

# Ecosystem Services Assessment in the Basque Country

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# Ecosystem Services Assessment in the Basque Country

- 1- Ecosystem services
- 2- An integrative approach
  - Mapping ES
  - People demand
- 3- Indicators of multifunctionality
- 4- Conclusions. Implementation in management strategies and politics



# 1- Ecosystem Services

## Benefits that ecosystems provide to society



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**2005**



### About the Millennium Assessment

The Millennium Ecosystem Assessment assessed the consequences of ecosystem change for human well-being. From 2001 to 2005, the MA involved the work of more than 1,360 experts worldwide. Their findings provide a state-of-the-art scientific appraisal of the condition and trends in the world's ecosystems and the services they provide, as well as the scientific basis for action to conserve and use them sustainably.

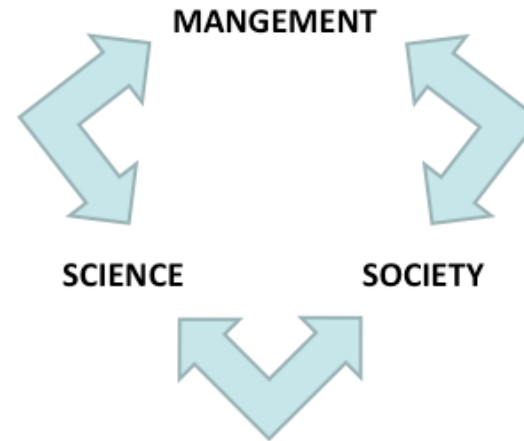
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Millennium Ecosystem assessment:  
scientific basis for action



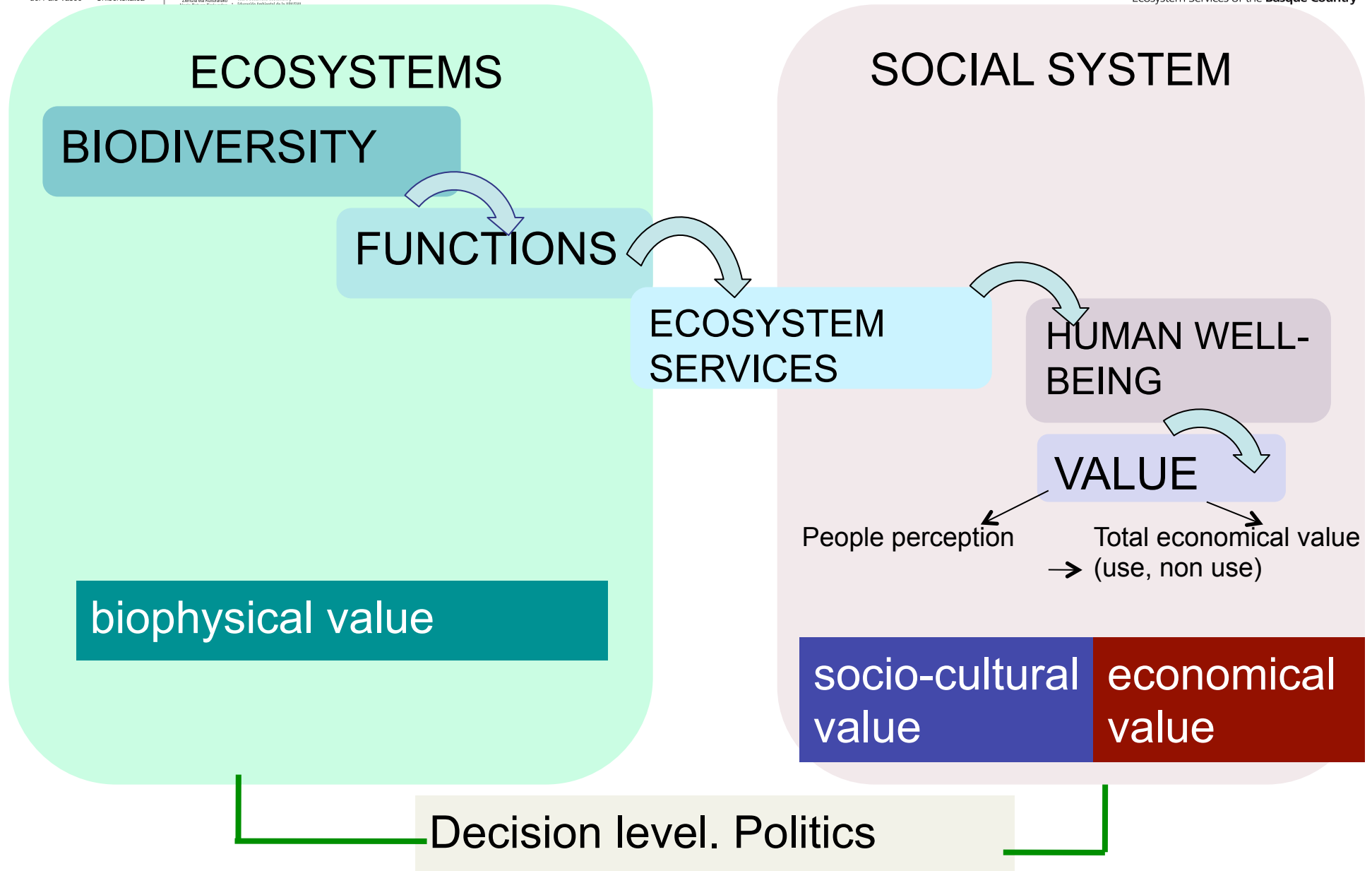
Nature,  
basis  
of well-being

Millennium Ecosystem Assessment in the **Basque Country**



A regional integrative approach to enhance the link between science, policy-making and society.

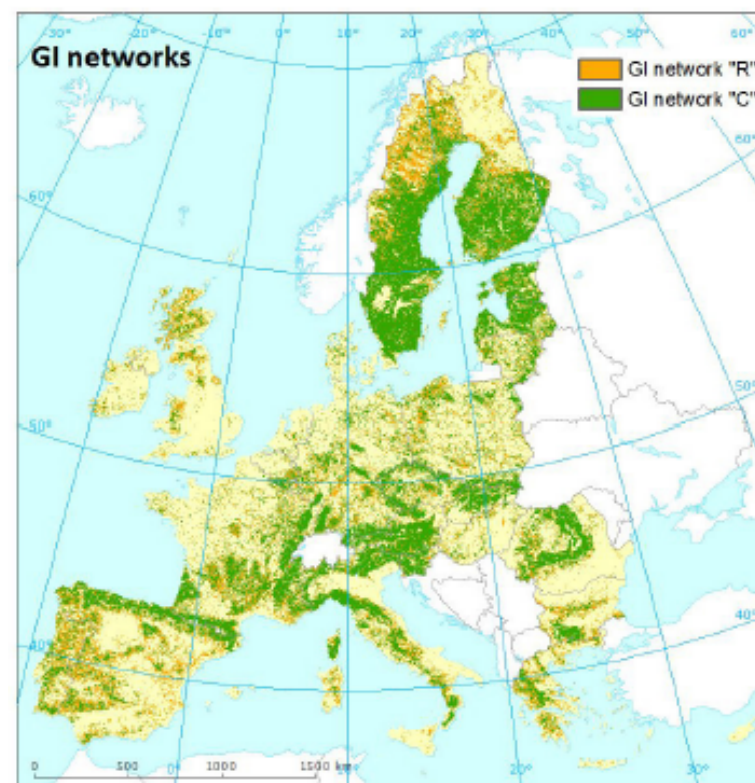
## 2- An integrative approach



## - Mapping ecosystem services

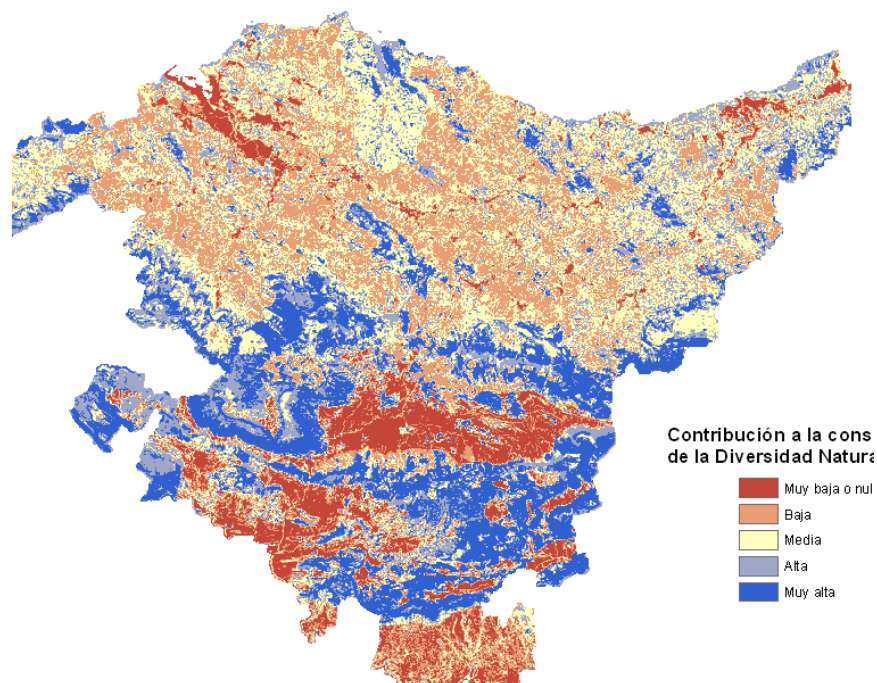
Identifying hotspots or priority areas for multiple ecosystem services to enhance sustainable land management

Biodiversity, water delivery, flood control, carbon store, pollination, aesthetic value,

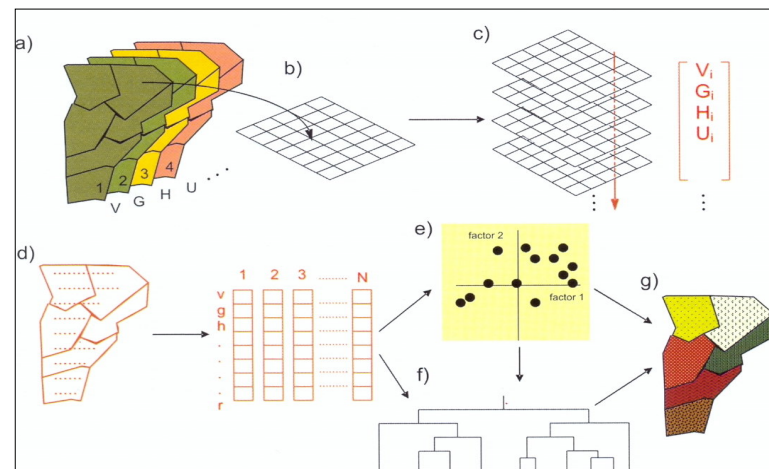
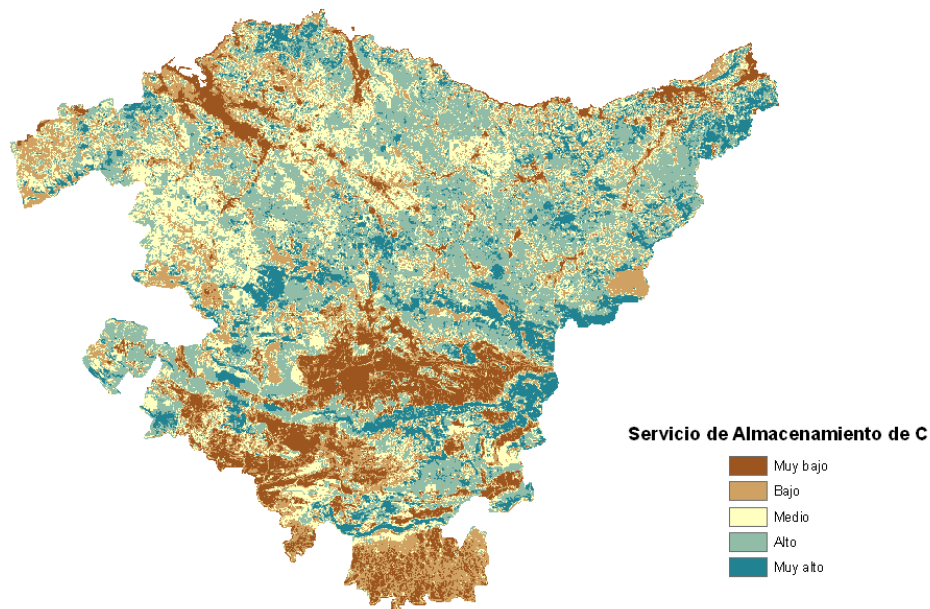


**Green Infrastructure**

## Biodiversity



## Carbon store

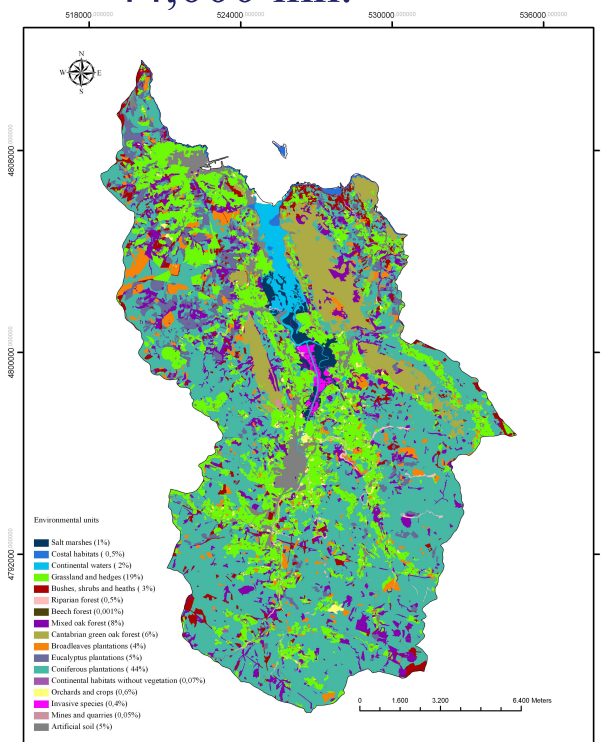


## Case study: Urdaibai BR

### *The Plan for Landscape Management*

- Aim: contribute to the debate about the role of ecosystem services in conservation
  - to what extent the conservation of biodiversity will ensure the provision of ecosystem services?.
- 
- Questions:
    - 1- which ecosystems are the most important producers of biodiversity, carbon storage and water regulation?
    - 2- to what extent do the biodiversity, carbon storage and water regulation hotspots overlap?

- **Study area:** watershed in northern Spain: Urdaibai B.R.
- Costal and mountainous landscapes. 220km<sup>2</sup> ; 44,000 inh.



**Coniferous plantations**  
 44%, natural forests 15%

## Methodology

**Biodiversity** was calculated and valued as (CITA):

- $B = f(r) + f(q) + f(p)$   
 richness; habitat quality (succession); degree of legal protection.

**Carbon storage C** (biomass and soil) was valued as (IPCC, 2003):

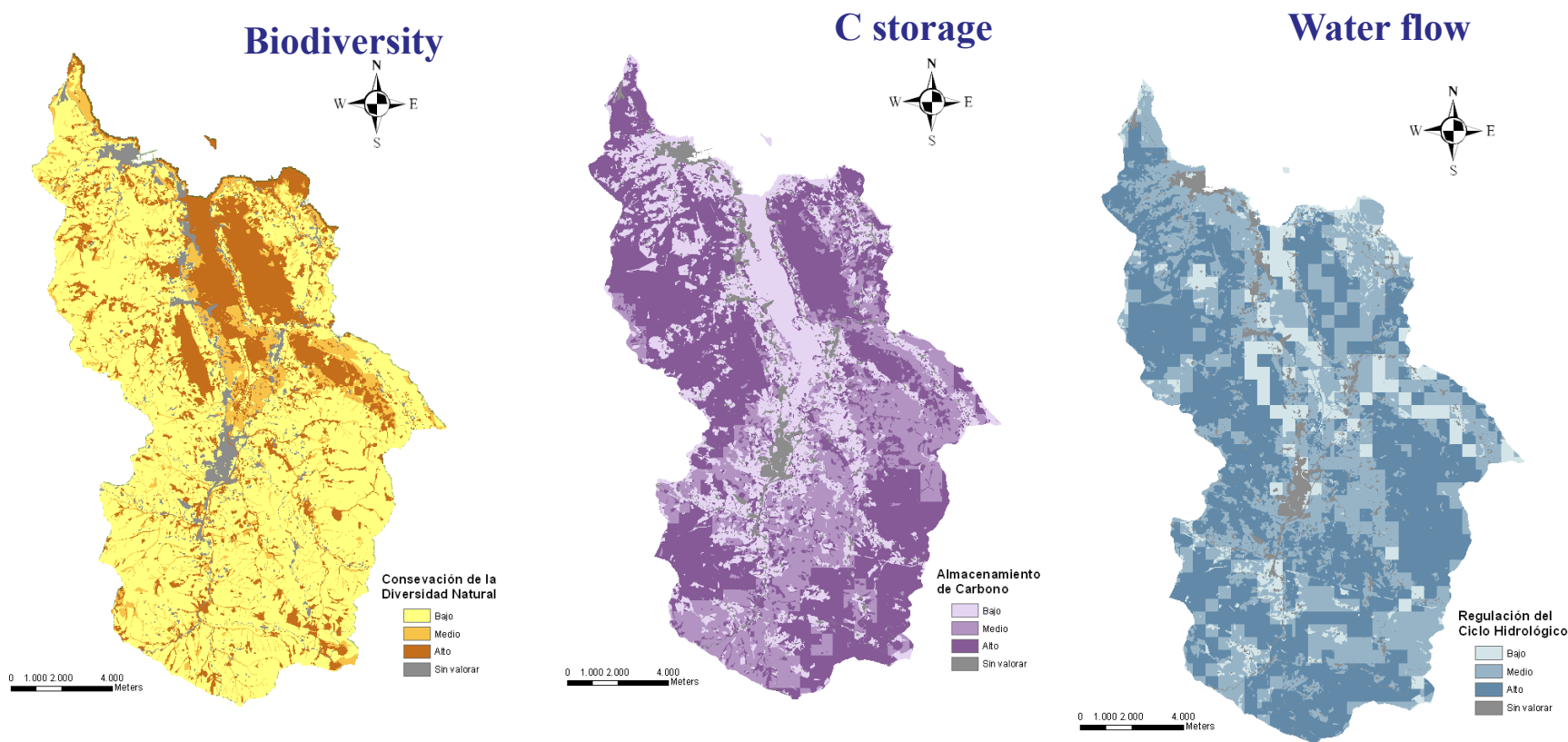
- Inventory of organic C stored in the soil (Neiker-Ihobe, 2004). CB (biomass)  
 $CB = V * BEF * (1 + R) * D * CF$   
 the root-to-shoot ratio; wood density; the carbon fraction of dry matter

**Water flow regulation** was based on the TETIS model (Vélez et al., 2009) (WC) was calculated as (mm / year):

- $WC = Hu/R$   
 water stored in the soil; annual rainfall; corrected annual potential evapotranspiration

- A Geographic Information System-based approach was designed to estimate spatially the value of the biodiversity and ecosystem services. Spatial units were grid cells with a size of 4 m<sup>2</sup>.

# Results: Maps of biodiversity, carbon storage, water flow regulation, aesthetic value and recreation



## - Results

- Natural forests are the ecosystems that most contribute to biodiversity, carbon storage and water flow regulation
- Conservation of natural forests should improve biodiversity, carbon storage and water flow regulation (Master Plan for Use and Management)
- **Forest plantations contribute to some ecosystem services but have negative effects on the biodiversity**
- **Conservation based only on ecosystem services might be detrimental to biodiversity**

Onaindia et al. 2013. Environmental science and policy 33: 283-294

Onaindia et al., 2013. *Forest Ecology and Management* 289:1-9.

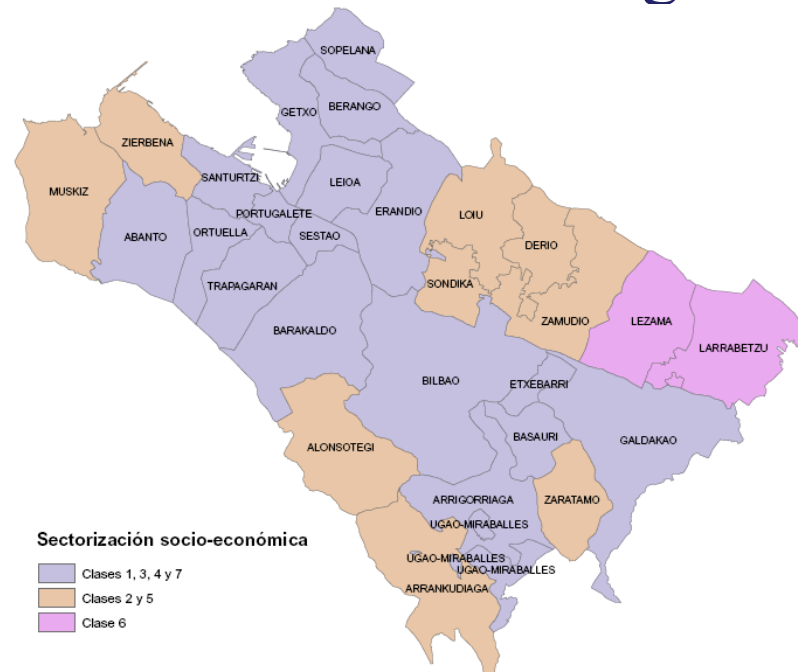
# -Social demand. Case of study: metropolitan area of Bilbao (30 minutes RB). A urban/ rural/natural gradient

406 km<sup>2</sup>

•893.298 habitantes

•2.200 inh/km<sup>2</sup>

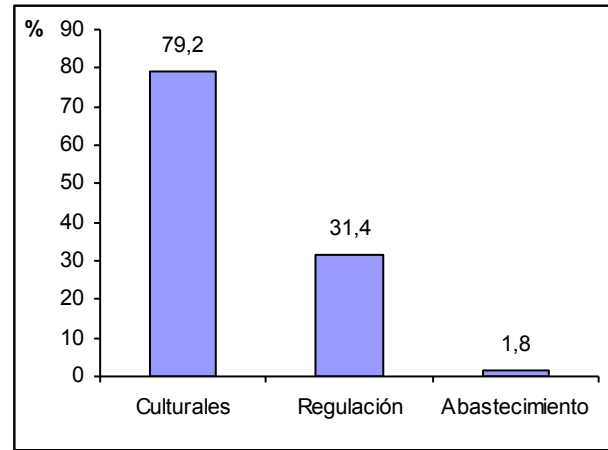
•(Bilbao 8.564 inhab/km



- High % of urban soil: services
- Primary sector
- Mixed uses: agriculture and industrial

✓ Define  
multifunctional areas

## Social approach: demand of ES



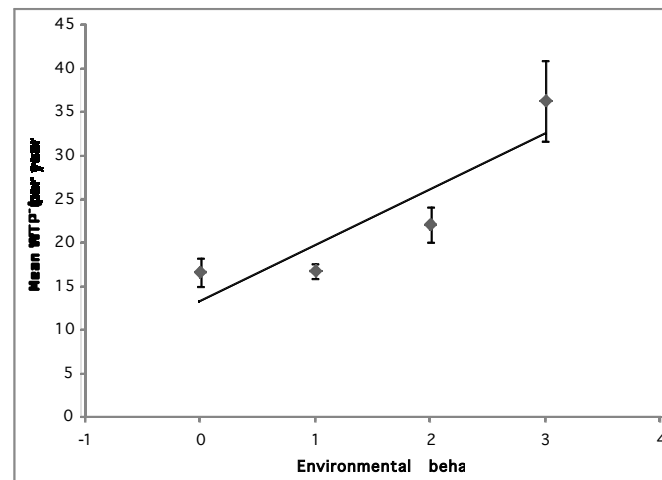
The most important services:

-Biodiversity

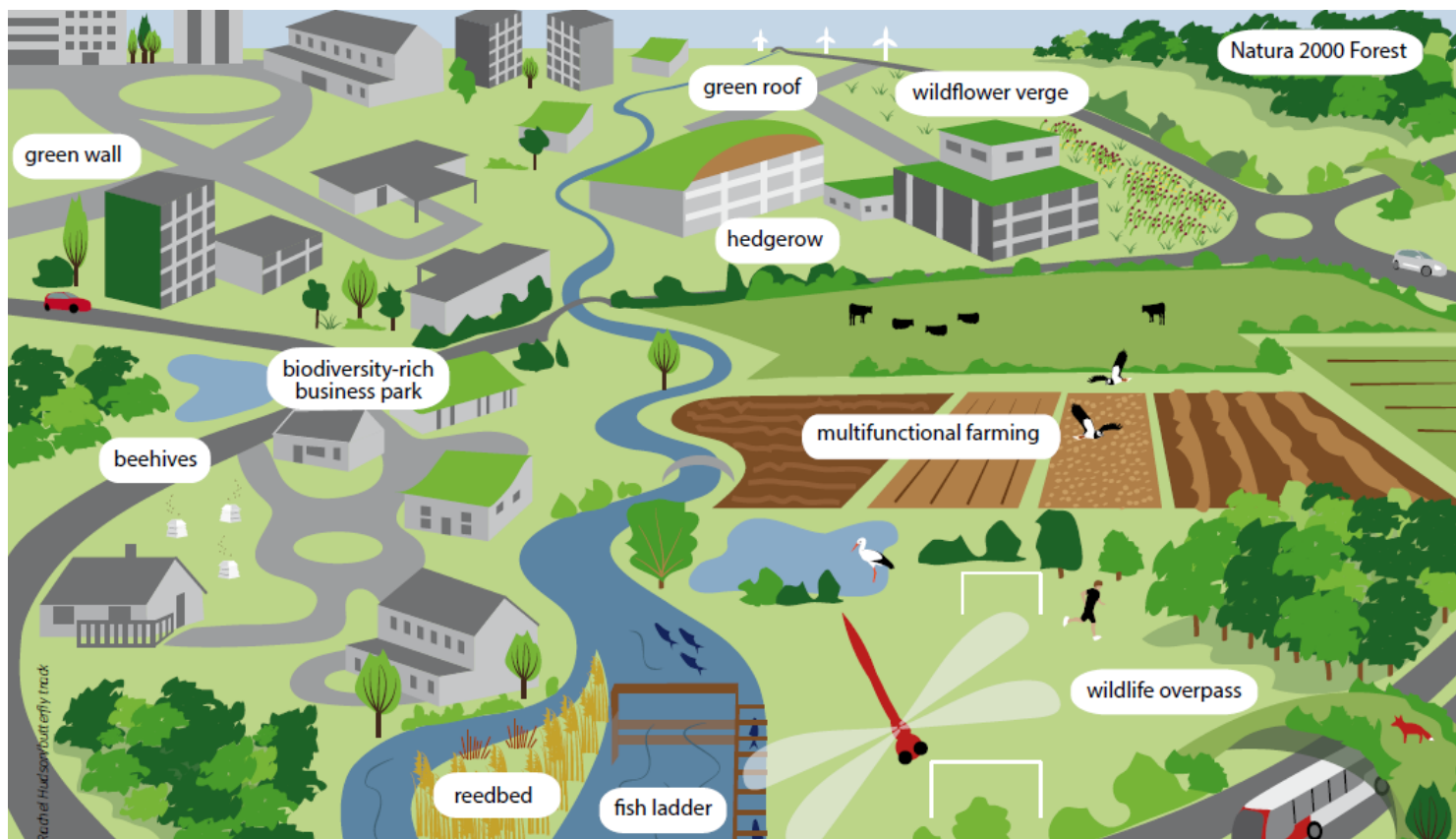
- Air quality

- Education level and age :  
most influent for the value  
given to ES

Williness to pay (WTP)



# Connected green infrastructures: natural/rural/urban



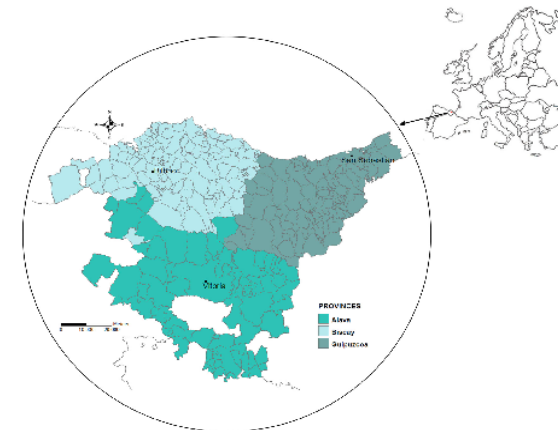
There is a great deal of permeability between the urban-rural- natural environments as well as integration of the periurban landscape in urban processes (mutual dependency).

### 3- Indicators of multifunctionality

## Define an index of landscape multifunctionality based on ES

The contribution of the municipalities to the provision of ecosystem services is not considered for economical incentives, even though they are fundamental for human well-being

# 1,200 km<sup>2</sup>, 250 municipalities, 2,200,000 inhabitants



**Fig. 1.** Study area.

Rodríguez-Loinaz et al., 2014. *Journal of Environmental Management* 147:152-163.

# Selected indicators of Ecosystem Services 15 indicators for 11 ES

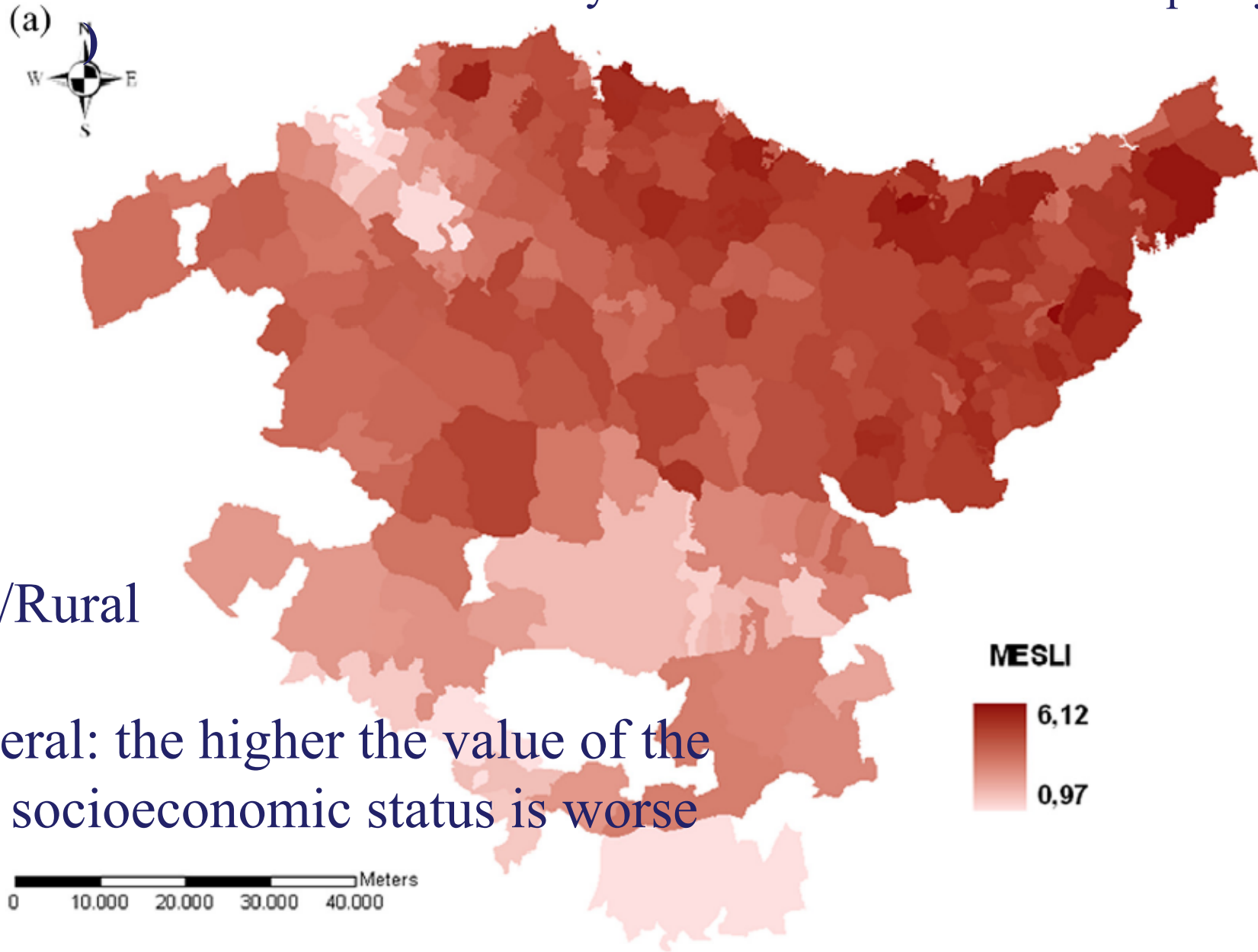
**Table 1**

List of selected ecosystem services and biodiversity values with their potential indicators and low and high performance benchmarks (Min. t. s., Max. t. s.: minimum and maximum value in entire time series data). References that use the indicator, or a similar indicator, are noted.

Services	Indicators	Low performance benchmarks	Target	References
<b>Provisioning</b>				
Food	DC: Density of head of cattle (N°/100 ha)	0	Max. t. s.	Burkhard et al., 2012; Kandziora et al., 2012
	AP: Agricultural production (Ton/ha)	0	Max. t. s.	Maes et al., 2012; European Commission, 2014
Raw materials	Timb: Timber in forest plantations (m <sup>3</sup> /ha)	0	Max. t. s.	Burkhard et al., 2012; Maes et al., 2012
Freshwater	RO: Runoff = renewable water supply (mm)	Min. t. s.	Max. t. s.	MEA, 2005
<b>Regulating</b>				
Global climate regulation	SCSB: Stored C in soil and biomass (Ton C/ha)	0	Max. t. s.	Maes et al., 2012; Kandziora et al., 2012; van Oudenhoven et al., 2012; Layke et al., 2012
Maintenance of soil fertility	OCS: Organic C in soil (Ton C/ha)	0	Max. t. s.	Maes et al., 2012
Local climate regulation	Et: Evapotranspiration (mm)	Min. t. s.	Max. t. s.	Burkhard et al., 2012; Kandziora et al., 2012; Layke et al., 2012
Water flow regulation	SWS: Soil water storage capacity (mm)	0	Max. t. s.	van Oudenhoven et al., 2012; Layke et al., 2012
	SWI: Soil water infiltration capacity (cm/h)	0	Max. t. s.	Maes et al., 2012; Layke et al., 2012; Gomez-Baggethun and Barton, 2012
Water purification	RF: Cover of riparian forest in river margins (% in 25 m buffer)	0%	100%	Plieninger et al., 2012; European Commission, 2014
	NF: Cover of natural forest (% of municipality's surface)	0%	Max. t. s.	European Commission, 2014
Erosion prevention	Eros: Areas without erosion problems (% of municipality's surface)	0%	100%	Kandziora et al., 2012
<b>Cultural</b>				
Tourism	RTS: Density of rural tourism establishments (N°/km <sup>2</sup> )	0	Max. t. s.	Burkhard et al., 2012; Kandziora et al., 2012
<b>Biodiversity</b>				
	SP: Special protection area	0	Max. t. s.	Maes et al., 2012

$$MESLI = \sum_{i=1}^{11} \frac{\text{Observed value}_i - \text{Low performance benchmark}_i}{\text{Target}_i - \text{Low performance benchmark}_i}$$

## Results: Multifunctionality index value for each municipality



# Results for management

- The indicator is a tool for measuring the multifunctionality, and to develop a system of socio-economic compensation for the provision of ecosystem services at municipality level
- Recognising the contribution of the municipalities to human well-being has the potential to improve the socioeconomic situation and reduce the differences between them

## 4- Conclusions

The perspective of ecosystem services contributes to develop sound land-use policies and planning actions

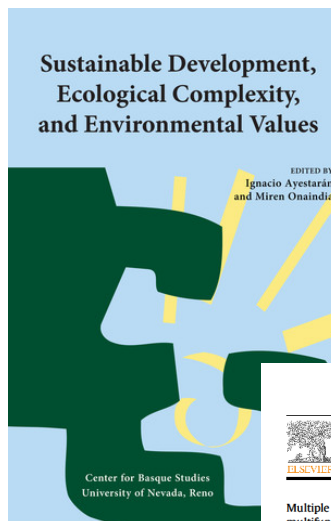
- Conservation Plans based on ecosystem services and biodiversity. Urdaibai (PRUG), Planning for the Metropolitan area of Bilbao (PTP), Strategy for Land Management (DOT)
- Socio-economic compensation for landscape multifunctionality. Inex

- **Important issues:**

- Stakeholders ' participation and collaboration between researchers, technicians and politicians
- Development of technical tools: mapping, indicators, others (spatially explicit accurate information).
- Engagement in Networks



# Outreach materials



## CARTOGRAFIADO DE LOS SERVICIOS DE LOS ECOSISTEMAS

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## Naturaleza, la base del bienestar

Evaluación de los Ecosistemas del Milenio en la CAPV



### Multiple ecosystem services landscape index: A tool for multifunctional landscapes conservation

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#### ABSTRACT

The contribution of ecosystems to human well-being has been widely recognized. Taking into account existing trade-offs between ecosystem services (ES) at the farm scale and the dependence of multiple ES on processes that take place at the landscape scale, long-term preservation of multifunctional landscapes must be a priority. Studies carried out from such perspectives, and those that develop appropriate indicators, could provide useful tools for integrating ES in landscape planning. In this study we present a new integrative environmental indicator based on the ES provided by the landscape and named 'multiple ecosystem services landscape index' (MESLI). Because, operations and trade-offs between ES are presented at regional or local levels, being different from those presented at larger scales, MESLI was developed at municipality level. Furthermore, in order to identify main drivers of change in ES provision at the landscape scale, an analysis of trade-offs between the environmental and the socio-economic characteristics of the municipalities was carried out. The study was located in the Basque Country and the results demonstrated that the MESLI index is a good tool to measure landscape multifunctionality at local scales. It is effective evaluating landscapes, distinguishing between municipalities based on ES provision, and identifying the drivers of change and their effects. This information about ES provisioning at the local level is useful for policy-making; therefore, MESLI would be very useful for policy-makers and land managers because it provides relevant information to local scale decision-making.

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#### 1. Introduction

The contribution of ecosystems to the world's economy and human well-being has been widely recognized in science and policy (Carter, 2012; Eitzinger et al., 2008; Eitzinger and Burkhard, 2012; van Oudenhoef et al., 2013). Ecosystems provide a number of goods and services to humans such as food, water, carbon sequestration, flood control, climate regulation, erosion control, aesthetic beauty and recreation (MEA, 2005). Nevertheless, most ecosystem services (ES) are external to the market system (e.g., flood control and climate regulation), thus their economic value is not quantified. Only a few services such as food and timber, have market value (Costanza et al., 1997; Sayer et al., 2012). This has given rise to the degradation of non-marketed services as a result of actions taken to increase the supply of marketed ES (Costanza et al., 2010).

Costanza, 2007). Safeguarding and enhancing the provision of non-marketed ES is crucial from both the human and economic perspectives. As a consequence, initiatives have been developed to promote the supply of non-marketed services (Costanza et al., 2010), such as payments for ecosystem services schemes (Schoor and Marnett, 2012; Woolden et al., 2010), habitat banking (Duke, 2013; Yin et al., 2010) or different subsidies. One of the main drawbacks of these initiatives is that they usually follow a farm scale approach, which goes after the provision of a desired service on a particular land (van der Horst, 2011). This farm scale approach is biased in two ways. First, it does not take into consideration the existing synergies and trade-offs between different services (Dymond et al., 2011; Hock et al., 2012; Dymond et al., 2013). It does not either 'trading' of ES in a trading scheme (Duke et al., 2013) and usually prioritizes only one service such as water purification, mitigation of flooding, ecosystem, biodiversity conservation, or carbon sequestration (Dymond et al., 2013), leading to potential trade-offs with other services that are either not recognized or undervalued. Second, it is well known that the provision of many ES depends on processes

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### Escenarios de futuro en Bizkaia

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And many active stakeholders

# Thank you Eskerrik asko

## Think global and act local



## .....*Sustainable Development Goals*....