztasuna

Arriskua merkatuek automatikoki emandako soluzio optimoetan sinestean agertzen da. Kallis eta lagunek (2013) iradoki zuten bezala, galdera ez da dirua baztertzea ala ez natura baloratzerako orduan, baizik eta noiz eta nola baloratu diruarekin. Helburua berdintasunezko trantsizio sozial-ekologikoa lortzea bada, orduan, balorazio ekonomikoa guztiz onargarria da. Hala ere, lau irizpide bete beharko lirateke (Kallis *et al*., 2013): ingurumenaren hobekuntza; justizia banaketa eta berdintasuna; balio-artikulazio erakunde pluralen mantentzea; eta merkantilismoari aurre egitea.

Lehenengo eta bigarren irizpideak argi daude. Ingurumen baldintzak eta giza berdintasunak hobetu eta boterea birbanatu beharra dago. Esate baterako, ekonomikoki ahulagoak diren komunitateak kontuan hartu behar dira, eta EZen erabiltzaileei karga gehigarri bat aplikatuz gero, ordainketa modua diru-sarrera txikiagoa duten pertsonei egokitu behar zaie. Hirugarren irizpideari dagokionez, beste balorazio eta konplexutasun hizkuntzak aldarrikatzen dira. Bada, natura baloratzea ez da diru-balio bat ematea soilik. EZen egoera ekosistemen eta sistema sozialen eraginpean dago, eta beraz, iraunkortasunerako bideak eskaintza-eskari esparru osoaren balorazioaren premia du (Griggs *et al*., 2013), EZen eskaintza, eskaria eta interes osagaiak barne hartuz. Rockströmek (2015) dioenez, ekonomiaren mehatxua gizartean, natura baloratzeko gure ezintasuna da, eta hori dela eta, orokorrean diru-baliotan neurtuak diren balore instrumentaletatik haratago, balio pluralek gero eta inportantzia handiagoa irabazten ari dira (Jacobs *et al*., 2016; Pascual *et al*., 2017; Arias-Arévalo *et al*., 2018). Einsteinen esanak jarraituz, "arazo bat ezin da konpondu hau sortzen lagundu duen pentsamendu bera erabiliz", eta ondorioz, EZek iraunkortasunaren erronkak konpontzeko rola beteko badute, ezin dugu EZen kontzeptua neurri edo metodologia bakar batera murriztu, baizik eta ikuspuntu integratu eta holistiko batera. Hortaz, EZen eta SSEen konplexutasun osoa ulertu ahal izateko, zerbitzu hornitzaileak (ekosistemak) eta onuradunak edo interesdunak eta erakunde edo gobernu aniztasuna (sistema sozialak) aztertzea funtsezkoa da.

Gainera, laugarren irizpideari dagokionez, aipatu beharra dago balorazio ekonomikoa sarritan, sustatzaileen borondatearen kontra normalean, EZen merkantilizaziorako teknologia metriko eta marko diskurtsibo bezala erabilia izan dela (Robertson, 2006), azkenean SSEk andeatuz. Kallis eta lagunek (2013) esaten dutenaren arabera, merkantilizazioa jabetza kentzearen pilatzeaz sortutako garapen kapitalistaren prozesuen parte da, hau da, ondasun komunen itxitura (Harvey, 2007), neoliberalismoarekin azentuatu egiten dena. Ondorioz, lehen merkatu guneak ez zirenetan, produktuen hedapena ematen da, epe luzean biodibertsitatearen kontserbazioan eta EZen eskuratzean kalteak sortuz (Gómez-Baggethun & Ruiz-Perez, 2011). Hori dela eta, balorazio ekonomikoa barne hartzen duen testuinguru politiko-ekonomikoaren epaiketa eta kontzientzia erabakigarria da, Gómez-Baggethun & Ruiz-Perez (2011) lagunek ‘asmo oneko balorazioaren tragedia’ deiturikoan erori nahi ez badugu. Diru eta merkantzien espazioa mugatu behar dugu ingurumen politikan, eta behin hori eginda, merkatuan barneratu nahi ditugun externalitateak eta kanporatu nahi ditugun internalitateak erabaki, esklabutzarekin egin zen bezala, adibidez (Gómez-Baggethun & Ruiz-Perez, 2011).

Laburbilduz, EZen ebaluazioan etika, politika, erantzukizuna eta beste jarrera batzuk kontuan hartu behar dira eta holistikoki ikertu. Horretarako, balio biofisikoak, monetarioak eta sozio-kulturalak osagarriak, eta ez ordezko, diren balio pluralak aplikatu beharko dira. Baina, batez ere, merkantilizatze ez-desiragarriari kontra egiteko eta balio pluralak eta instituzioak existitzen eta ugaritzen direla ziurtatzeko, ekintza politikoa beharrezkoa da (Kallis *et al*., 2013).

5.3. EKOSISTEMEN ZERBITZUAK ERABAKI-HARTZEAN INTEGRATZEKO ERRONKA

EZen balorazioa kudeaketa erabaki iraunkorragoak aurrera eramateko, tirabirak aurkitzeko eta interesdunen arteko interes gatazkak konpontzeko pausu garrantzitsua da (Farber *et al*., 2002;

Costanza *et al*., 2011; Castro *et al*., 2014). Alabaina, EZen balorazioa erabaki-hartzean guztiz integratzeko arazo ugari badaude konpontzeke eta hauek praktikan jartzeko erronka ere oraindik dirau (Jax *et al*., 2018).

Hasteko, kudeaketa teknikari, politika-arduradun, ikertzaile eta beste eragile batzuen artean lankidetza eta elkarlana beharrezkoa da. Norberaren lana erabakiak hartzeko baliagarria izan daitekeela esan dezakegu, baina interesdunekin inplikazio eta elkarrekintza zuzenik ez badago, politikan nekez aplikatuko da (Burkhard *et al*., 2010). EZ politikan eta lurzoruaren kudeaketan ezartzea oztopatzen dituzten arrazoiak ugariak dira, baina komunikazio falta eta finantzaketa tresna egokiak izan ohi dira arruntenak (Groot *et al*., 2010; Saarikoski *et al*., 2018).

Komunikazio faltak akats kontzeptual eta metodologikoak ekar ditzake. Bistakoa badirudi ere, ezagutza argi eta garbi komunikatu beharko litzateke eta EZen hizkuntza literatura zientifikotik kanpoko jarduera profesional eta publiko orokorrera zabaldu. EZen kudeaketak aniztasun instituzional maila guztiak kontuan hartzea suposatzen du, erakunde ez-formaletatik edo ezagutza tradizionaletik (tokiko eskala) hasita, instituzio legal eta formaletaraino, hala nola, legeak eta pizgarri ekonomikoak (eskualde-, nazio- eta eskala globala) (Gómez-Baggethun *et al*., 2013). Hots, berriz ere, alderdi biofisikoa, ekonomikoa eta sozio-kulturala kontsideratzen duen ikuspuntu holistikoa ezinbestekoa da. Bestela, instituzio ez-formaletako balio soziokulturalak kontuan hartzen ez baditugu, 'kontserbazioa *vs*. garapena' ereduan aurkituko gara, non lurzoruaren erabileraren intentsifikazioari edo hornikuntza zerbitzuen sustapenari garapena deritzen eta erregulazio zerbitzuen sustapenari kontserbazioa (Folke, 2006; Martín-López *et al*., 2011); zeinak, aldi berean, informazio monetarioa ematera eramaten gaituen, erabaki-hartzaileak kontserbatzearen, eta ez degradatzearen, errentagarritasunaz konbentzitzeko.

Baina erabaki-hartzean aldaketa bat antzemateko, nahitaezkoa da EZen balioak instituzio formaletan txertatzea. Izan ere, nahiz eta tokiko komunitateak piramidearen oinarria izan, aldaketa instituzional formalik gabe, komunitateek gizartearentzat kaltegarriak diren jokabide txarrak izaten jarraituko dute ziurrenik, e.b. gehiegizko arrantza eta erregai fosilen erabilera altua (Daily *et al*., 2009). Bereziki, Bizkaian, landaketa exotikoen eta hauen kudeaketaren inguruan Administrazioak duen rola harritzekoa da. Egia da azkenaldi honetan baso-ziurtapenen bidezko baso kudeaketa iraunkorra (PEFC – Basogintza Ziurtapena) sustatu dela, eta gaur egun, Bizkaiko baso landaketen %22k ziurtapenak dauzkate (OBSERVAPEFC, www.observapefc.es). Hala ere, asmoak bide egokian doazela dirudien arren, azpimarratu beharra dago PEFCa, FSCa – *Forest Stewardship Council* delakoa ez bezala, egur industriako enpresek sustatu zutela. FSCa 1993an sortu zen lehen baso-ziurtagiria da, Gobernuz Kanpoko Erakunde (GKE) kontserbazionistek sustatua, eta beraz, ingurumen-eskakizunak PEFCak proposatutakoak baino askoz handiagoak dira. Orobat, Administrazioak adin bereko, batera landatutako eta matarrasen bidez moztutako zuhaitzei zuzendutako baso diru-laguntzak ematen jarraitzen du oraindik, eta badirudi ez dagoela kezkatuta eukalipto monokultiboek pinu landaketak ordezkatzearekin. Etsenplu ona eman beharrean, Erabilera Publikoko

Mendien %70a gutxi gorabehera pinu eta eukalipto landaketek osatzen dituzte, eta duela gutxi, *Kolore guztietako basoak* izeneko plataformak Bizkaian baso autoktonoa berreskuratzeko proposatutako neurri ezberdinak baztertu egin ditu (Kolore guztietako basoak; https://koloreguztietakobasoak.wordpress.com/), funtsean, baso hauen kudeaketa iraunkorra eta eremu publikoetan bertoko basoa landatu eta kontserbatzea eskatzen zituztenak. Aldiz, azpimarratu beharra dago, ezer ez baino hobe, beste neurri batzuk onartu direla. Horrela, hemendik aurrera, Erabilera Publikoko Mendietan bertoko espezieen landaketak ez dira lerro edo lauki-saretan ipiniko, eta 2018 urteko bukaerarako, ekimenean parte hartzea erabakitzen duten jabe pribatuentzako diru-sarrera berri bat sortuko dela esan dute.

Eta hona hemen, non finantzazio instrumentuek, EZen balorazio ekonomikoa medio, gure baliabide naturalak eta paisaiak modu iraunkorrago batean eta epe luzera kudeatzeko esku hartzen duten. Konpentsazio ekonomiko hauek aukera-kostuen printzipioan oinarritzen dira. Honen arabera, galdutako aukera baten kostua edo lurra errentagarri bihurtzeko aukera galtzearen kostuak konpentsatu beharko lirateke (Adams *et al*., 2010; Schmidt *et al*., 2014). Zentzu honetan, Ekosistemen Zerbitzuen Ordainketak (EZO) bezalako ekimenak, kontserbazioa eta baliabideen kudeaketa iraunkorra sustatzeko modu gero eta popularragoa bilakatzen ari dira (van Noordwijk *et al*., 2012; Pascual *et al*., 2014; Ferguson *et al*., 2016). EZO eskemak ordainketa instituzionalizatuak dira, non EZen erabiltzaileek zerbitzu horiengan inpaktua murrizteko edo babesteko ordaintzen duten (Wunder *et al*., 2008). Bertoko egoera biofisiko eta sozioekonomikoa kontuan hartuz gero, ekosistemen kudeaketa hobetu eta tokiko komunitateen ongizatea areagotu dezakete (Wunder, 2013). Baina, arestian aipatu dugun bezala, arretaz pentsatu beharra daukagu ‘asmo oneko balorazioaren tragedia’ delakoan ez jausteko. Besteak beste, ingurumen pizgarri programa hauekin erlazionatuta dauden kezken artean ondorengoak aurki ditzakegu (Chan *et al*., 2017a): externalitate berriak, eskubide eta erantzukizun ezegokiak, segimenduaren zama, motibazioen aldaketa, aplikagarritasun mugatua, eta goitik beherako agintera.

Adibidez, externalitate berriak sor daitezke basotze programekin, hazkunde azkarreko zuhaitz landaketa exotikoak sustatzen direnean karbono harrapaketa aitzaki (Alexander *et al*., 2011). Horrez gain, EZOek gure erantzukizunaren ulermena aldaraz dezakete eta jendea ingurumena andeatzea eragin diru bat jaso ezean (Gómez-Baggethun & Ruiz-Pérez, 2011; Solazzo *et al*., 2015), edota kontserbatzeko gure motibazio intrintseko edo altruistak suntsitu (Rode *et al*., 2015). Honek guztiak, tranpak ekar ditzake eta kutsatzailea ordaintzen denaren ideia okerra. Gainera, lehen aipatutako justizia banaketa eta berdintasunarekin lotuta, eraginkortasunak pobreagoak direnak (lurjabe txikiak) eta praktika egokiagoak egiten dituztenak baztertzera eraman dezake (Pascual *et al*., 2014). Horretaz gain, orokorrean, EZO eskemen aplikazioa kasu oso konkretuetara mugatuta dago, non onuradun konkretu batzuek hornitzaile konkretu batzuei diru bat ematen dieten EZ konkretu baten kontserbazio jarduerak sustatzeko, hauen arteko sinergiak eta tirabirak kontuan hartu barik (Rodríguez-Loinaz *et al*., 2018). Amaitzeko, nahiz eta iraunkortasunerako ingurumen politikak arrakastatsuak izateko administrazioa edo zaintza hobetu beharra dagoela ezaguna izan, EZO programen malgutasun ezagatik eta parte-hartzeko gonbidapen faltagatik sortzen da azken arazoa.

Chan eta lagunek (2017a) iradoki bezala, iraunkortasuna erdiesteko, EZO programek parte hartzeko motibazio ez-monetarioak eta administrazioa edo zaintza bultzatu behar dituzte. Lurralde kudeaketaren zaintzan laguntzeagatik sari moduan hartu beharko litzateke programa, eta ordainketa partekatua eskainiaz, gure kontserbatzeko motibazioak aldatzea saihestuko genuke eta erantzukizunen banaketa zuzenagoa izango litzateke (Chan *et al*., 2017b). Labur esanda, tokiko ezagutza eta parte-hartzea funtsezkoak dira. Berriz ere, tokiko ezagutzan oinarritutako instituzio ez-formalak instituzio piramideen oinarri izatea behar-beharrezkoa da, partaide izatearen sentimendua eta parte-hartze soziala bultza daitezen, eta azken batean, gizartea eta natura birkonektatu. Baina gizartea iraunkortasunera eraldatu dezakeen benetako gizarte-natura lotura lortzeko, eragin puntuak edo sistema konplexuetan aldaketa txiki baten bitartez sistemaren aldaketa transformazionala sustatzeko kapaz diren lekuak (Meadows, 1999) identifikatzea nahitaezkoa da (Abson et al., 2017; Ives et al., 2018), erakunde formal eta ez-formalen arteko elkarrekintzarekin batera.

Esku artean dugun kasuari dagokionez, Rodríguez-Loinaz eta lagunek (2018) Bizkaian proposatutako ildo bera jarraituz, baso autoktonoaren eta nekazaritza ekologikoaren azalera handitzea gure pizgarri mekanismoaren oinarri izan liteke. Aldaketa honek EZ asko barneratuko lituzke, zera bakar batean pentsatu beharrean. Arestian esan bezala, neurri hauek ur masen kalitatearen hobekuntza ekarriko lukete, eta biodibertsitatea eta turismoa eta aisia ere hobetuko lirateke balio estetikoa ere handituko bailitzateke. Egurraren merkatuak ere arrakasta handiagoa izan litzake kalitatea handitzearekin batera (Breukink *et al*., 2015) eta matarrasak iraganeko kontua izan zintezkeen. Gertatzen dena da landaketa exotikoen eta bertokoen arteko diru-laguntzen ezberdintasun txikiak ez duela ekonomikoki errentagarri egiten bertokoengatik apustu egitea. Beraz, eta egungo basogintza sektoreak globalizazioaren eta eraikuntza sektorearen eskaria murriztearen ondorioz errentagarritasun osoa galdu duela kontuan harturik (Rodriguez-Loinaz *et al*., 2018), eta pinu landaketetan onddoek eragindako kalte handiak kontsideratuz, eszenatoki berriak sortzea lehentasunezkoa da. Eta UBEn ia guztia jabetza pribatua izanda, EZOak aukera onena dirudite. Finantziazio-eskema hauek munduko herrialde askotan aplikatuak izan dira eta aktibo nagusia kapital naturala den tokietan hazkunde berdearen aldeko alternatiba izatea bilatzen dute. Pizgarri hauek eta zerga lagunkoiak diru-laguntzak baino eraginkorragoak izan daitezkeela argudiatu da, izan ere, praktika iraunkorrak saritzen eta sustatzen dituzte, eta diru-laguntzek ez dute zertan EZen eskaintzan lagundu.

Bertoko basoaren sustapenaren kostu gehigarria finantzatzeko, gure ustetan, apurka-apurka, pinu eta eukalipto landaketentzako bideratutako aurrekontua baso autoktonora zuzendu zitekeen. Horrela, hasiera batean, gatazkarik ez izateko, egur sektoreko aurrekontua pixkatxo bat murriztu eta bertoko basoaren sustapena handitu liteke, azkenean, aurrekontua guztiz berbideratuta egon arte. Dagoeneko bertoko espezieak landatzen dituztenek ere diru kantitate jakin bat jasoko lukete hasiera batean, emandako zerbitzuengatik. Gainera, ez da onargarria

Administrazioak Erabilera Publikoko Mendietan espezie aloktonoak landatzen jarraitzea. Hortaz, horrelakoak ekiditeko aukera bat izan liteke udalerriak finantzatzeko aurrekontua bertoko basoaren azaleraren arabera birbanatzea, eta modu honetan, beste udalerriak iraunkortasunaren alde bultzatuak izan daitezke. Era berean, Administrazioak, erabiltzen ez diren lurretan edo eta ahalmen agrologiko handiko eremuetan, hiri lorategi ekologikoak sustatzeko zenbait neurri ezarri beharko lituzke, janari osasungarriak eta pestizida bakoak ekoizteko eta beste EZ batzuk, e.b. airearen erregulazioa, espezieentzako habitata, aisialdi eta ingurumen hezkuntza eskaintzeko. Hemen, Lurralde Zaintza (LZ) (www.landstewardship.eu) aukera ona izan liteke baita ere. LZ delakoa, jabetza pribatu edo instituzio publiko eta GKEen arteko kustodia akordio boluntarioen (dohaintza eta/edo salerosketa) bidezko lursailen kudeaketan datza, beti ere kontserbazio helburuekin. Egun, *Lurgaia Fundazioa* bezalako fundazioek 150 ha inguru kudeatzen dituzte UBEn bertoko basoa berreskuratzeko xedearekin, eta azalera handituko delakoan daude (J. Hidalgo, komunikazio pertsonala, 2018ko iraila). Baina Administrazioak ere, GKEengana jo zezakeen lursail hauetako jabe pribatuekin akordioak sinatzeko eta nekazaritza ekologikoa sustatzeko, aholkularitza teknikoa eta segimenduaren truke. Azkenik, tokiko enpresek euren ingurumen inpaktuak arintzeko eta naturaren babesan laguntzeko, EZOak bezalako kontserbazio ekimenetan parte har dezaten neurriak hartu beharko lirateke. Honek guztiak, basogintza sektorea edo beste industriez herritar batzuek duten pertzepzio negatiboak aldatzen lagun lezake eta iraunkortasunerako trantsizioa sustatu.

5.4. ETORKIZUNEKO AUKERAK

Ikerketa honek paisaiaren plangintzan EZen ebaluazioa ezartzeko ideia batzuk ematen ditu, baina oraindik UBEn EZen esparruaren integrazio sakona lortzeko lan gehiago beharrezkoa da. Funtsean, kontuan hartu beharreko hiru hutsune garrantzitsu lan honetan, EZen ebaluazio tenporalaren eta prozesu parte-hartzaileen falta, eta pizgarri mekanismoei buruz erantzun gabeko galdera ugariak izan daitezke.

EZ baloratzerako orduan, espazio eta denbora dimentsioak gehiago ikertzea komenigarria izango litzateke, lortutako balioak gaizki ulertu ez ditzagun. EZen balorazio biofisiko, ekonomiko eta sozio-kulturala testuinguru menpekoa da eta espazio eta denbora eskalen arabera aldatu egiten da, baita interesdun edo onuradun taldeen arabera ere. Beraz, datu hauen integrazioak EZen ebaluazioan plangintza eta kudeaketa erabakiak txertatzea ahalbidetuko luke eta, ondorioz, gutxiegi/gehiegi estimatzeak murriztu.

Gainera, aurretik esan bezala, tokiko interesdun, politika-arduradun, eta tokiko eta eskualdeko gobernuko kudeaketa teknikariekin prozesu parte-hartzaileak izateak, alderdi desberdinen arteko elkar ulertzea erraztuko luke eta administrari edo zaindari bezala sentiarazi, pertsonen inplikazioa handituz. Horretaz aparte, EZen balio ezberdinak elkarren arteko osagarri izateko garrantzia kontuan hartuta, teknika edo balorazio desberdinak konbinatzen dituen ikerketan jarraitzea nahitaezkoa da, metodo kualitatiboak eta kuantitatiboak nahastuz. Adibidez, OBa, DBa eta lehentasunen zerrenda bezalako beste EZen balorazio metodoak, narratiba balorazioa edo metodo deliberatiboekin konbina daitezke. Bada, *4.4. Kapitulua*n, EZen balioak konparatzeko, hauen osagai ezberdinak konbinatzen ahalbidetzen zuen metodologia bat proposatu genuen arren, hurrengo urratsa lortutako emaitzak aztertzeko eta hitzarmen batera ailegatzeko lantegiak edo antolatzea izango litzateke.

Halaber, *4.3. Kapitulua*n lortutako emaitzek, UBEn bertoko biztanleriak dituen lehentasunei buruzko informazioa ematen digute. Informazio hau ingurumen pizgarri programak ezartzeko abiapuntu ona izan liteke. Hala eta guztiz ere, ezer egin baino lehen, galdera batzuk erantzun beharko genituzke: Nork ordaindu beharko luke? Zein izan beharko litzateke ordainketa modua eta banaketa? Nola egin onuradunak ordainketetan inplikatzeko eta hornitzaileak, berez, motibatzeko? Nola egin segimendua? Eta berriro ere, parte-hartze prozesua gakoa izan liteke. Gainera, eszenatoki hipotetiko batera heltzeko inkestatuek ordaintzeko dituzten jarrerak eta motibazioak ulertzeak, kudeatzaile eta politikariek inbertsio neurri egokiagoak erabakitzeko lagun lezake. Beraz, ikerketa honen etorkizuneko beste aukera bat, aldagai sozioekonomiko eta intereseko beste aldagai batzuen eta atributuen, e.b. kostua, arteko elkarrekintzak aztertzea izango litzateke. Horrez gain, 200 bat online inkesta eginda dauzkagu dagoeneko Euskadiko herritarrei, eta etorkizunean, tokiko biztanleen eta UBEtik kanpo bizi diren euskal herritarren arteko emaitzak konparatzea izango litzateke ideia. Hala eta guztiz ere, garrantzitsua da azpimarratzea gatazken ebazpena ezin dela moneta-tresnen aplikaziotik abiatu, baizik eta arazoaren edo aldaketa-eragileen analisitik. Era berean, gatazka hauek konpontzeko modua tresna ezberdinak konbinatuz lortzen da normalean, hala nola, legeria hobea eta EZOak. Hori dela eta, dagoeneko guztion ongia denaren kudeaketa egokia egiten dituztenen motibazioak aztertzeak ere, tresna mota hauek hobeto ezartzen lagun dezake, eta zerbitzu bat eskaintzeagatik ordaindu beharrean, saritu.

BIBLIOGRAFIA

Abson, D.J., Fischer, J., Leventon, J., Newig, J., Schomerus, T., Vilsmaier, U., et al., 2017. Leverage points for sustainability transformation. Ambio 46(1), 30-39.

Adams, V.M., Pressey, R.L., Naidoo, R., 2010. Opportunity costs: Who really pays for conservation? Biol. Conserv. 143, 439-448.

Alexander, S., Nelson, C.R., Aronson, J., Lamb, D., Cliquet, A., Erwin, K.L., et al., 2011. Opportunities and Challenges for Ecological Restoration within REDD+. Restor. Ecol. 19, 683-689.

Arias-Arévalo, P., Gómez-Baggethun, E., Martín-López, B., Pérez-Rincón, M., 2018. Widening the evaluative space for ecosystem services: A taxonomy of plural values and valuation methods. Environ. Value 27(1), 29-53(25).

Balvanera, P., Pfisterer, A.B., Buchmann, N., He, J.-S., Nakashizuka, T., Raffaelli, D., Schmid, B., 2006. Quantifying the evidence for biodiversity effects on ecosystem functioning and services. Ecol. Lett. 9, 1146-1156.

Bernués, A., Rodríguez-Ortega, T., Ripoll-Bosch, R., Alfnes, F., 2014. Socio-Cultural and Economic Valuation of Ecosystem Services Provided by Mediterranean Mountain Agroecosystems. PLoS ONE 9(7): e102479.

Breukink, G., Levin, J., Mo, K., 2015. Profitability and Sustainability in Responsible Forestry: Economic Impacts of FSC Certification on Forest Operators. World Wide Fund for Nature, Gland, Switzerland.

Burkhard, B., Petrosillo, J., Costanza, R., 2010. Ecosystem services: bridging ecology, economy and social sciences. Ecol. Complex. 7, 257-259.

Burkhard, B., de Groot, R., Costanza, R., Seppelt, R., Jorgensen, S.E., Potschin, M., 2012. Solutions for sustaining natural capital and ecosystem services. Ecol. Indic. 21, 1-6.

Casado-Arzuaga, I., Madariaga, I., Onaindia, M., 2013. Perception, demand and user contribution to ecosystem services in the Bilbao Metropolitan Greenbelt. J. Environ. Manage. 129, 33-43.

Castro, A.J., Verburg, P.H., Martín-López, B., García-Llorente, M., Cabello, J., Vaughn, C.C., López, E., 2014. Ecosystem service trade-offs from supply to social demand: a landscape-scale spatial analysis. Landsc. Urban Plan. 132, 102-110.

Chan, K.M.A., Satterfield, T., Goldstein, J., 2012. Rethinking ecosystem services to better address and navigate cultural values. Ecol. Econ. 74, 8-18.

Chan, K.M.A., Balvanera, P., Benessaiah, K., Chapman, M., Diaz, S., Gomez-Baggethun, E., et al., 2016. Why protect nature? Rethinking values and the environment. PNAS 113, 1462-1465.

Chan, K.M.A., Anderson, E., Chapman, M., Jespersen, K., Olmsted, P., 2017a. Payments for ecosystem services: Rife with problems and potential—For transformation towards sustainability. Ecol. Econ. 140, 110-122.

Chan, K.M.A., Olmsted, P., Bennett, N., Klain, S.C., Williams, E.A., 2017b. Can Ecosystem Services Make Conservation Normal and Commonplace? In: Levin, P.S., Poe, M.R. (Eds.), Conservation for the Anthropocene Ocean, 225-252.

Costanza, R., Kubiszewski, I., Ervin, D., Bluffstone, R., Boyd, J., Brown, D., et al., 2011. Valuing ecological systems and services. F1000 Biology Reports 3, 14.

Daily, G., Polasky, S., Goldstein, J., Kareiva, P.M., Mooney, H., Pejchar, L. et al., 2009. Ecosystem Services in Decision Making: Time to Deliver. Front. Ecol. Environ. 7(1), 21-28.

de Groot, R.S., Alkemade, R., Braat, L., Hein, L., Willemen, L., 2010. Challenges in integrating the concept of ecosystem services and values in landscape planning, management and decision making. Ecol. Complex. 7(3), 260-272

Europarc-España. 2017. Anuario 2016 del estado de las áreas protegidas de España. Ed. Fundación Fernando González Bernáldez. Madrid.

Ferguson, I., Levetan, L., Crossman, N.D., Bennett, L.T., 2016. Financial Mechanisms to Improve the Supply of Ecosystem Services from Privately-Owned Australian Native Forests. Forests 7, 34.

Folke, C., 2006. The economic perspective: conservation against development versus conservation for development. Conserv. Biol. 20, 686-688.

García-Llorente, M., Castro, A. J., Quintas-Soriano, C., López, I., Castro, H., Montes, C., Martín-López, B., 2016. The value of time in biological conservation and supplied ecosystem services: A willingness to give up time exercise. J. Arid Environ. 124, 13-21.

Garmendia, E., Mariel, P., Tamayo, I., Aizpuru, I., Zabaleta, A., 2012. Assessing the effect of alternative land uses in the provision of water resources: evidence and policy implications from southern Europe. Land Use and Policy 29, 761-770.

Geijzendorffer, I.R., Cohen-Shacham, E., Cord, A.F., Cramer, W., Guerra, C., Martín-López, B., 2017. Ecosystem services in global sustainability policies. Environ. Sci. Policy 74, 40-48.

Gómez-Baggethun, E., de Groot, R., 2010. Natural capital and ecosystem services: The ecological foundation of human society. In: Hester, R.E & Harrison, R.M (eds) Ecosystem Services: Issues in Environmental Science and Technology. Cambridge: Royal Society of Chemistry, 118-145.

Gómez-Baggethun, E., Ruiz-Pérez, M., 2011. Economic valuation and the commodification of ecosystem services. Prog. Phys. Geog. 35(5), 613-628.

Gómez-Baggethun, E., Kelemen, E., Martín-López, B., Palomo, I., Montes, C., 2013. Scale Misfit in Ecosystem Service Governance as a Source of Environmental Conflict. Society & Natural Resources: An International Journal 26(10), 1202-1216.

Griggs, D., Stafford-Smith, M., Gaffney, O., Rockström, J., Öhman, M.C., Shyamsundar, P., et al., 2013. Policy: sustainable development goals for people and planet. Nature 495, 305-307.

Harrison, P.A., Berry, P.M., Simpson, G., Haslett, J.R., Blicharska, M., Bucur, M., et al., 2014. Linkages between biodiversity attributes and ecosystem services: A systematic review. Ecosyst. Serv. 9, 191-203.

Harvey, D., 2007. A brief history of neo-liberalism. Oxford University Press, Oxford.

Ives, C.D., Abson, D.J., von Wehrden, H., Dorninger, C., Klaniecki, K., Fischer, J., 2018. Reconnecting with nature for sustainability. Sustain. Sci. 13(5), 1389-1397.

Jacobs, S., Dendoncker, N., Martín-López, B., Barton, D.N., Gómez-Baggethun, E., Boeraeve, F., et al., 2016. A new valuation school: Integrating diverse values of nature in resource and land use decisions. Ecosyst. Serv. 22(B), 213-220.

Jax, K., Furman, E., Saarikoski, H., Barton, D.N., Delbaere, B., Dick, J., et al., 2018. Handling a messy world: Lessons learned when trying to make the ecosystem services concept operational. Ecosyst. Serv. 29(C), 415-427.

Kallis, G., Gómez-Baggethun, E., Zografos, C., 2013. To value or not to value? That is not the question. Ecol. Econ. 94, 97-105.

Kenter, J.O., Hyde, T., Christie, M. Fazey. I., 2011. The importance of deliberation in valuing ecosystem services in developing countries—Evidence from the Solomon Islands. Global Environ. Chang. 21(2), 505-521.

Kenter, J.O., O'Brien, L., Hockley, N., Ravenscroft, N., Fazey, I., Irvine, K.N., et al., 2015. What are shared and social values of ecosystems? Ecol. Econ. 111, 86-99.

Kumar, M., Kumar, P., 2008. Valuation of the ecosystem services: a psychocultural perspective. Ecol. Econ. 64, 808-819.

Liu, S., Costanza, R., Farber, S., Troy, A., 2010. Valuing ecosystem services. Theory, practice, and the need for a transdisciplinary synthesis. Ann. NY. Acad. Sci., 1185, 54-78.

Lo, A.J., 2014. More or less pluralistic? A typology of the remedial and alternative perspectives on monetary valuation of the environment. Environ. Value. 23, 253-274.

MA, 2005. Ecosystems and Human Well-being: Synthesis. Island Press, Washington, DC.

Martín-López, B., Montes, C., Benayas, J., 2007. Influence of user characteristics on valuation of ecosystem services in Doñana Natural Protected Area (south-west Spain). Environm. Conserv. 34(3), 215-224.

Martín-López, B., García-Llorente, M., Palomo, I., Montes, C., 2011. The conservation against development paradigm in protected areas: Valuation of ecosystem services in the Doñana social–ecological system (southwestern Spain). Ecol. Econ. 70, 1481-1491.

Martín-López, B., Gómez-Baggethun, E., García-Llorente, M., Montes, C., 2014. Trade-offs across value-domains in ecosystem services assessment. Ecol. Indic. 37, 220-228.

McDougle, L., Handy, F., Katz-Gerro, T., Greenspan, I., Lee, H.-Y., 2015. Factors predicting proclivity and intensity to volunteer for the environment in the US and South Korea. J. Environ. Plann. Man. 58(5):837-854.

Meadows, D., 1999. Leverage points: Places to intervene in a system. Hartland: The Sustainability Institute.

Merino, A., Fernández-López, A., Solla-Gullón, F., Edeso, J.M., 2004. Soil changes and tree growth in intensively managed Pinus radiata in northern Spain. For. Ecol. Manage. 196, 393-404.

Onaindia, M., Fernandez de Manuel, B., Madariaga, I., Rodriguez-Loinaz, G., 2013. Co-benefits and trade-offs between biodiversity, the carbon storage and water flow regulations. Forest Ecol. Manag. 289, 1-9.

Palacios-Agundez, I., Casado-Arzuaga, I., Madariaga, I., Onaindia, M., 2013. The relevance of local participatory scenario planning for ecosystem management policies in the Basque Country, northern Spain. Ecol. Soc. 18(3): 7.

Palacios-Agundez, I., Fernandez de Manuel, B., Rodriguez-Loinaz, G., Peña, L., Ametzaga-Arregi I., Alday, J.G., et al., 2014. Integrating stakeholders' demands and scientific knowledge for the inclusion of ecosystem services in landscape planning. Landscape Ecol.

Pascual, U., Phelps, J., Garmendia, E., Brown, K., Corbera, E., Martin, A., et al., 2014. Social Equity Matters in Payments for Ecosystem Services. BioScience 64(11), 1027-1036.

Pascual, U., Balvanera, P., Díaz, S., Pataki, G., Roth, E., Stenseke, M., et al., 2017. Valuing nature's contributions to people: the IPBES approach. Curr. Opin. Environ. Sustainability 26, 7-16.

Randle, M., Dolnicar, S., 2015. The characteristics of potential environmental volunteers: implications for marketing communications. Australas. J. Env. Man. 22(3),329-339.

Robertson, M.M., 2006. The nature that capital can see: Science, state and market in the commodification of ecosystems services. Environ. Plann. D 24, 367-387.

Rode, J., Gómez-Baggethun, E., Torsten, K., 2015. Motivation crowding by economic incentives in conservation policy: A review of the empirical evidence. Ecol. Econ. 117, 270-282.

Rodríguez-Loinaz, G., Amezaga, I., Onaindia, M., 2013. Use of native species to improve carbon sequestration and contribute towards solving the environmental problems of the timberlands in Biscay, northern Spain. J. Environ. Manage. 120, 18-26.

Quintas-Soriano, C., Martín-López, B., Santos-Martín, F., Loureiro, M., Montes, C., Benayas, J., García-Llorente, M., 2016. Ecosystem services values in Spain: A meta-analysis. Environ. Sci. Policy 55(1), 186-195.

Raudsepp-Hearne, C., Peterson, G.D., Tengö, M., Bennett, E.M., Holland, T., Benessaiah, K., MacDonald, G.K., Pfeifer, L., 2010. Untangling the Environmentalist's Paradox: Why Is Human Well-being Increasing as Ecosystem Services Degrade? BioScience 60(8), 576-589.

Rockström, J., 2015. 5 reasons why the economy is failing the environment, and humanity. World Economic Forum Annual Meeting Article.

Rodríguez-Loinaz, G., Amezaga, I., Onaindia, M., 2011. Efficacy of management policies on protection and recovery of natural ecosystems in the Urdaibai Biosphere Reserve. Nat. Areas J. 31, 358-367.

Rodríguez-Loinaz, G., Peña, L., Palacios-Agundez, I., Ametzaga-Arregi, I., Onaindia, M., 2018. Identifying Green Infrastructure as a Basis for an Incentive Mechanism at the Municipality Level in Biscay (Basque Country). Forests 9, 22.

Saarikoski, H., Primmer, E., Saarela, S., Antunes, P., Aszalós, R., Baró, F., et al., 2018. Institutional challenges in putting ecosystem service knowledge in practice. Ecosyst. Serv. 29(C), 579-598.

Schmidt, J.P., Moore, R., Alber, M. 2014. Integrating ecosystem services and local government finances into land use planning: A case study from coastal Georgia. Landsc. Urban Plan. 122, 56-67.

Spash, C.L., Urama, K., Burton, R., Kenyon, W., Shannon, P., Hill, G., 2009. Motives behind willingness to pay for improving biodiversity in a water ecosystem: economics, ethics and social psychology. Ecol. Econ. 68(4), 955-964.

Simpson, R.D., 2011. The Ecosystem Service Framework: A Critical Assessment. Ecosystem Services Economics (ESE), working paper nº5. UNEP.

Solazzo, A., Jones, A., Cooper, N., 2015. Revising payment for ecosystem services in the light of stewardship: the need for a legal framework. Sustain. For. 7(11), 15449-15463.

UN, 2017. Department of Economic and Social Affairs, Population Division. World Population Prospects: The 2017 Revision, Key Findings and Advance Tables. Working Paper No. ESA/P/WP/248.

UNESCO, 2017. [online] Available at: www.unesco.org/ [Accessed 2018].

van Noordwijk, M., Leimona, B., Jindal, R., Villamor, G.B., Vardhan, M., Namirembe, S., et al., 2012. Payments for Environmental Services: Evolution Toward Efficient and Fair Incentives for Multifunctional Landscapes. Annu. Rev. Env. Resour. 37(1), 389-420.

van Zanten, B.T., Koetse, M.J., Verburg, P.H., 2016. Economic valuation at all cost? The role of the price attribute in a landscape preference study. Ecosyst. Serv. 22(B), 289-296.

WCED, 1987. World Commission on Environment and Development. Report of the World Commission on Environment and Development. G. H. Brundtland, (Ed.). Oxford: Oxford University Press.

Wiedmann, T.O., Schandl, H., Lenzen, M., Moran, D., Suh, S., West, J., Kanemoto, K., 2015. The material footprint of nations. P. Natl. Acad. Sci. 112 (20), 6271-6276.

Wunder, S., Engel, S., Pagiola, S., 2008. Taking stock: a comparative analysis of payments for environmental services programs in developed and developing countries. Ecol. Econ. 65(4), 834-852.

Wunder, S., 2013. When payments for environmental services will work for conservation. Conserv. Lett. 6, 230-237.

6. Kapitulua

Ondorioak

6. ONDORIOAK

Ikerketa honek giza sistemen eta sistema naturalen arteko lotura konplexuak aztertzen ditu, EZ eta hauen osagai ezberdinak ebaluatuz, eta UBEn plangintza eta kudeaketa iraunkorrerako orientabideak ematen ditu. Jarraian, tesiaren ondorio nagusiak:

1) UBEren izendapenak bertoko biztanlerian ez du eragin negatiborik izan; aldiz, kontserbazioa bultzatu eta garapen sozioekonomiko eta kulturalaren hobekuntzan eragina izan lezakeela dirudi.

2) Azken 44 urteotan gertaturiko lurzoru erabileren aldaketek ekosistemen zerbitzuen diru-balioan eragin handiegirik izan ez duten arren, bistan dago lurraldea homogeneizatu eta multifuntzionalitatea galtzea eragin dutela. Alabaina, ekosistemen zerbitzuen balio biofisiko eta diru-balioaren arteko berdintasun analisiaren arabera, biosfera erreserba izendatzeak honen kontserbazioan lagundu izan du, nukleoak bi balorazioen arteko akoplamendu altuena duelarik.

3) Gizartearen nahiekin bat datozen etorkizuneko kudeaketa estrategiak diseinatzeak pertzepzio sozialak ulertu eta hauen interesak kontuan hartzea suposatzen du. Zentzu honetan, HEak informazio baliagarria eman dezake kudeaketa alternatiboen planak diseinatzeko, gizartearen lehentasunak kontuan hartuta.

   Oro har, UBEko tokiko biztanleria egungo egoera aldatzeko gogoz dago, kudeaketa alternatiboen eszenatoki berriak ezartzeko helburuarekin. Badirudi inkestatuek ekosistemen osasunari garrantzi handiagoa ematen diotela aisialdiari baino, eta EZen eskaintza altuago duten erabilera anitzeko lurrak hobesten dituztela. Zehazki, inkestatuen kezka nagusia ur masen kalitatearen hobekuntza izan zen, bertoko basoaren eta nekazaritza ekologikoaren azaleraren handitzea eta biodibertsitatearen babesa jarraiki, aisialdia garrantzi gutxienekoa izanik.

4) EZen eskaintza, eskaria eta interes osagaiak aztertuta lortutako informazio desberdinak azpimarratzen duenez, EZen dimentsio ezberdinak konbinatu beharrean gaude, bakoitza bere aldetik ebaluatu beharrean.

   Diru metriken mugek (merkatuan oinarritutakoa *vs.* OBa) eta interes osagaien bitartez ebaluatutako balorazio sozio-kulturalak bariantzarik altuena azaltzeak, balorazioa, berez, birpentsatzera eta EZen ebaluazio integratua eta balio aniztasuna bilatzen duten metodo multi-metrikoak aldarrikatzera eramaten gaitu.

5) Muga metodologiko batzuetatik haratago, EZen eskaintza, eskaria eta interes osagaien arteko (des)adostasunak aztertzeko metodologia berritzaile bat proposatu genuen sozioekonomikoki eta ingurumenaren aldetik antzekoak diren unitate desberdinetan.

   Desadostasunen ebaluazioa gatazka potentzialen identifikazioan eta gizartearen nahiekin eta ekosistemen gaitasunarekin bat datozen alternatibak garatzeko lagungarri izan daiteke. UBEren kasuan, unitate sozioekonomiko ezberdinen arteko informazioa berdina dela ikusi genuen, eta hortaz, EZen osagaien arteko desadostasun patroia, ikerketa-arearen ezaugarri sozioekonomiko eta lur erabilerak baino, EZen multzoarekin erlazionatuta dagoela ondorioztatu genuen.

6) Gaur egungo baso landaketa monokultibodun paisaia, landa mosaiko tradizional multifuntzional batera aldatzea, bai ekosistema naturalak berreskuratuz bai nekazaritza eta basogintza praktika iraunkorrak sustatuz, iraunkortasunera bideratutako erantzun aukera egokia izan liteke.

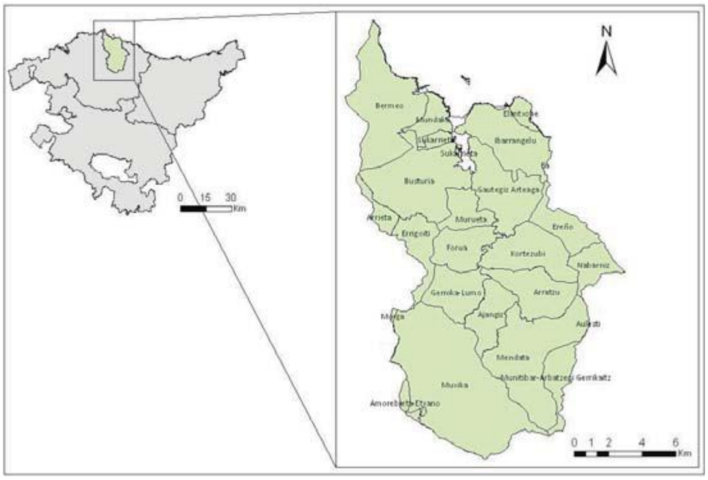
   Hala ere, etorkizuneko ikerketa, kudeaketa iraunkorren estrategia arrakastatsuak bermatzeko, parte-hartze prozesuetan eta ikerlari eta politikari edo kudeaketa teknikari eta interesdunen arteko loturak indartzean oinarritu beharko litzateke.

GALDEKETA A

KUDEAKETA ESZENATOKI EZBERDINEN EBALUAZIOA URDAIBAI BIOSFERA ERRESERBAN

Euskal Herriko Unibertsitateak UPV/EHU naturak gizakiari eskeintzen dizkion onurei buruzko euskal gizartearen iritzia ezagutu nahi du.

Ikerketarako aukeratutako gunea Urdaibai Biosfera Erreseba da, Bizkaiako Busturialdea eskualdean kokatuta, 220 km^2 inguruko azalerarekin eta 22 udalerri bere barnean.



Urdaibai Biosfera Erreserba bisitatu duzu noizbait? Bai □ Ez □

1. EZAUGARRI OROKORRAK:

Urdaibai 1984. urtean **Biosfera Erreserba** deklaratu zen bere balio natural eta kulturalagatik. Geroago, 1993. urtean, **Ramsar Hezegunea** listatuan eta Europar Batasuneko **Natura 2000 Sarean** barneratzen da, **Hegaztientzako Babes Bereziko Gune** batekin eta **Kontserbazio Bereziko** 3 **Gune**ekin.

1.1. “Biosfera Erreserba” edo “Natura 2000” babes figura ezagutzen al duzu? Bai □ Ez □

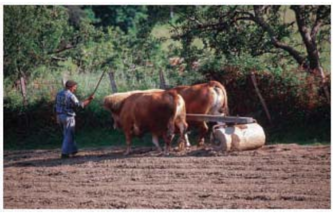
Jarraian, Urdaibai Biosfera Erreserbaren ezaugarri nagusiak deskribatuko ditugu ondorengoen arabera: 1) nekazal jarduera, 2) biodibertsitatea (animaliak eta landareak), 3) ur-masen kalitatea, 4) baso autoktonoa eta 5) aisia.

NEKAZAL JARDUERA

Nahiz eta gutxirarte inguru honetako iturri ekonomiko nagusia nekazaritzan oinarritzen zen, honek protagonismoa galdu du eta **lurraldearen %3a** besterik ez du hartzen. Egun, nekazaritza konbentzionala (ez ekologikoa) nagusi bada ere, **nekazaritza ekologikoa gero eta ohikoagoa da, lurraldearen %0,5a okupatuz**, nekazaritza azalera osoaren 1/6, alegia.

Nekazal jarduera inguruan lurzati txiki ezberdinetan antolatzen da, baserrien paisaia tipikoa sortuz. Gainera, Urdaibaiko nekazaritza produktuek **"Alubias y Pimientos de Gernika"** label kalitatea dute, zeinek, txakolia eta beste produktuekin batera, eskualdea nekazaritza produktuen erreferente bihurtu duten.


Nekazal ingurua


Goldaketan


Gernikako Astelehena


Baserria

1.2. Nekazal inguru batean bizi zara? Bai □ Ez □

BIODIBERTSITATEA (Animaliak eta Landareak)

Inguruan hainbat habitat mota ezberdin egoteak animalia eta landare espezie aniztasun altua suposatzen du. Guztira, **700 animalia espezie baino gehiago eta 800 landare espezie baino gehiago** daude. Bereziki, bere landaretza singularragatik eta hegaztientzako (migratzaile zein sedentario) atseden gune izateagatik, estuarioa interes bereziko eremu bat da.


Euskal armeria


Mokozabal arrunta


Iratze tropikala


Bisoi europarra


Ferra-saguzar handia


Sorgin-orratza

1.3. Animaliazalea edo/eta landarezalea zara? Bai □ Ez □

UR-MASEN KALITATEA

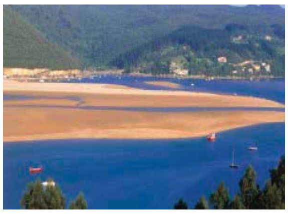
Urdaibain 4 ur-masa mota ezberdintzen dira: ibaiak, estuarioa, kostaldeko urak eta lurrazpiko urak.

Uraren Esparru Zuzentarauak **ur-masen egoera orokorra hauen egoera kimiko eta ekologikoaren arabera** definitzen du, "ona" edo "ona baino txarragoa" sailkapenak lortuaz. Kasu honetan, **kostaldeko urek eta ibaiek egoera globala "ona" daukate, Artigas ibaiak salbu**. Bestalde, lurrazpiko urek, konkretuki **Gernika akuiferoak, eta estuarioak, egoera global "ona baino txarragoa"** aurkezten dute, eta beraz, hainbat bainu guneek, esaterako, Laida, Laidatxu eta Sukarrietako hondartzek ere bai.


Ibaia


Oka ibaiko goiko estuarioa


Marisma


Laidako hondartza

1.4. Urdaibain bainurako ur kalitatea ona dela uste duzu? Bai ☐ Ez ☐

BASO AUTOKTONOA

Baso autoktonoa haritza, pagoa eta artea bezalako zuhaitzek osatzen dute. Urdaibain baso autoktonoa oso fragmentatuta dago, babes neurri ezberdinei esker bere azalera pixkat handitu den arren. Gutxi gorabehera, **lurraldearen %17a** okupatzen du, artadi kantauriarra, Euskadiko kostaldeko baso garrantzitsuenetarikoa, nabarmentzen delarik.

Beste onuren artean, baso autoktonoak lurzoruaren eraketa eta egonkortzeari laguntzen dio, airearen kalitatea hobetzen du, aldaketa klimatikoaren kontra dihardu, ur kantitatea eta kalitatea hobetzen du, paisaiaren edertasunean eragina du, eta animalia eta landare espezie ugarien habitata da.


Artadi kantauriarra


Pagadia


Hariztia

1.5. Baso autoktonoa erakargarria dela uste duzu? Bai ☐ Ez ☐

AISIA

Urdaibaik **kultura, arkitektura eta arkeologia ondare** garrantzitsua dauka, bere balio sinbolikoagatik Gernikako Arbola eta Batzar Etxea nabarmenduz. Halaber, **150 km inguruko ibilbideak eta 24 aisialdirako gune** ditu. Honek guztiak, natur ekintzen eskaintza zabalarekin batera, hondartzetara zuzendutako udako turismoaz aparte, urtean zehar ere jende piloa erakartzen du.

Gernikako arbola

Ibilbidea

Erromatar aztarnategia Foruan

Ogoñoko talaia

Kanoak

Hegaztiak behatzen

1.6. Urdaibaiko ibilbide eta aisialdirako gune ezberdinak maiz erabiltzen al dituzu? Bai □ Ez □

2. AUKERAK ETA KUDEAKETA KOSTUAK:

Gune babestuaren kudeaketa oso garestia da eta dirua behar du. Eusko Jaurlaritzak eta beste erakunde euskaldunek kantitate ekonomiko jakin bat bideratzen dute urtero naturaren kontserbazio eta hobekuntzarako. Hala ere, ingurumenari zuzendutako diru kopurua urte batetik bestera aldaztuz doa ezartzen diren lehentasunen arabera.

Hori dela eta, agintariek Urdaibai aparteko moduan babesteko lanetan ari dira **Nazio Batuen Ingurumenerako Programa sare mundialean barneratuta dagoen Fundazio bat sortuz**. Fundazio honek, kontserbazio maila eta ingurumen zerbitzu ezberdinak bermatuko lituzke, eskuragarri dagoen diruaren arabera.

Ondoren, Urdaibai kudeatzeko etorkizunerako alternatiba ezberdinak erakutsiko dizkizugu:

Nekazal jarduera ekologikoa

Egoerak bere horretan jarraituz gero, nekazaritza jarduera ekologikoetara bideratutako lurren azalera berdin mantenduko litzatekeela uste da, gutxi gorabehera azalera osoaren %0,5a. Aldiz, esku hartuz gero, **nekazaritza jarduera ekologikora bideratutako azalera %2ra edota %5era handitu liteke**, beti ere, ingurumen jardunbide eta kudeaketa egokiak (adb. lurzoruaren galera sahiesteko goldea murriztuz edo ekidinez, pestizida kimikoen erabilera gutxituz, zuhaitzak edo zuhaixkak nahastuz eta espezie polinizatzaile edo bestelakoentzat habitatak sortuz) eta hiri baratzeak sustatuz, zeintzuk ingurumen hezkuntzarako tresna gisa baliogarriak izango lirateke.

Esku-hartzerik EZ	Esku-hartzerik BAI	
%0,5	**%2**	**%5**

2.1. Kalitate etiketa (*Eusko* Label, Nekazaritza ekologikoa...) duten produktuak kontsumitzen dituzu normalean? (1=bat ere ez, 5=asko)

1 □ 2 □ 3 □ 4 □ 5 □

Biodibertsitatea (Animaliak eta Landareak)

Dagoen bezala jarraituz gero, espezie mehatxatuen kopurua berdin mantenduko litzatekeela estimatzen da. Urdaibaik 70 animalia eta landare espezie inguru ditu Euskal Autonomia Erkidegoko Espezie Mehatxatuen Katalogoan; hauetatik, 5ek babes kudeaketa planak dauzkate. Burututako ekintzen arabera, **espezie babestuen kopurua** 5 espezietatik **15 edo 25 espezietara handitu liteke**.

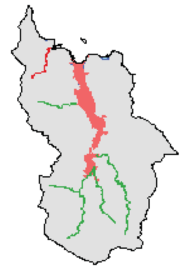
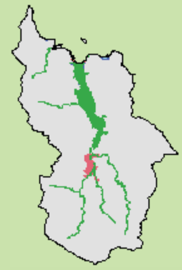
Esku-hartzerik EZ	Esku-hartzerik BAI	
5 espezie babestuta	**15** espezie babestuta	**25** espezie babestuta

2.2. Zer nolako garrantzia dute zuretzat animalia eta landareek? (1=bat ere ez, 5=asko)

1 □ 2 □ 3 □ 4 □ 5 □

Ur-masen kalitatea

Dagoen bezala jarraituz gero, ur-masen kalitatea berdin mantenduko litzatekeela uste da. Aurrera eramandako ekintzen arabera, Artigas **ibaiaren ur kalitateak, estuarioarekin batera**, hobera egin lezake egoera **"ona"** delakora pasaz **(HOBEA), edota gerta liteke ibaien, estuarioaren eta lurrazpiko uren egoera "ona"** delakora aldatzea **(EZIN HOBEA)**.

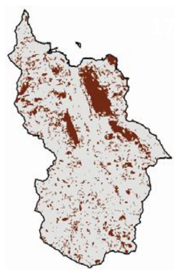
Esku-hartzerik EZ	Esku-hartzerik BAI	
		
ALDAKETARIK EZ	HOBEA	EZIN HOBEA

2.3. Zer nolako inportantzia ematen diozu zuk ur-masen egoerari? (1=bat ere ez, 5=asko)

1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐

Baso autoktonoa

Egoerak bere horretan jarraituz gero, baso autoktonoaren azalera berdin mantenduko litzatekeela aurreikusten da, azalera osoaren %17a okupatuz. Egindako ekintzen arabera, baso autoktonoaren azalera **%30era edo %40ra handitu liteke**, beti ere, egun Urdaibaiko azaleraren erdia okupatzen duten pinu eta eukaliptu baso landaketak ordezkatuz.

Esku-hartzerik EZ	Esku-hartzerik BAI	
%17 	%30 	%40 

2.4. Zer nolako garrantzia ematen diozu zuk baso autoktonoari? (1=bat ere ez, 5=asko)

1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐

Aisia

Dagoen bezala jarraituz gero, ibilbideen eta aisialdirako guneen egoerak txarrera egingo lukeela uste da. Buruturiko ekintzen arabera, aisialdirako guneen eta ibilbideen **kontserbazio egoera "HOBEA" edo "EZIN HOBEA"** izan liteke.

Esku-hartzerik EZ	Esku-hartzerik BAI	
ALDAKETARIK EZ	HOBEA	EZIN HOBEA

2.5. Zer nolako garrantzia ematen diozu zuk aisaialdiari ibilbideen eta aisialdirako guneen erabileran oinarrituz? (1=bat ere ez, 5=asko)

1 □ 2 □ 3 □ 4 □ 5 □

3. AUKEREN HAUTAKETA:

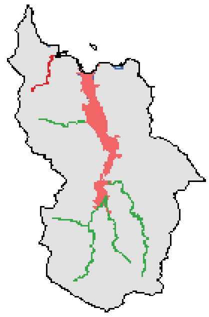
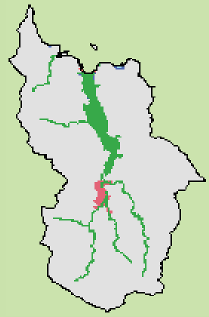
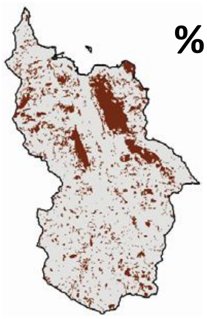
Lehenago aipatutako Fundazioa sortuko balitz**, euskal gizarte osoari aplikatuko litzaiokeen urteko ordainketa tasa berri baten bidez finantziatuko litzateke, 10 urteko iraupenarekin.**

Fundazioa honek eskuragarri izango lukeen **diru kopurua inkestatutako gehiengoak erabakitakoaren araberakoa** izango litzateke. **Ezer ez ordaintzea erabakitzen baduzu**, iradokitako **ekintzak ez lirateke burutuko**.

3.1. Ekonomikoki laguntzearen helburuak eta ondorioak ulertzen al dituzu? Bai □ Ez □

Ondoren**, aukera ezberdinak** (Egungo egoera, Programa A edo Programa B) **dituzten zenbait txartel** erakutsiko dizkizugu. Aurkeztutako txartel bakoitzeko, hauta ezazu zure gustuetara ondoen egokitzen den aukera.

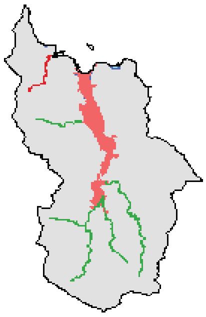
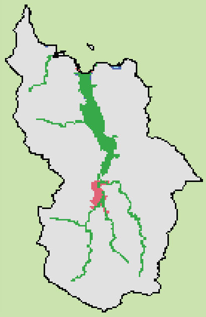
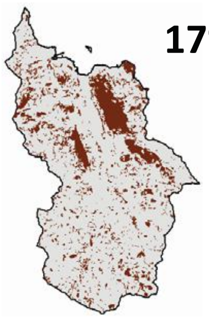
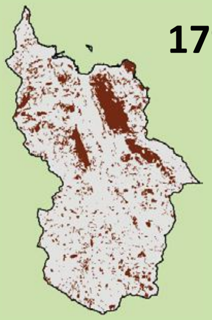
3.2. Beheko taulan agertzen diren babes maila ezberdinak lortzeko diru kantitate jakin bat ordaindu beharko bazenu, zein aukera nahiagoko zenuke?[1]

BLOKE 1 - 1	Egungo egoera	Programa A	Programa B
NEKAZAL JARDUERA EKOLOGIKOA % nekazal jarduera ekologikoaren azalera	**%0,5**	**%0,5**	**%5**
ANIMALIAK ETA LANDAREAK Espezie babestuen kopurua	**5** **espezie babestuta**	**25** **espezie babestuta**	**15** **espezie babestuta**
UR KALITATEA Ur masen egoera globala	 **ALDAKETARIK EZ**	 **ALDAKETARIK EZ**	 **HOBEA**
BASO AUTOKTONOA % baso autoktono azalera	**%17** 	**%17** 	**%40** 
(EKO)TURISMOA ETA AISIA Ibilbide eta aisirako guneen kontserbazio egoera	**ALDAKETARIK EZ**	**ALDAKETARIK EZ**	**EZIN HOBEA**
KOSTUA (€) Urteko ordaina 2026. urterarte (10 urte)			

Aukeratzen dut: A ☐ B ☐ C ☐

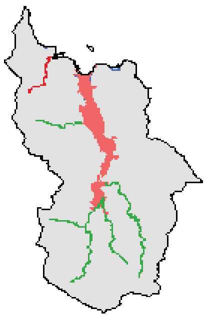
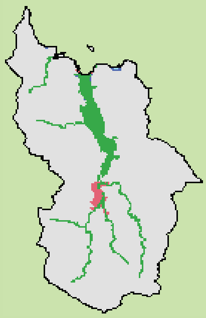
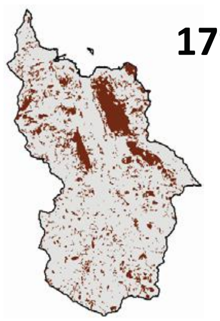
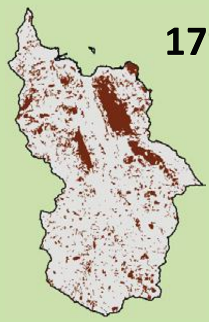
[1] A aukera hautatuz gero, galdetu 3.8; bestela, hurrengo aukera multzoekin jarraitu.

3.3. Eta kasu honetan, zein nahiagoko zenuke?

BLOKE 1 - 2	Egungo egoera	Programa A	Programa B
NEKAZAL JARDUERA EKOLOGIKOA % nekazal jarduera ekologikoaren azalera	**%0,5**	**%5**	**%0,5**
ANIMALIAK ETA LANDAREAK Espezie babestuen kopurua	**5** **espezie babestuta**	**5** **espezie babestuta**	**25** **espezie babestuta**
UR KALITATEA Ur masen egoera globala	 **ALDAKETARIK EZ**	 **HOBEA**	 **ALDAKETARIK EZ**
BASO AUTOKTONOA % baso autoktono azalera	**17%** 	**17%** 	**30%** 
(EKO)TURISMOA ETA AISIA Ibilbide eta aisirako guneen kontserbazio egoera	**ALDAKETARIK EZ**	**EZIN HOBEA**	**HOBEA**
KOSTUA (€) Urteko ordaina 2026. urterarte (10 urte)			

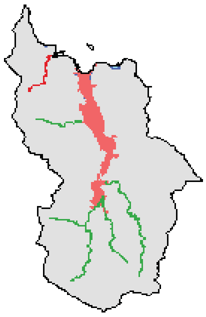
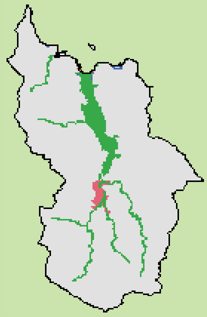
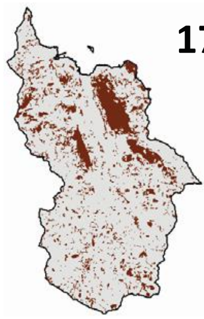
Aukeratzen dut: A ☐ B ☐ C ☐

3.4. Eta kasu honetan, zein nahiagoko zenuke?

BLOKE 1 - 3	Egungo egoera	Programa A	Programa B
NEKAZAL JARDUERA EKOLOGIKOA % nekazal jarduera ekologikoaren azalera	**%0,5**	**%5**	**%2**
ANIMALIAK ETA LANDAREAK Espezie babestuen kopurua	**5** **espezie babestuta**	**25** **espezie babestuta**	**5** **espezie babestuta**
UR KALITATEA Ur masen egoera globala	 **ALDAKETARIK EZ**	 **HOBEA**	 **ALDAKETARIK EZ**
BASO AUTOKTONOA % baso autoktono azalera	 **17%**	 **40%**	 **17%**
(EKO)TURISMOA ETA AISIA Ibilbide eta aisirako guneen kontserbazio egoera	**ALDAKETARIK EZ**	**HOBEA**	**ALDAKETARIK EZ**
KOSTUA (€) Urteko ordaina 2026. urterarte (10 urte)			

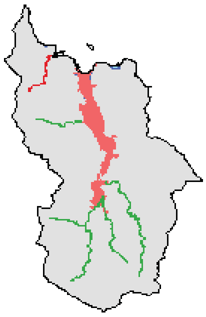
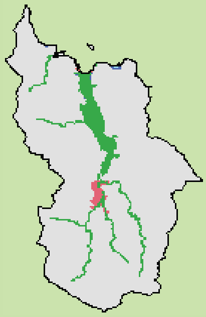
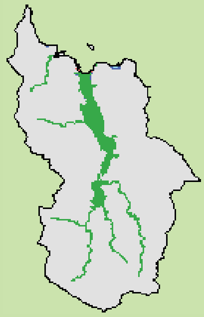
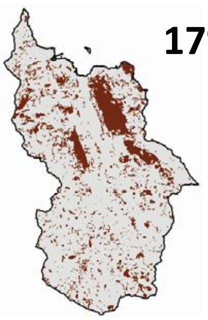
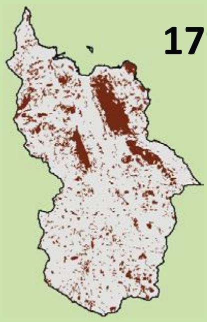
Aukeratzen dut: A ☐ B ☐ C ☐

3.5. Eta kasu honetan, zein nahiagoko zenuke?

BLOKE 1 - 4	Egungo egoera	Programa A	Programa B
NEKAZAL JARDUERA EKOLOGIKOA % nekazal jarduera ekologikoaren azalera	**%0,5**	**%2**	**%5**
ANIMALIAK ETA LANDAREAK Espezie babestuen kopurua	**5** **espezie babestuta**	**15** **espezie babestuta**	**5** **espezie babestuta**
UR KALITATEA Ur masen egoera globala	 **ALDAKETARIK EZ**	 **ALDAKETARIK EZ**	 **HOBEA**
BASO AUTOKTONOA % baso autoktono azalera	 **17%**	 **40%**	 **30%**
(EKO)TURISMOA ETA AISIA Ibilbide eta aisirako guneen kontserbazio egoera	**ALDAKETARIK EZ**	**EZIN HOBEA**	**ALDAKETARIK EZ**
KOSTUA (€) Urteko ordaina 2026. urterarte (10 urte)			

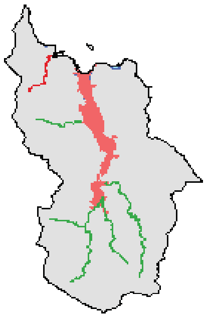
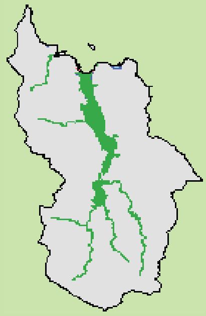
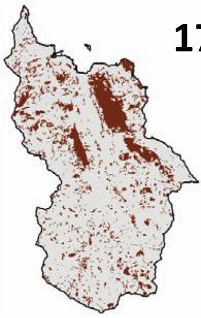
Aukeratzen dut: A ☐ B ☐ C ☐

3.6. Eta kasu honetan, zein nahiagoko zenuke?

BLOKE 1 - 5	Egungo egoera	Programa A	Programa B
NEKAZAL JARDUERA EKOLOGIKOA % nekazal jarduera ekologikoaren azalera	**%0,5**	**%0,5**	**%5**
ANIMALIAK ETA LANDAREAK Espezie babestuen kopurua	**5** **espezie babestuta**	**5** **espezie babestuta**	**15** **espezie babestuta**
UR KALITATEA Ur masen egoera globala	 **ALDAKETARIK EZ**	 **HOBEA**	 **EZIN HOBEA**
BASO AUTOKTONOA % baso autoktono azalera	 **17%**	 **30%**	 **17%**
(EKO)TURISMOA ETA AISIA Ibilbide eta aisirako guneen kontserbazio egoera	**ALDAKETARIK EZ**	**HOBEA**	**EZIN HOBEA**
KOSTUA (€) Urteko ordaina 2026. urterarte (10 urte)	 **0 €**	 **15 €**	 **100 €**

Aukeratzen dut: A ☐ B ☐ C ☐

3.7. Eta kasu honetan, zein nahiagoko zenuke?

BLOKE 1 - 6	Egungo egoera	Programa A	Programa B
NEKAZAL JARDUERA EKOLOGIKOA % nekazal jarduera ekologikoaren azalera	**%0,5**	**%2**	**%0,5**
ANIMALIAK ETA LANDAREAK Espezie babestuen kopurua	**5** **espezie babestuta**	**15** **espezie babestuta**	**5** **espezie babestuta**
UR KALITATEA Ur masen egoera globala	 **ALDAKETARIK EZ**	 **EZIN HOBEA**	 **ALDAKETARIK EZ**
BASO AUTOKTONOA % baso autoktono azalera	**17%** 	**30%** 	**40%** 
(EKO)TURISMOA ETA AISIA Ibilbide eta aisirako guneen kontserbazio egoera	**ALDAKETARIK EZ**	**ALDAKETARIK EZ**	**HOBEA**
KOSTUA (€) Urteko ordaina 2026. urterarte (10 urte)			

Aukeratzen dut: A ☐ B ☐ C ☐

3.8. “Egungo egoera” aukera (0 €-ko ordainketa urtean) hautatu baduzu, zergatik izan da?

- Dauden aukerak ez dira horren erakargarriak balio dutenarekin
- Bestelakoak

3.9. “Bestelakoak” erantzunez gero, zergatik aukeratu duzu erantzun hau? Hauta ezazu aukera BAT BAKARRIK.

- Ezin dut tasa gehigarri bat ordaindu nire zergetan (*)
- Badira beste lehentasunak (lana, osasuna, hezkuntza…) (*)
- Dirua beste zonalde batzuetara bideratzea nahiago dut (*)
- Ingurumenak bost axola niretzat (*)
- Ingurumenaren babesean nahiko ordaintzen dela uste dut (*)
- Dagoeneko zerga nahiko ordaintzen dira. Optimizazio ekonomikoa beharrezkoa da
- Ingurumena kaltetzen dutenek baino ez luketela ordaindu behar uste dut
- Ez dut konfidantzarik Administrazioan eta proposamen hauek burutuko direnik ere ez dut sinisten
- Ez dut uste proposamen hauek arrakasta izango dutenik
- Nire eskubidea da ekosistemen egoera osasuntsua izatea

3.10. Seguru sentitzen zara egindako hautaketekin? (1=oso seguru, 5=oso zalantzati)

1 2 3 4 5

3.11. Zein da zure ustetan hautaketen zailtasun maila? (1=oso erreza, 5=oso zaila)

1 2 3 4 5

3.12. Zure hautaketetan kontuan hartu ez duzun atributorik ba al dago? (behar dituzun kasila guztiak marka itzazu):

- Nekazal jarduera ekologikoa
- Animaliak eta landareak
- Ur kalitatea
- Baso autoktonoa
- (Eko)turismoa eta aisia
- Kostua (€)

3.13. Zein da zure adostasun maila esaldi hauekin?:

- Inkesta honen emaitzek POLITIKA ARDURADUNAK Urdaibaiko kudeaketa alternatiba desberdinez INFORMATZEKO balioko dute.

  (ez nator bat) 1 □ 2 □ 3 □ 4 □ 5 □ 6 □ 7 □ (guztiz ados)

- NIRE ERANTZUNEK/HAUTAKETEK azken erabaki politikoan eragingo dute.

  (ez nator bat) 1 □ 2 □ 3 □ 4 □ 5 □ 6 □ 7 □ (guztiz ados)

- Kudeaketa plan berria martxan jarriz gero, PERTSONA GUZTIEK diru kopuru bat ordaindu beharko dute.

  (ez nator bat) 1 □ 2 □ 3 □ 4 □ 5 □ 6 □ 7 □ (guztiz ados)

- Kudeaketa plan berria martxan jarriz gero, diru kopuru bat ordaindu beharko dut NIK.

  (ez nator bat) 1 □ 2 □ 3 □ 4 □ 5 □ 6 □ 7 □ (guztiz ados)

- Politika arduradunek kudeaketa plana pertsonen LEHENTASUNAK kontuan hartuta ezarriko dute.

  (ez nator bat) 1 □ 2 □ 3 □ 4 □ 5 □ 6 □ 7 □ (guztiz ados)

3.14. Jokabide guztiek inpaktuak eragiten dituzte. Zein ondorio da gehien kezkatzen dizuna? (1 = bat ere ez, 5 = asko)

"Hurrengoetan eragina duten ingurumen arazoetaz kezkatuta nago":	1	2	3	4	5
– Landareak					
– Animaliak					
– Hegaztiak					
– Uretako espezieak					
– Ni neu					
– Nire osasuna					
– Nire bizitza estiloa					
– Nire etorkizuna					
– Nire inguruko jendea					
– Mundu guztia					
– Umeak					
– Ondorengo belaunaldiak					

4. ALDAGAI SOZIOEKONOMIKOAK:

4.1. Sexua: ☐ Gizona ☐ Emakumea

4.2. Adina: ☐ 18-30 ☐ 31-45 ☐ 46-60 ☐ 61-75 ☐ > 76

4.3. Jaioterria:

☐ Bizkaia
☐ Gipuzkoa
☐ Araba
☐ Nafarroa
☐ Estatua
☐ Atzerria

4.4. Bizilekua: P.K.: _____________________ Herria: ____________________

4.5. Lotura inguruarekin (behar dituzun kasila guztiak marka itzazu)**:**

☐ Bizi naiz
☐ 2. bizilekua
☐ Lan / Ikasi
☐ Familia daukat
☐ Aisia
☐ Bat ere ez

Zenbatero bisitatzen duzu Urdaibai?

☐ Bizi naiz
☐ Astero
☐ Hilabetero
☐ Urtean noizbehinka
☐ Urtean behin baino gutxiago
☐ Inoiz ez

Jabetzarik baduzu Urdaibain? Bai ☐ Ez ☐

☐ Pisua
☐ Familiabakarreko etxea
☐ Lantokia
☐ Laborantza-lurra
☐ Baso-lurra

4.6. Lan egoera:

☐ Ikaslea
☐ Langabetua
☐ Etxeko lanak
☐ Jubilatua
☐ Enplegatua lanaldi erdian
☐ Enplegatua lanaldi osoan
☐ Autonomoa

4.7. Ikasketak:

☐ Lehen hezkuntza
☐ 2. Hezkuntza / Batxilergoa / Erdi-mailako HZ
☐ Goi-mailako HZ / Unibertsitatea
☐ Bat ere ez

4.8. Familia-egitura (bakarrik independizatuak):

Heldu kopurua (≥18 urte): ___________ Ume kopurua (<18 urte): ___________

4.9. Ingurumen asoziazioren batekin ekonomikoki kolaboratzen al duzu? ☐ Bai ☐ Ez

4.10. Zure nortasun kulturala euskalduna dela esango zenuke?

☐ Batezbestekoa baino gitxiago ☐ Batezbestekoa bezalakoa ☐ Batezbestekoa baino gehiago

4.11. Esan al zeniguke zein tartetan aurkitzen diren zure hileroko diru-sarrerak? (Gogoratu inkesta hau guztiz anonimoa dela eta datuak konfidentzialak direla):

☐ Diru-sarrerik ez
☐ < 450 €
☐ 450 - 900 €
☐ 901 - 1.500 €
☐ 1.501 - 2.000 €
☐ 2.001 - 2.500 €
☐ > 2.501 €

Eskerrik asko!

GALDEKETA B

EKOSISTEMEN ZERBITZUEN BALORAZIOA URDAIBAI BIOSFERA ERRESERBAN (UBE)

(UBE-ri buruzko azalpen laburra, barneratzen dituen herriak eta bere garrantzia)

1. **Bizilekua?** (P.K., Probintzia)____

2. **Nondik zatoz?** (Herria, Probintzia)____

3. **Zenbat pertsonek bidaiatzen dute zurekin batera?**______________________________

4. **Zenbat denbora emango duzu UBE bisitatzen?** ________________________________

5. **Zure bidaiaren arrazoi nagusia UBE bisitatzea izan da?**

   Bai ☐ Ez ☐ Besteak beste ☐

   Balora itzazu hurrengo arrazoi posibleak 1etik 5era:

   Natura / Paisaia ☐ Balio kulturala (museo bisita, etab.) ☐

   Kirol jarduerak ☐ Atsedena / Espiritualtasuna ☐

   Picnic-a / Egunpasa ☐

6. **UBEn bisitaturiko leku ezberdinen kopurua:** _________

7. **Zenbat aldiz (edo ze maiztasunarekin) bisitatu duzu UBE azkenengo urtean?** (12 hilabete)

   ____

8. **Zure bisitan esperotako gastuen zenbatekoa aukeratu** (persona bakoitzeko)**:**

Gastu mota	**0 €**	**0-10 €**	**10-20 €**	**20-30 €**	**30-40 €**	**>40 € (Zenbat?)**
Ostatua						
Jakiak						
Garraioa (gasolina, peajeak, etab.)						
Aisia (museoak, kirola, etab.)						
Erosketak						
Bestelakoak						

(UBEk eskeintzen dituen ekosistemen zerbitzuak eta haien azalpena)

9. UBE-ak eskeintzen dituen hurrengo ekosistemen zerbitzuetatik, <u>zuretzat</u> zeintzuk dira 5 garrantzitsuenak? Eta garrantzi gutxieneko 5ak? Baloratu 1etik 5era zerbitzu garrantzitsuenak:

✓ **<u>Hornikuntza zerbitzuak:</u>**

Nekazaritza ☐

Abeltzaintza ☐

Arrantza ☐

Egurra (materiala) ☐

Ur geza ☐

☐

✓ **<u>Erregulazio zerbitzuak:</u>**

Klimaren eta airearen erregulazioa (*)
(Aldaketa klimatikoa, CO_2-aren harrapaketa eta kutsadura eta hautsa) ☐

Nutrienteen erregulazioa (*)
lurraren emankortasuna) ☐

Erosio kontrola(*)
(lurzoruaren galtzea saihestu) ☐

Haizearen indargetzea
(adb. hondartzetako dunek haize zakarra indargetzen dute) ☐

Uraren erregulazioa eta garbiketa (*)
(uraren filtrazioa eta kalitatearen hobekuntza) ☐

Polinizazioa
(polen transferentzia haziak eta fruituak sortzeko) ☐

Kontrol biologikoa
(plaga eta gaixotasunen kontrola zenbait animalien partez) ☐

Habitata espezientzat (*) ☐

✓ **<u>Zerbitzu kulturalak</u>**

Turismoa eta Aisia (*) ☐

Ikerkuntza ☐

Ingurumen hezkuntza ☐

Gozamen estetikoa (*)
(paisaia eta ohiturak) ☐

(Azaldu nola ekosistemen zerbitzuek giza-ongizatea hobetzen duten, modu zuzenean zein zeharka, ez direla behar bezainbeste baloratzen, etab.)

10. Ingurumen zerbitzu hauek giza-ongizatea hobetzen dutela jakinda, agintariek UBE modu berezi batean babesteko lanetan ari dira *-z markatutako zerbitzu horien mantetzea bermatuko lukeen Euskal Fundazio bat sortuz, Fundazio hau sortuko balitz, UBEk eskeintzen dituen zerbitzu hauek maintein daitezen diru kantitate boluntario bat ordaintzeko prest egongo zinateke urtero?

☐ Bai, zenbat? ______________________________(€/urte)
(13. galderara pasa zaitez)

☐ Ez. Zergatik?[1] ______________________________

____

11. Beste kontribuzio era hautatu ahal izanez gero laguntzeko prest egongo zinateke? Nola? Aukera ezazu 1 bakarrik:

- Borondatezko dohaintza ingurumen elkarte bati

Lokala	☐	Estatala	☐
Probintziala	☐	Internazionala	☐

Zenbat?______________________________ (€/urte)

- Zerga ordainketa extra hurrengo aurrekontuetan:

Udala	☐	Eusko Jaurlaritza	☐
Diputazioa	☐	Estatala	☐

Zenbat?______________________________ (€/urte)

- Errenta aitorpenaren %0,7a eman ☐
(jakinda dirua beste aplikazio-eremuetatik hona desbideratzen dela)

- Boluntario lana (adb. Kontserbazio lanak) ☐

Ordu/urte ______________________________

- Beste bat: ______________________________ ☐

Zenbat?______________________________ (€/urte)

[1] Protesta diren arrazoiak baino ez apuntatu.

12. Balorazazu 1etik 5era zure adostasun maila esaldi hauekin (1=guztiz desados, 5=guztiz ados):

	1	**2**	**3**	**4**	**5**
Zerga nahiko ordaintzen dira					
Naturaren kontserbazioa Estatuaren ardura da					
Beste lehentasunak daude (lana, osasuna, hezkuntza…)					
Beste ingurumen/sozial elkartekin kolaboratzen dut					
Beste zonalde batek lehentasuna du niretzat					
Besteen kontribuzioa ikusi nahi dut eta gero erabaki					

13. Nola banatuko zenuke kantitate hori %tan hurrengo zerbitzuen artean? (%100a zerbitzu bati eman edo zerbitzu ezberdinen artean banatu):

Klimaren eta airearen errugulazioa ☐

Uraren erregulazioa eta garbiketa ☐

Erosio kontrola ☐

Nutrienteen erregulazioa ☐

Habitata espezientzat ☐

Turismoa eta aisia ☐

Gozamen estetikoa ☐

(Galdera pertsonalak)

14. Sexua: Gizona ☐ Emakumea ☐ **15. Adina:** ____________

16. Lanbidea ____

17. Hezkuntza-maila:

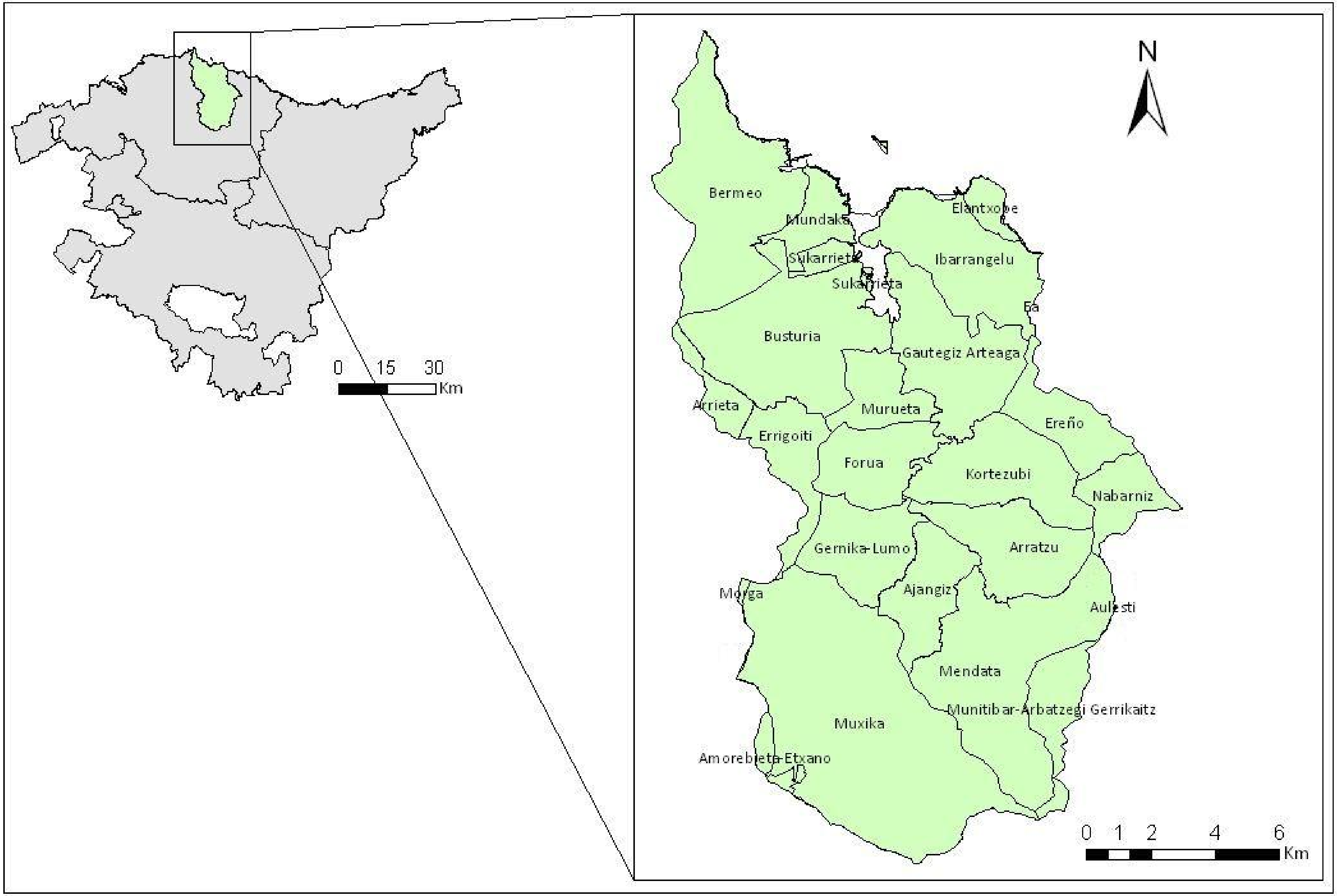
- Lehen hezkuntza ☐
- Bigarren Hezkuntza / Batxilergoa / Erdi-mailako HZ ☐
- Unibertsitatea / Goi-mailako Heziketa-Zikloa ☐
- Bat ere ez ☐

18. Ze tartetan aurkitzen dira zure hileroko diru-sarrera garbiak (pertsonalak)? Gogorazazu inkesta hau anonimoa dela eta datuak guztiz konfidentzialak:

- < 900 € ☐
- 901 – 1.500 € ☐
- 1.501 – 2.000 € ☐
- 2.001 – 2.500 € ☐
- > 2.500 € ☐

19. Zenbat pertsona bizi zarete etxean? ____

Mila esker zure laguntzagatik!

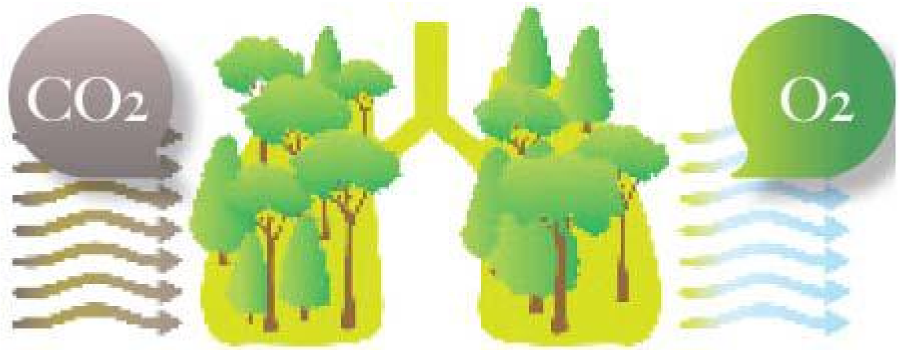

0 15 30 Km
N
Bermeo
Mundaka
Sukarrieta
Sukarrieta
Elantxobe
Ibarrangelu
Ea
Busturia
Gautegiz Arteaga
Arrieta
Murueta
Errigoiti
Ereño
Forua
Kortezubi
Nabarniz
Gernika-Lumo
Arratzu
Morga
Ajangiz
Aulesti
Mendata
Munitibar-Arbatzegi Gerrikaitz
Muxika
Amorebieta-Etxano
0 1 2 4 6 Km

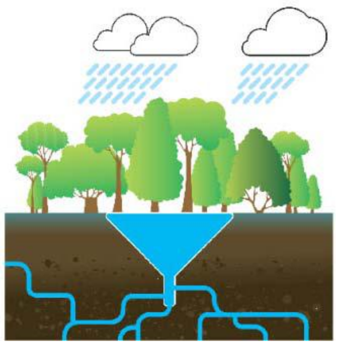
Produkzio zerbitzuak:






Erregulazio zerbitzuak:





Habitata espezientzat:






Zerbitzu kulturalak: