THE SOCIAL DIMENSION OF BIODIVERSITY POLICY IN THE EUROPEAN UNION: VALUING THE BENEFITS TO VULNERABLE COMMUNITIES

by

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Abstract

This paper uses spatial mapping tools, including Geographic Information Systems (GIS) to explore the social dimension of biodiversity policy, in order to identify and analyze the strength of the linkage between biodiversity and human livelihoods in different geographic locations. Our analysis is focused on Europe, where biodiversity and ecosystem benefits have been well studied for many ecosystems and concentrates in particular on forest, coastal and freshwater wetland ecosystems both at country level and downscaled to a higher geographical resolution. We focus on European rural areas with a high density of agricultural land-use and investigate the dependencies between the socio-economic, biodiversity and ecosystem value indicators in selected rural regions and across different income groups. Moreover, social vulnerability indicators are also identified and mapped in a spatial gradient so as to investigate the role of biodiversity in the definition of social vulnerability contours maps in particular for rural communities living in remote regions. The results of this study provides important insights for EU policymakers to design potential policy instruments that can on the one hand promote biodiversity conservation and prevent natural resources from degradation, and on the other hand contribute to social stability and human livelihoods.

Keywords: biodiversity policy, biodiversity benefit, vulnerable groups, European Union, spatial analysis

JEL: Q56, Q57, Q58

1 Introduction

Biodiversity is a complex and multi-dimensional concept, which is generally understood as the quantity and variability among living organisms – either within species (genetic diversity), between species, or between ecosystems - that underpins the supply of a variety of ecosystem services from which humans can benefit directly or indirectly. Although the contribution of biodiversity to human livelihoods is complex in nature, the results of the United Nations' Millennium Ecosystem Assessment (MA) as shown in Figure 1, imply that the role of biodiversity in supporting human livelihoods, including those of vulnerable groups such as the rural poor, can be examined by assessing the intensity of the linkage between ecosystems, the services they provide, and the constituents of human wellbeing. Such intensity represents the benefits of biodiversity.

Ecosystem services that are underpinned by biodiversity include the provision of food and water, disease management, climate regulation, flood control, spiritual fulfillment, and aesthetic enjoyment, which have been recognized as having an essential role in achieving the United Nation's Millennium Development Goals (UNEP-WCMC, 2007).

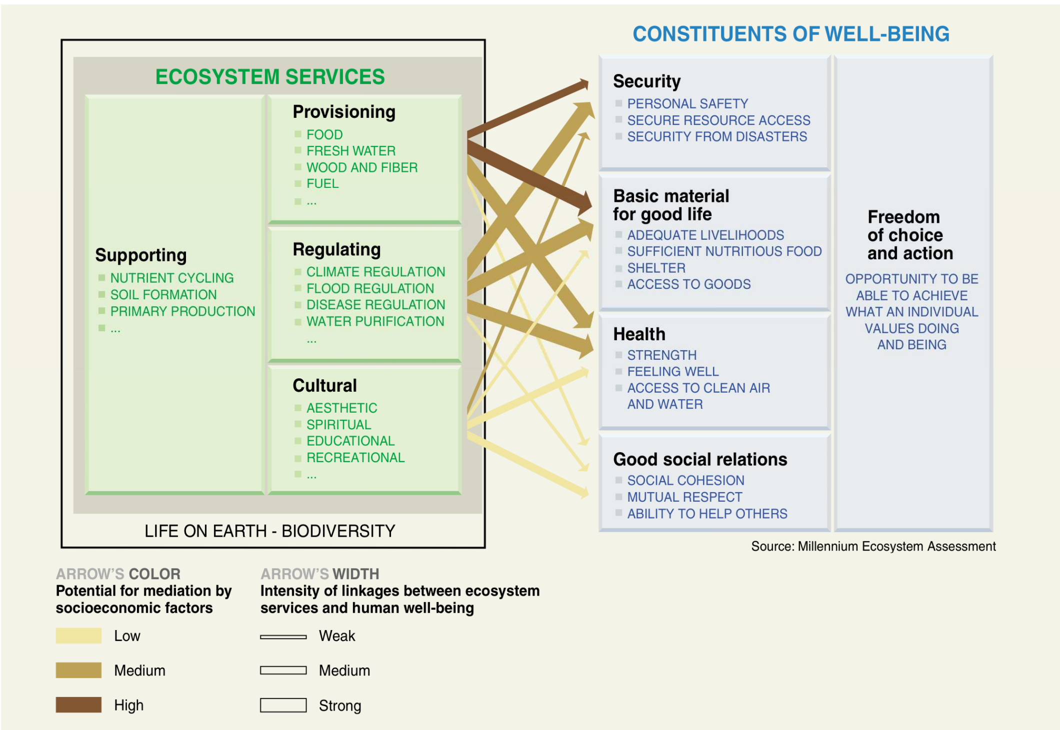


Figure 1. Linkages between ecosystem services and human well-being (Source: MA, 2005, pp. iv)

Ecosystem services are important to different economic sectors. Primary sector activities such as agriculture, forestry, fisheries and hunting depend on a wide range of provisioning, regulating and supporting services which together shape the natural capital on which these sectors depend and determine sector inputs, processes and outputs. A variety of manufacturing activities depend on ecosystem services for the delivery of raw material inputs. Service sectors such as tourism, education and the media rely on the cultural services delivered by ecosystems. All sectors are dependent on ecosystem services indirectly in maintaining the health of the workforce, the living and working environment, and for providing protection from natural hazards.

Given that biodiversity underpins the provision of a variety of ecosystem goods and services, policies targeting at biodiversity conservation may have important implications to livelihoods enhancement and poverty alleviation. The synergies of biodiversity benefits and human livelihoods may vary in particular between developed and developing countries. For instance, a recent EC report (Nunes *et al.* 2010) has shown that in the developing world, a large proportion of employment is dependent on biodiversity and the ecosystem services it provides. By contrast, in developed regions such as the EU, the provisioning role of biodiversity and ecosystems is now responsible for only a small proportion of livelihoods. Direct employment in nature conservation is significant and growing and so is the employment in nature-based tourism and recreation (Nunes *et al.* 2010). The extent to which biodiversity conservation can benefit human livelihoods is an important question confronted by policymakers, who need to evaluate the trade-offs between biodiversity benefits and opportunity costs of conservation activities and to maximize the social benefits of biodiversity policies. The answer, however, requires an in-depth understanding of the social dimension of biodiversity policy, by analyzing the ways in which human livelihoods depend on biodiversity and ecosystem services and by examining the level of the respective dependency.

With this perspective in mind, the present paper will explore the use of spatial mapping tools and Geographic Information Systems (GIS) to explore the social dimension of biodiversity policy, so as to identify and analyze the strength of the linkage between biodiversity and human livelihoods at different geographic levels. The analysis focuses on the European scale, where biodiversity and ecosystem benefits have been well studied for many ecosystems and concentrates on forest, coastal and freshwater wetland ecosystems both at country level and downscaled to a higher geographical resolution (See Ding et al. 2010, Ghermandi et al. 2009 and 2010). The data on socio-economic and biodiversity conditions of the countries under consideration are also well documented in the literature. These three types of information will be mapped in a spatial gradient. It is expected that the resulting maps will provide important insights for the EU policymakers to design potential policy instruments that can on one hand promote biodiversity conservation and prevent natural resources from degradation, and on the other hand contribute to social stability and human livelihoods (e.g. increased number of jobs in the protected area and/or ecosystem-related economic activities).

The reminder of the paper is structured as follows. In Section 2, a conceptual model is used to present the methodological framework developed for mapping and analyzing the linkages of biodiversity and human livelihoods. Section 3 defines the core socio-economic and biological indicators and introduces data to be used in the spatial analysis. Section 4 investigates the links between a country's or region's economy, its biodiversity richness and the provision of ecosystem services. Section 5 concludes and provides recommendations for biodiversity policy in the EU.

2 Methodology

2.1 A Conceptual Model for Evaluating the Linkages of Biodiversity Benefits and Human Livelihoods

The conceptual model embraced in this paper to evaluate the linkages of biodiversity benefits and human livelihoods sheds light on two distinct value transmission mechanisms. The first captures the market value components of the biodiversity benefits on human livelihoods. A second component encapsulates the non-market dimensions – see Figure 2. Thus, human wellbeing benefits from biodiversity and ecosystem services in terms of the directly increased household revenues from resource-related economic activities as well as the enhancement of various non-income benefits from the ecosystem services received.

First, with respect to income related livelihoods, ecosystem services are essential inputs for many primary sectors in the economy, including forestry, agriculture, fishery, and tourism or direct source of income/revenues to the local communities (consumers/firms) who are involved in markets trading ecosystem services, such as food and wood fuel, among others. The strength of this linkage can be estimated through a systematic economic sector analysis, and the results reflect the degree of *dependency* of the local economies with respect to biodiversity and ecosystem services, including their role in the creation of employment/income opportunities to the communities. In this context, valuing the economic revenues that rural dwellers or poor local communities can extract from the use of environmental resources enables us to assess their quantitative contribution to rural livelihoods and the extent of dependency of rural people on natural products and ecosystem services.

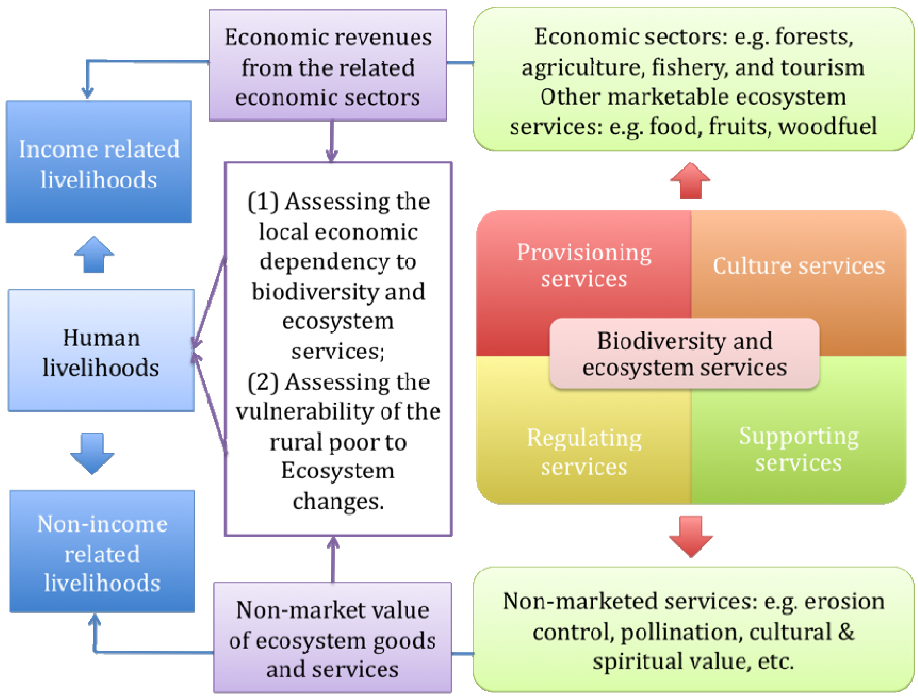


Figure 2. Framework of assessing the human livelihoods through biodiversity and ecosystem services

Second, ecosystem services also contribute to non-income related human livelihoods. The ecosystem regulating and supporting services will safeguard the living environment as well as guarantee the continuous economic activities of humans, in particular the rural dwellers; whereas the ecosystem cultural services are essential to the spiritual and cultural value of the local communities. The strength of these linkages can be estimated through a systematic economic analysis of the non-income related value of biodiversity and ecosystem services on human livelihood, which in turn allows to complement the understanding of the degree of *dependency* of the local economies with respect to biodiversity and ecosystem services. Moreover, both value transmission mechanisms enable the understanding of the degree of *vulnerability* of the local economies, in particular the rural poor, with respect to changes, or losses, of biodiversity and the respective impacts on the provision of ecosystem services.

Finally, it is important to note that the economic valuation exercise stems from microeconomic theory, proving a partial-equilibrium analysis of the economic problem at a local scale. In the case of quantifying the biodiversity benefits to the rural poor, we are particularly interested in the cash or non-cash income that local communities can obtain from the extractive use of natural resources and how much can this contribute to rural livelihoods. This perspective indicates that the current economic analysis focuses on the supply side of products, which are transformed into benefits to the economy by either being used as resource endowments in production of the primary sectors (e.g. timber production) or being provided to outsiders in the form of ecosystem-based services (e.g. recreation and tourism services). Although benefits of ecosystem services exist in different forms, it is clear that both benefits can be traced directly/indirectly in the marketplace and lead to the increase of cash income and the creation of new job opportunities to the local population. Therefore, we interpret the estimated economic values of ecosystem services as the contribution to the total income that supports the livelihoods of rural communities. The magnitude of the ecosystem value can also reflect the poverty level of vulnerable groups in the rural areas.

2.2 GIS Spatial Mapping of Biodiversity Benefits and Rural Vulnerable Groups

Empirical evidence has shown spatial coincidence between ecosystem services and strong dependence of poor rural livelihoods on those services (Chomitz and Nelson, 2003; Müller et al., 2006 and Dasgupta et al., 2005). Such strong dependence on natural resources makes the rural poor very vulnerable to any change in ecosystems and biodiversity. Natural resource degradation and biodiversity loss can affect the poor by impairing household consumption derived from natural products and the proportion of wealth generated in ecosystem-related production and employment. In this context, GIS maps can be a powerful tool for investigating the spatial coherence of biodiversity and rural vulnerable groups, identifying conservation priorities and the cost-effective biodiversity policies that promote both biodiversity conservation and poverty alleviation. In the analysis we strongly rely on GIS to integrate different spatial layers of information, which are targeted at capturing various levels of socio-economic characteristics of the population, biodiversity richness or economic value of ecosystem services. In the context of GIS mapping, we focus in particular on those vulnerability-related indicators that allow us to look in detail to the spatial disaggregation of the data. In the following sections, the role of biodiversity and ecosystem services in supporting human well-being is discussed at different geographical scales and for different types of vulnerability in poor economies, rural communities and remote communities.

Spatial mapping requires both data quality and quantity, therefore we only focus on European countries, where detailed information is available, for describing (1) the socio-economic characteristics, (2) the value of ecosystem goods and services, and (3) biodiversity conditions. More specifically, we explore the use of a set of indicators to evaluate and map all three abovementioned aspects in a spatial gradient, so that we are able to identify and analyze the strength of the linkage between biodiversity and human livelihoods at different geographic locations – see Figure 3. Finally, the outcome of the spatial analysis have important policy implications in terms of identifying priority locations where policy instruments can be most cost-effective for reallocating resources as well as identifying winners and losers so as to improve the efficiency of biodiversity policy. If empirical evidence supports the assumption that a biodiversity rich area is associated with high poverty, then the enforcement of well-defined biodiversity policies are expected to have multiple positive effects in these regions, in terms of reducing natural degradation, improving the living environment of the rural poor, and increasing income and employment opportunities to the local communities. In principle, the outcomes of such policy implementation will be reaching the social optimum.

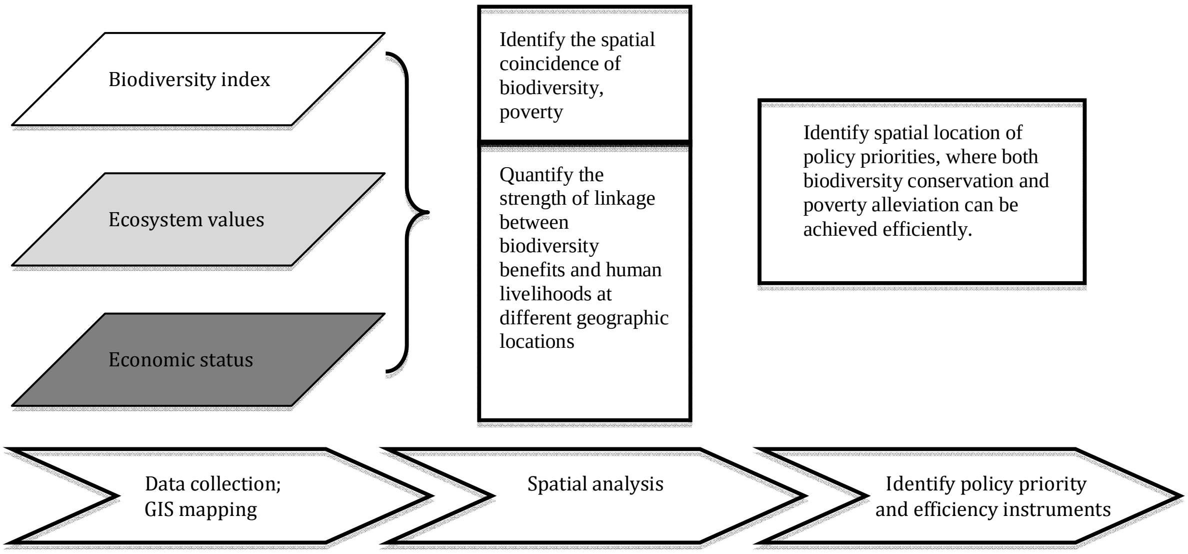


Figure 3. An illustration of the GIS analysis of spatial coincidence of biodiversity richness and human livelihoods

3 Data

3.1 Identification of the Rural Poor in Europe Using Socio-Economic Indicators

Poverty is multidimensional and encompasses inability to satisfy basic needs, lack of control over resources, lack of education and skills, poor health, malnutrition, lack of shelter, poor access to water and sanitation, vulnerability to shocks, violence and crime, lack of freedom and powerlessness. In most world areas, the poorest communities of a country are often the indigenous people or ethnic minorities who live in a remote location or on the marginal lands of rural areas, relatively far from essential elements of the modern economies, such as big cities, large paved roads and ports. Whereas in Europe, rural poverty is practically nonexistent, some countries such as Romania and Bulgaria, are characterized by having 40 per cent of the poor people are living in rula communities, who are also among the poorest communities in Europe. In addition, more than eight out of ten in the Republic of Moldova live below the two-dollar-a-day poverty line, many of them in rural areas[1].

In many rural areas of the new member states, poverty has increased as a result of privatization of former collective and state farms after the collapse of the former communist system, leaving rural workers unemployed and with few opportunities for alternative employment. In particular, lack of local employment, distances from the markets of Western Europe, and scarcity of land and plot fragmentation are key factors that determine the rural poverty in the region and result in a flow of rural migration to urban areas in search of jobs and services (IFAD, 2002). Poverty is becoming an important issue in Europe as it comes hand in hand with vulnerability, a measurement of the societal resistance or resilience of rural communities to the loss of biodiversity and ecosystem services, reflecting their inability of adapting to any shocks and damages (e.g. climate change, floods and drought) to the natural resources on which their livelihoods depend. High vulnerability arises in the poor rural communities whose livelihoods are directly extracted from the sale of primary resources (e.g. farmers, fishermen and foresters) or reliant on the selling of their labour. Moreover, vulnerability may also increase with respect to the increasing remoteness of communities whose potential is limited in terms of their accessibility to markets in big towns/cities, and additional source of income from off-farm employment opportunities in the nearby urban areas. In response, the EU has earmarked a significant part of its common budget for development of the least advantaged rural areas within new member states in Eastern Europe.

To profile the rural poor in the European countries under consideration, four key socio-economic indicators, including GDP per capita (2007US$, PPP), agriculture added value over GDP, unemployment rate (% of population aged 15 and over, 2007) and rural population (% of total, 2007) are chosen. These are selected to measure the level of economic development in each country and the importance of primary sectors in the country's economy. Table 1 summarises the information of the four socio-economic indicators across different income groups.

[1] http://www.ruralpovertyportal.org/web/guest/region/home/tags/europe

Table 1. Socio-economic vulnerability indicators in European countries

		Socio-economic Indicators			
OECD Income groups	Country	GDP per capita (2007US$, PPP)	Agriculture added value over GDP (%)	Unemployment rate, 2007 (% of population aged 15 and over)	Rural population, 2007 (% of total)
High income	Austria	44,879	2	4.4	33
	Belgium	42,609	1	7.5	3
	Denmark	57,051	1	3.8	14
	Finland	46,261	3	6.9	37
	France	41,970	2	8.3	23
	Germany	40,324	1	8.6	26
	Ireland	59,324	2	4.6	39
	Luxembourg	103,042	0	4.1	17
	Netherlands	46,750	2	3.2	19
	Norway	82,480	2	2.5	23
	Sweden	49,662	1	6.2	16
	Switzerland	56,207	1	3.7	27
	UK	45,442	1	5.3	10
Middle income	Czech	16,934	3	5.3	26
	Greece	27,995	4	8.3	39
	Italy	35,396	2	6.1	32
	Portugal	20,998	3	8.0	41
	Spain	32,017	3	8.3	23
	Slovenia	23,379	3	4.8	51
Low income	Hungary	13,766	4	7.4	33
	Poland	11,072	5	9.6	39
	Slovakia	13,891	4	11.1	44
	Bulgaria	5,163	9	6.9	29
	Croatia	11,559	7	9.6	43
	Estonia	15,578	5	4.7	31
	Latvia	11,930	4	6.0	32
	Lithuania	11,356	5	4.3	33
	Romania	7,703	10	6.4	46

Source: World Bank - World development indicator; UNDP - Human Development Indicator; EUROSTAT

EU countries are not homogeneous with respect to the average income levels. For instance, the GDP per capita in the European countries considered in this study ranged in 2007 between $82,480–$103,042 in, respectively, Norway and Luxembourg, and $5,163–$7,703 in Bulgaria and Romania. Such disparities are captured in the OECD classification of economies, which identifies three distinct groups: high-income, middle-income and low-income[2]. Non-OECD countries are classified in Table 1 based on the relative value of GDP per capita in 2007 as middle-income economies (Slovenia) or low-income economies (i.e., Bulgaria, Croatia, Estonia, Latvia, Lithuania, and Romania). The unemployment rate provides some insights on a country's social stability and the size of rural population is an important demographic indicator for calculating population density and income disparities between the rural and urban areas. Moreover, the table also shows that an average of nearly 40% of the population in the selected Eastern and Southern European countries are rural, with agriculture added value over GDP doubled compared to those of the industrialized northern and western zones of Europe.

Agriculture added value over GDP is an indicator of the extent to which a nation's economy depends on its primary products - raw materials extracted from land and ocean. It refers to the net outputs of primary sectors - including forestry, hunting, and fishing, as well as cultivation of crops and livestock production - after adding up all outputs and subtracting intermediate inputs. It is calculated without making deductions for depreciation of fabricated assets or depletion and degradation of natural resources. This indicator embraces all kinds of agricultural products that are traded in the marketplace. The economic dependence of less developed economies on natural capital is considered more significant than those in the developed countries because the economic structure of the former is based on the production and export of primary products, which are characterised by high labor intensity production, but low technical inputs. Thus in Table 1, a high value of this indicator is found to correspond to poorer economies in the low-income category, while low value of the same indicator falls between high- and middle- income categories. In other words, high agriculture added value over GDP indicates that the country's economy depends largely on the quantitative extraction of natural resources. Thus, this indicator can be used to indicate which communities may appear more vulnerable to changes in biodiversity and ecosystem services.

[2] The OECD classification distinguishes three income categories as follows: i.e. high-income countries (with a GDP per capita about $29,254 USD), middle-income countries (with a GDP per capita between $19,244 USD and $29,254 USD) and low-income countries (with a GDP per capita lower than $19,244 USD) (OECD, 2010).

3.2 Spatial Profile of the Biodiversity in Europe

In order to characterize the spatial distribution of biodiversity in Europe, we rely on the index of biodiversity described in Wendland et al. (2009). Such index builds upon the information on species ranges of mammals, birds and amphibians from global vector data (Baillie et al., 2004; BirdLife International, 2006; IUCN, 2006) and combines it in a single index by weighing species ranges by their threat status as defined by IUCN's Red List (IUCN website, 2007). The technical details on the weighing procedure and construction of the aggregated index are given in Wendland et al. (2009). The final index is presented in a 30 arc second grid (approximately 1 km at the equator) and is mapped globally. In Figure 4, we present the distribution of the biodiversity index within Europe and for terrestrial ecosystems.

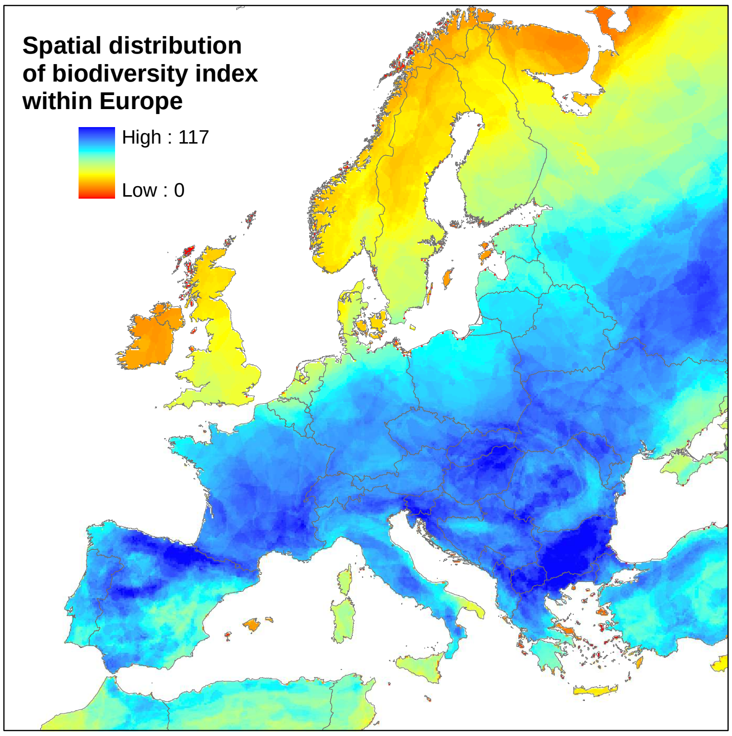


Figure 4. Distribution of terrestrial biodiversity within Europe (source Wendland et al., 2009)

Figure 4 shows that terrestrial biodiversity is distributed unevenly in Europe. North European countries including Scandinavia, United Kingdom, and Ireland are characterized by relatively low biodiversity. The highest values of terrestrial biodiversity within Europe are found in East European countries, notably Bulgaria and Slovakia, and in the Northern regions of Spain. Within some countries there is an important range of variability in the index.

Table 2. Biodiversity indicators for European countries

Country	Bird species (number)[1]	Mammal species (number)[1]	Reptile species (number)[1]	Vascular plant species (number)[1]	Biodiversity index[2]
Albania	303	73	37	3031	76.29
Austria	412	101	16	3100	76.52
Belgium	427	92	12	1550	62.13
Bulgaria	379	106	33	3572	91.31
Bosnia-Herzegovina	312	78	27	-	77.69
Switzerland	382	93	17	3030	77.35
Czech Republic	386	88	11	1900	76.60
Germany	487	126	15	2682	68.99
Denmark	427	81	8	1450	36.50
Spain	515	132	67	5050	70.81
Estonia	267	67	6	1630	54.85
Finland	421	80	5	1102	39.70
France	517	148	46	4630	76.46
United Kingdom	557	103	16	1623	34.73
Greece	412	118	63	4992	62.74
Croatia	365	96	34	4288	76.90
Hungary	367	88	18	2214	84.62
Ireland	408	63	6	950	22.93
Italy	478	132	55	5599	67.14
Lithuania	227	71	6	1796	67.32
Luxembourg	284	66	9	1246	71.94
Latvia	325	68	7	1153	60.33
Macedonia	291	89	29	3500	89.93
Netherlands	444	95	13	1221	49.16
Norway	442	83	7	1715	29.65
Poland	424	110	11	2450	70.82
Portugal	501	105	38	5050	68.75
Romania	365	101	22	3400	78.36
Serbia and Montenegro	381	96	35	4082	81.01
Slovakia	332	87	14	3124	83.67
Slovenia	350	87	29	3200	85.71
Sweden	457	85	7	1750	34.14

[1] Source: UNEP-WCMC (2004)

[2] Estimated by the authors based on the index in Wendland et al. (2009)

For instance, in Italy high values of the biodiversity index are to be found in mountainous regions in the Alps and Apennines, while low-lying regions and, particularly, islands present lower values of the index. It is important to notice that, at a global scale, European countries score rather poorly in the biodiversity index compared to biodiversity hotspots in South America, Africa and South East Asia where the highest values of the index are found (up to 407).

Table 2 below summarizes the information on various biodiversity indicators assessed at country level. The data on the number of known bird, mammal, reptile, and vascular plant species were gathered from UNEP-WCMC (UNEP, 2004) and are compared to the average score of the biodiversity index by Wendland et al. (2009) for each European country. Overall, the highest biodiversity in terms of number of species of birds, mammals, amphibians, and vascular plants is found in France, Italy, and Spain. All three countries are characterized by a relatively high value in the biodiversity index. It is reminded that the index is not constructed only based on the number of species but also on their threat status as defined by IUCN's Red List. Despite the smaller range of species, several Central and East European countries (e.g., Bulgaria, Macedonia, Slovenia) are characterized by a higher score in the biodiversity index. On the lower side of the range, countries such as Estonia, Ireland, Lithuania, Luxembourg and Latvia present the smallest range of animal and plant species. Ireland also has the lowest values among the considered countries for what concerns the biodiversity index. Notably, the United Kingdom is characterized by the largest number of known bird species but shows a relatively low diversity in reptiles and vascular plants and is characterized by a low value of the biodiversity index.

3.3 Profile of Ecosystem Values in Europe

The economic values of forests, coastal ecosystems and freshwater wetlands in Europe are estimated based on three types of ecosystem services defined in the MA report (2005), i.e., provisioning, regulating and cultural services. For forest ecosystems, the valuation exercise is conducted based on the hybrid economic valuation methodology described in Ding et al. (2010), which combines the use of alternative valuation techniques, depending on the type of ecosystem under consideration. Regarding wetland and coastal ecosystems, the valuation estimates are the results of meta-analytical value transfer based on the methodology presented in Ghermandi et al. (2009, 2010). For this study, data are taken from various sources. Bio-physical data regarding the land-use changes and quantity of various forest products and carbon stocks are taken from FAO (2005). Economic valuation databases (such as EVRI), electronic journals and unpublished studies and reports are surveyed to select original non-market valuation studies for meta-analysis and value transfer. The final numeric valuation estimates are the outcome of a partial equilibrium analysis, which considers only a subset of all ecosystem types and services. While the total value of forest and wetland ecosystem embraces the whole range of provisioning, regulating and cultural services, the value of coastal areas is limited to their recreational value.

The valuation results for the selected ecosystems are used in this study as an indicative measure of the magnitude of the contribution of the considered ecosystem services to the wellbeing of the populations of beneficiaries, whether at the local level or at the country level. In this context, the valuation exercise sheds light on the quantitative assessment of the impacts of losing biodiversity and ecosystem services on the beneficiaries, including vulnerable groups such as the rural poor. In addition, economic valuation will also constitute one instrument on which to design and evaluate biodiversity policy instruments aimed at improving the current allocation of market driven resources, enhancing the environmental sustainability of economic activities as well as contributing to alleviating poverty, enhancing social structure and creating jobs. Therefore, valuing ecosystem services, understanding their contributions to human livelihoods and identifying the beneficiaries and relevant stakeholders is important for any policy design targeted at (1) halting biodiversity degradation, (2) correcting the externalities, (3) compensating the losers of biodiversity loss, (4) creating incentives to more effective conservation of biodiversity, and (5) ultimately sustaining the long-term local economic development and human well-being,

The estimated economic values of three ecosystems are summarized in Figure 5. In order to illustrate the contribution of ecosystem benefits to the local economies, we calculated the percentage of total value provided by each ecosystem type over a country's GDP. Figure 5 shows the total values of ecosystem services and their composition in terms of the considered ecosystem types vary across different countries and income categories.

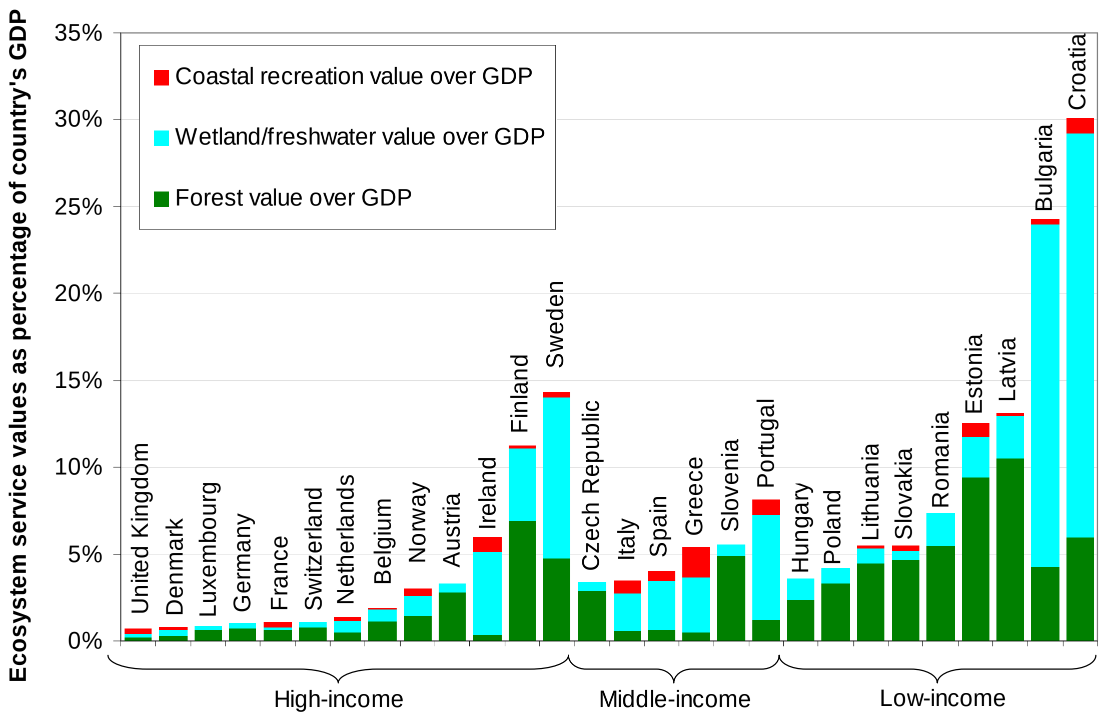


Figure 5. Contribution of forests, wetlands, freshwater and coastal ecosystem service values as percentage of country's GDP

As one can see, among high-income countries, Finland, Sweden and Ireland show the highest value of ecosystem services with respect to the national GDP. This is partly due to the large total area of wetland and freshwater ecosystems in these countries, which, despite the low per-hectare values results in high aggregated values. Secondly, the value of forest provisioning services in Sweden and Finland are particularly high, reflecting the fact that forestry is a widely practiced activity in these countries. In middle-income countries, relatively high values of forest ecosystems are found in countries that are landlocked or with a short coastline, such as the Czech Republic and Slovenia, while in the remaining countries high values are provided by wetlands and freshwater ecosystems and coastal recreation. In low-income countries, ecosystem service values tend to be high particularly for forests and, in Bulgaria and Croatia, wetlands and freshwater ecosystems. The high value of wetlands and freshwater ecosystems in Bulgaria and Croatia reflects the relatively high per-hectare values and the low GDP in those countries.

4 Spatial Analysis of the Dependency of Human Livelihoods on Benefits of Biodiversity and Ecosystem Services in Europe

Environmental income can play a crucial role in the livelihoods of communities in rural and remote locations, especially the poorest. Moreover and despite the fact that biodiversity and environmental conservation policies are mostly advocated in developed economies, larger proportions of the more pristine and less exploited natural resources are found in less developed economies where the resources are and were in the past less extensively exploited to support economic activities.

The purpose of this section is to investigate the links between a country's or region's economy, its biodiversity richness and the provision of ecosystem services. The information on socio-economic indicators and the spatial profile of biodiversity in European countries and regions is combined here with the results of the economic valuation of the ecosystem services provided by European ecosystems discussed in Section 3. The goal is to identify possible patterns in the level of dependency of national and local economies on the benefits of biodiversity and ecosystem services across a range of indicators, which are chosen to represent different degrees of economic development and vulnerability. Otherwise stated, the objective of the investigation is to test whether poor and vulnerable rural and remote communities are more strongly dependent on the provision of ecosystem services.

Figure 6 provide in essence the information on the spatial variability and overlap of the three components considered in this study across European countries. The three indicators depicted in the figure are GDP per capita, value of ecosystem services for the three types of ecosystems considered and the terrestrial biodiversity index. Values are mapped for EU NUTS-3 regions. The value of the biodiversity index in each region is derived from the georeferenced distribution presented in Figure 4 by averaging the value of the index within the boundaries of each administrative unit. The colors of the map represent the proportion of each of the three components, whereas the color is determined as a composition of three color bands: (i) blue, which represents GDP per capita; (ii) red, i.e., value per capita of ecosystem services; and (iii) green, i.e., value of the biodiversity index. The saturation of the color in each band in each region ranges between 0 and 255 and is determined by the local value of the indexes. For instance, the region with the lowest value of GDP per capita is attributed the value 0 for the blue band, while the region with the highest GDP per capita has saturation 255 for blue. Regions where the three indexes are equally split are represented in grey shades.

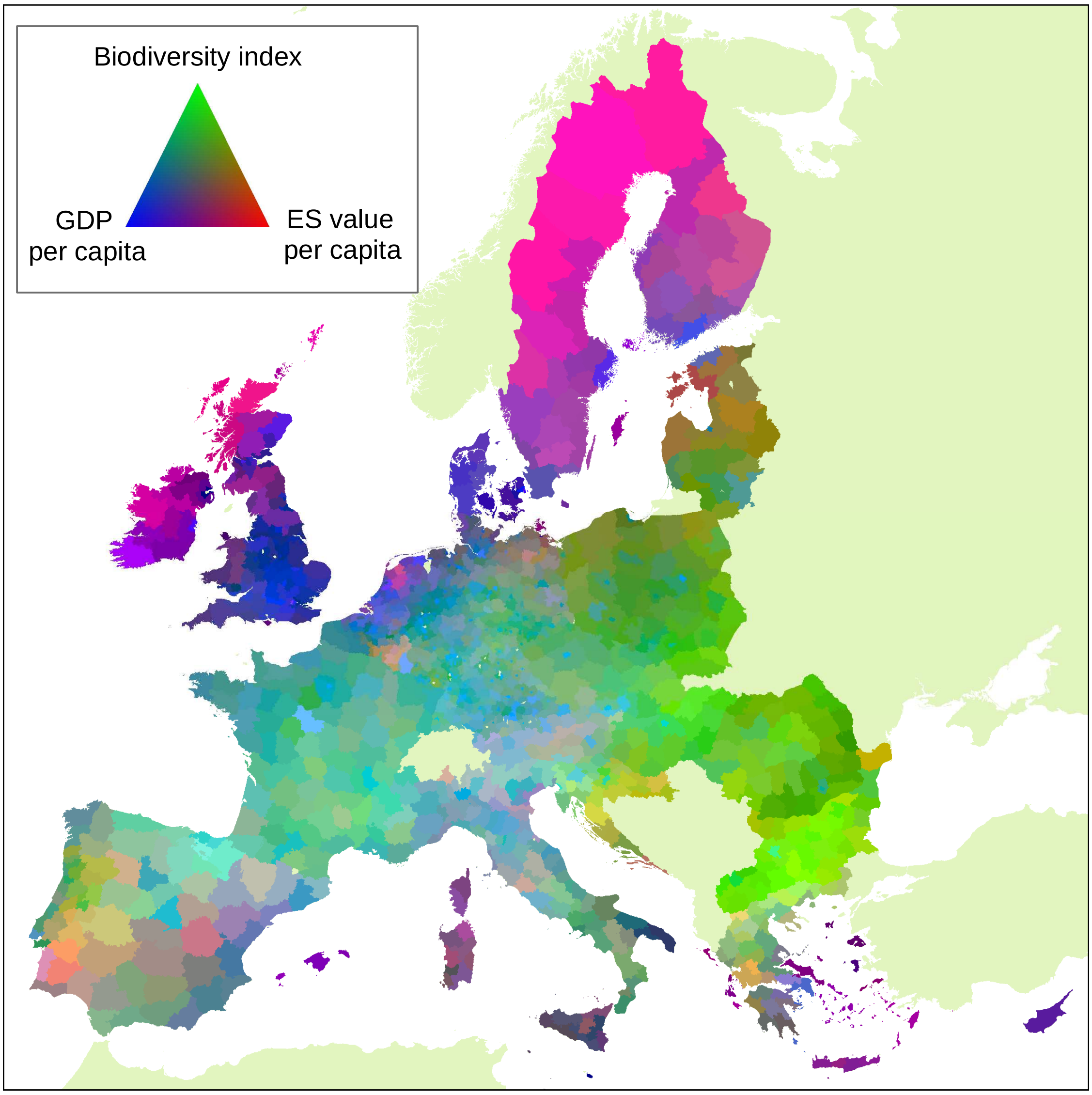


Figure 6. Overlap of the socio-economic, biodiversity and ecosystem service indicators in European NUTS-3 regions

Some broad trends can be identified by the analysis of Figure 6. New EU member states in East Europe (e.g., Poland, Hungary, Romania, and Bulgaria) are depicted in shades of green, indicating that the biodiversity component prevails in these regions over the socio-economic and ecosystem service indicators. This suggests that the biodiversity richness of these areas is not satisfactorily captured in the welfare of the local population and by the economy at large. In other European regions, blue shades prevail, indicating that the socio-economic indicator prevails over ecosystem service value and biodiversity. This is the case in particular of England, Benelux, Denmark, and, less markedly, of most regions of France Germany, and North Italy. Most metropolitan regions are identifiable by the more intense blue color. The composite color of North European and Scandinavian regions (e.g., Ireland, Scotland, Sweden, and Finland) is red/purple, implying that ecosystem service values are well integrated in the local economy, as attested for instance by the importance of the forestry sector in Scandinavian Europe. Finally, Mediterranean islands (e.g., Balearic islands, Corsica, Sardinia, Sicily, Malta, the Greek islands, and Cyprus) seem to constitute a separate category, as they are characterized by low values of both the socio-economic and biodiversity indicators.

4.1 Income-Related Vulnerability and the Link to Biodiversity

Household income level can be interpreted as a measure of the risk to fall into (deeper) poverty in the future as can be triggered by shocks at the community level or at the national and international level. It can thus provide an indication of the vulnerability of communities to socio-economic or environmental changes at the local or larger scale.

The countries in the European Union are not homogeneous with respect to the average income levels. In Figure 7, the average values of the selected socio-economic, biodiversity and ecosystem service value indicators across the three OECD income categories are presented. The socio-economic indicators chosen are the rural population as percentage of the total population, the unemployment rate in 2007 and the added value of agriculture to the country's GDP in 2007. The ecosystem services indicator reflects the total economic value of forests, freshwater wetlands and recreation in coastal areas as elicited in Section 3 over the total GDP of the country. The biodiversity indicator is the country average of the terrestrial biodiversity indicator discussed in Section 3.

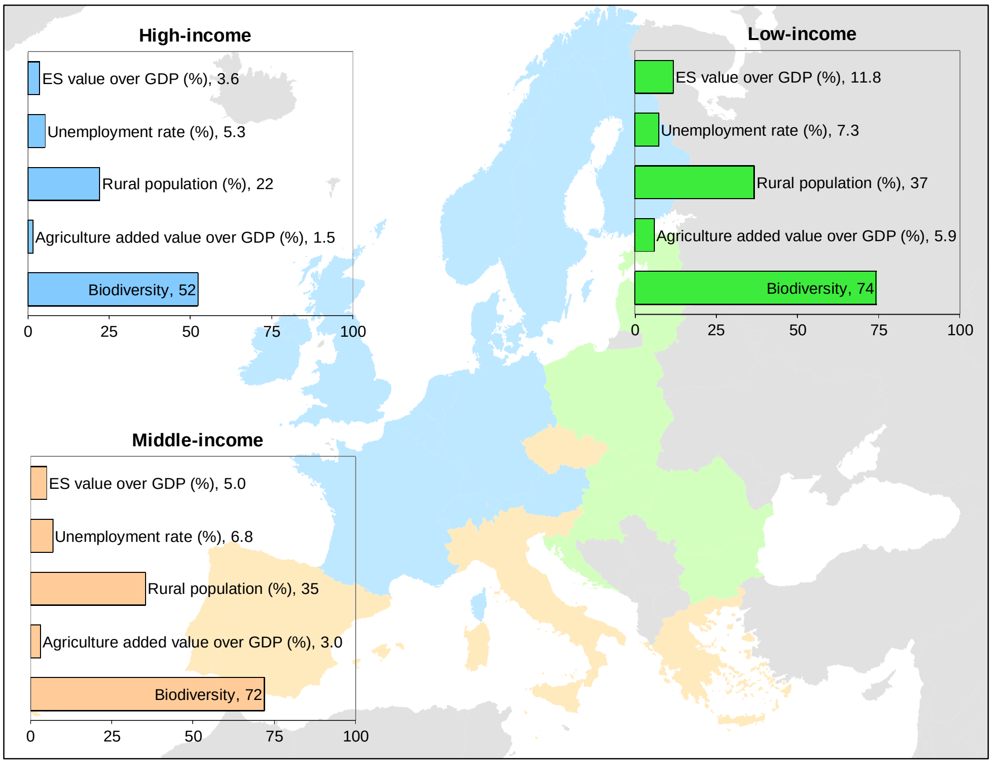
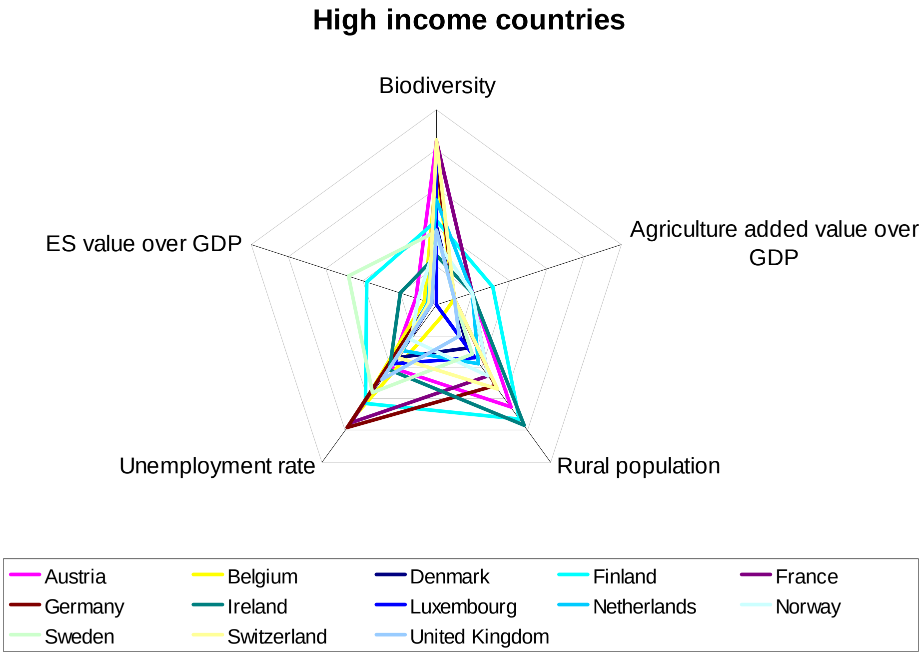
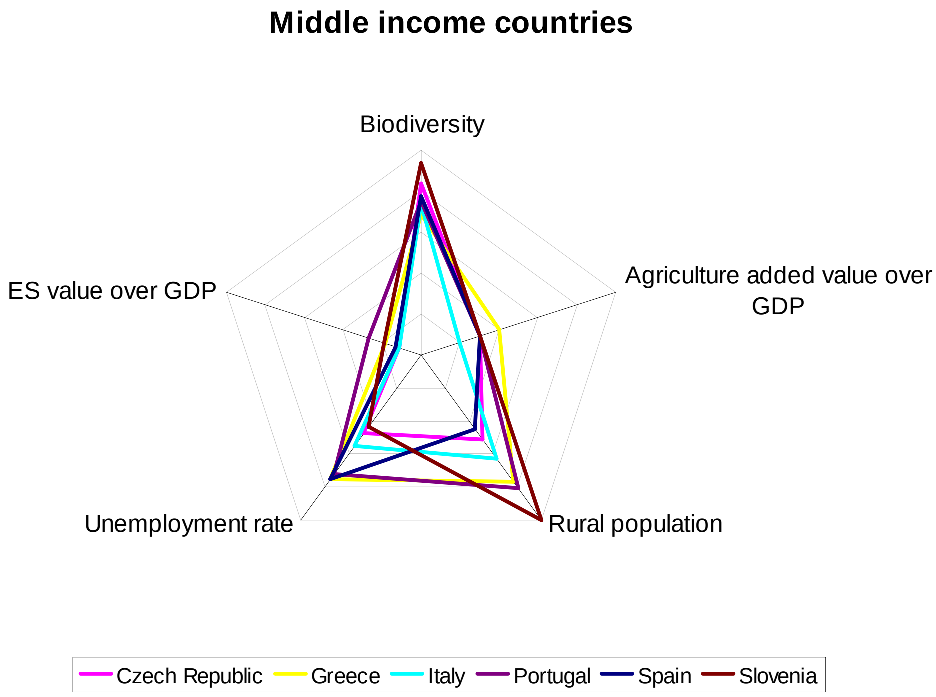


Figure 7. Average value of socio-economic, biodiversity and ecosystem service indicators in European countries according to income categories

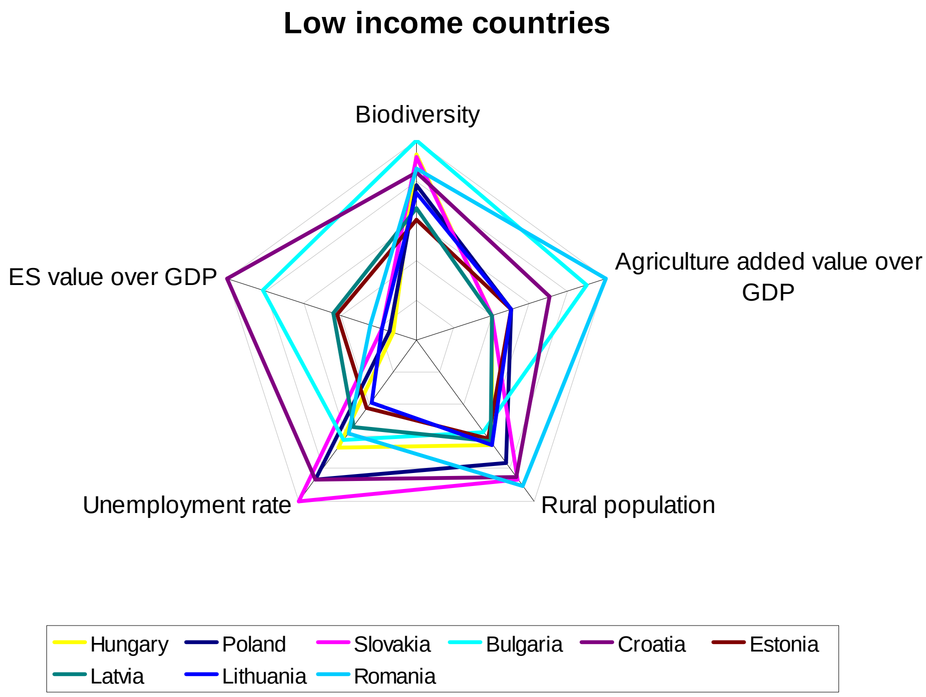
The results in Figure 6 highlight the presence of a correlation between ecosystem services, biodiversity and income-related vulnerability in the selected European countries. Moving from high-income to low-income countries one can note that the values of all socio-economic indicators increase towards higher vulnerability. The unemployment rate increases from 5.3% to 7.3%, the percentage of rural population from 22% to 37% and the dependence of GDP from the agricultural sector increases from 1.5% in high-income countries to 5.9% in low-income countries. High income countries show, however, a lower value of the biodiversity index than low-income countries. The dependence of the latter economies from ecosystem services is, on the other hand, higher. Ecosystem service values account for 11.8% of the GDP of low-income countries while only for 3.6% of high-income economies.


High income countries
Biodiversity
Agriculture added value over GDP
Rural population
Unemployment rate
ES value over GDP
Austria
Belgium
Denmark
Finland
France
Germany
Ireland
Luxembourg
Netherlands
Norway
Sweden
Switzerland
United Kingdom

(a)


Middle income countries
Biodiversity
Agriculture added value over GDP
Rural population
Unemployment rate
ES value over GDP
Czech Republic
Greece
Italy
Portugal
Spain
Slovenia

(b)



(c)

Figure 8. Linkage between ecosystem services value, biodiversity and socio-economic indicators in (a) high-income European countries; (b) middle-income European countries; (c) low-income European countries

The dependencies between the three dimensions in the individual countries emerge more clearly in Figures 8 (a)-(c) where European countries are grouped according to their income level based on the OECD classification and each of the axes in the spider charts represents one of the indicators. To enhance the readability of the results, the values of the indicators were standardized between 0 and 100, so that for each indicator the highest value on the axis is attributed to the country with the highest value of the indicator and the values for the remaining countries are rescaled accordingly.

Figures 8 (a)-(c) identify the possibility contours of human livelihoods, biodiversity and ecosystem services in European countries. Among the three income categories, the narrowest boundaries are found in high-income countries. With the exception of Austria, France and Switzerland, the biodiversity levels are lower than the average values in middle- and low-income countries. Moreover, the contribution of agricultural activities to the countries' economy is generally low, with the exception of Finland, where agriculture added value accounts for 3% of the GDP and 37% of the population lives in rural areas. Ecosystem service values generally provide a small contribution to the economy of high-income countries, with the notable exception of Sweden and Finland where they account for 14% and 11% of the country's GDP. In middle-income countries one can notice an enlargement of the boundaries, with the added value of agriculture, rural population and biodiversity levels increasing compared to high-income countries.

The largest possibility contours are in low-income countries where the highest levels of agricultural added value (10% in Romania), unemployment rate (11.1% in Slovakia) are found, suggesting a higher vulnerability of these economies to socio-economic and environmental shocks. Significantly, the highest values of biodiversity (91.3 in Bulgaria) and ecosystem service value over GDP (30% in Croatia) are also found in low-income economies. This suggests a large potential for biodiversity, mediated through the provision of ecosystem goods and services, to act as a positive stimulus for the countries' economy, create employment, and contribute to the livelihood and welfare of the populations.

4.2 Vulnerable Rural Communities and Their Dependency on Biodiversity

Because they are more highly dependent on the natural environment for the provision of food, shelter, and income, rural poor communities are more vulnerable to environmental and socio-economic changes. Biodiversity loss and degradation in the provision of ecosystem services may further aggravate the risk of social exclusion for such communities. Rural agricultural households are particularly vulnerable, since their income is in general to be more subject to variability than, for instance, low-income workers in urban areas. For this reason we focus in this section on rural agricultural areas to investigate the link between the livelihood of the rural poor, biodiversity and the provision of ecosystem services.

Among all NUTS2 regions in Europe, those with the highest density of agricultural land-use were selected, using GIS and based on the land-use patterns identified in the Corine land cover 2000 map (http://www.eea.europa.eu/publications/COR0-landcover). For the calculation, all the grid cells identified as "agricultural areas" in Corine were considered. These include arable land (i.e., non-irrigated, permanently irrigated and rice fields), permanent crops (i.e., vineyards, olive groves, fruit trees and berry plantations), pastures, and heterogeneous agricultural areas (i.e., annual crops associated with permanent crops, complex cultivation patterns, land principally occupied by agriculture with significant areas of natural vegetation, and agro-forestry areas). Among regions with agricultural land-use density of 70% or higher, the three NUTS2 regions with the lowest GDP per capita in 2007 were selected in order to verify the existence of different patterns in their dependence from biodiversity and ecosystem services. The three rural poor regions identified with this procedure are: Del-Alfold and Eszak-Alfold in Hungary, and Lubelskie in Poland. In addition, and for the sake of a running a comparative analysis, the three rural regions with highest GDP per capita values among the regions with a strong agricultural land-use density are also selected. We refer to Southern and Eastern Ireland, Berkshire, Buckinghamshire and Oxfordshire in the United Kingdom, and Groningen in the Netherlands. Table 3 summarizes the characteristics of the selected NUTS2 regions, including the values of the socio-economic, ecosystem service value and biodiversity indicators.

The total value of ecosystem services in the selected NUTS2 regions was calculated multiplying the average per-hectare value in the country where the regions are located (as calculated in Section 3) by the total area of respectively forests and freshwater wetlands. Coastal recreation was not considered in this analysis since some of the regions are landlocked (Del-Alfold, Eszak-Alfold, Lubelskie, and Berkshire, Buckinghamshire and Oxfordshire) while the remaining ones are not. The total area of forests and wetlands in each NUTS2 region was estimated based on the land-use categories of Corine and with the procedure previously described in Section 3. The value of the terrestrial biodiversity index in table 3 is the average value in each of the considered NUTS2 regions.

Table 3. Indicators of socio-economic condition, biodiversity richness and ecosystem services value in selected rural agricultural NUTS2 regions of Europe

NUTS2 region	GDP per capita, 2005 (US$/person /year)	Employment in primary sector, 2006 (% of total employment)	Unemployment rate, 2007 (% of population aged 15 and over)	Biodiversity index	Forest ecosystem service value (% of GDP)	Wetlands/ freshwater ecosystem service value (% of GDP)
Southern and Eastern (IE)	45,321	4.70	4.5	23.0	0.2	2.7
Berkshire, Buckinghamshire and Oxfordshire (UK)	43,269	1.19	4.0	40.4	0.1	0.0
Groningen (NL)	43,998	3.17	4.9	45.3	0.2	0.8
Lubelskie (PL)	9,773	35.86	9.5	77.1	4.2	0.8
Eszak-Alfold (HU)	10,708	4.42	10.3	87.6	1.5	1.8
Del-Alfold (HU)	11,388	9.38	10.8	82.8	1.7	1.9

The dependencies between the socio-economic, biodiversity and ecosystem value indicators in the selected rural regions are graphically visualized in Figure 8. Each of the axes in the spider chart represents one of the indicators, with the values of the indicators standardized between 0 and 100.

Figure 9 shows that the contours of human livelihood, biodiversity and ecosystem service values differ substantially between the two groups of regions, despite the fact that both groups represent rural agricultural areas. In low-income regions, both the employment in the primary sector as a share of total employment and the overall unemployment rate are higher, suggesting that these areas are particularly vulnerable to socio-economic changes and environmental degradation. The low employment rate in high-income agricultural regions may be explained by the high level of mechanization of agricultural practices in these areas. On the other hand, biodiversity levels are substantially higher in low-income regions and the value of forest ecosystem services is particularly high when compared to the total GDP of these regions. This supports the hypothesis that the economic structure of vulnerable rural regions of Europe – such as the selected low-income, agricultural regions – is more strongly dependent on biodiversity and the provision of ecosystem services than that of richer areas, even if remote and predominantly agricultural.

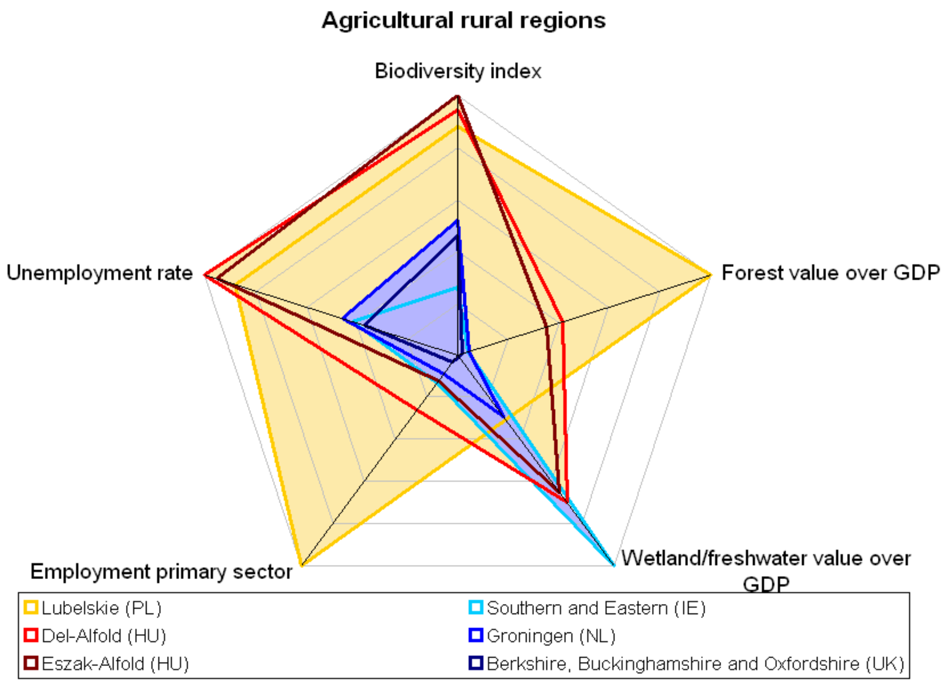


Figure 9. Linkage between ecosystem services value, biodiversity and socio-economic indicators in selected rural agricultural regions of Europe

4.3 Vulnerable Remote Communities and Their Dependency on Biodiversity

Communities living in remote regions are more vulnerable than populations in more accessible regions since access to substitute products and services may not be available or expensive. In mountainous areas, for instance, income alternatives are often scarce and communities are in general strongly dependent on the natural environment for their wellbeing. Here, we focus on two types of remoteness: first we consider mountainous regions of Europe as case-study for geographical remoteness, and second we look at distance from major cities as an indicator of the social dimension of accessibility.

The procedure followed for the selection of the mountainous case-study regions reflects the method used for the discussion of rural agricultural regions. Among all NUTS2 regions in Europe, we selected the regions with average elevation equal or higher than 700 m a.s.l. The average elevation in each region was obtained in a GIS, based on the information contained in the NOAA Digital Elevation Model, with 5 minutes resolution (http://www.ngdc.noaa.gov/mgg/global/seltopo.html). Among such regions, the three with the lowest GDP per capita and the four with the highest GDP per capita were selected for further investigation. The three remote poor regions are Yugozapaden in Bulgaria, Centru in Romania, and Ipeiros in Greece. The regions with highest GDP per capita are the Austrian regions of Salzburg, Vorarlberg, and Tirol and the Provincia Autonoma Bolzano/Bozen in Italy. The latter was included in the analysis as a fourth region in order to provide a differentiation of the considered regions across at least two different countries (i.e., Austria and Italy). Table 4 summarizes the characteristics of the selected NUTS2 regions, including the values of the socio-economic, ecosystem service value and biodiversity indicators. The total value of ecosystem services and biodiversity were calculated following the procedure previously outlined for rural regions. As before, the value of coastal recreation was not included in the analysis since all the selected regions are landlocked with the only exception of Ipeiros.

Table 4. Indicators of socio-economic condition, biodiversity richness and ecosystem services value in selected remote mountainous NUTS2 regions of Europe

NUTS2 region	GDP per capita, 2005 (US$/ person/ year)	Employment in primary sector, 2006 (% of total employment)	Unemploy ment rate, 2007 (% of population aged 15 and over)	Biodiversity index	Forest ecosystem service value (% of GDP)	Wetlands/fresh water ecosystem service value (% of GDP)
Yugozapaden (BG)	11,557	2.77	3.9	94.1	1.7	2.4
Centru (RO)	10,255	16.90	8.5	83.9	7.4	0.5
Ipeiros (GR)	19,185	19.21	10.0	75.2	1.5	15.3
Provincia Autonoma Bolzano/Bozen (IT)	36,805	0.00	2.6	77.5	2.0	2.0
Tirol (AT)	36,631	5.09	2.8	75.1	5.3	0.3
Vorarlberg (AT)	36,631	2.81	3.6	75.0	2.0	1.2
Salzburg (AT)	39,863	5.54	3.0	74.9	4.2	0.6

In addition to the indicators in Table 4, we evaluated the accessibility to large cities and exchange markets of the selected mountainous regions. For this purpose, we used a global map of accessibility that was developed by the Joint Research Center of the European Commission (http://bioval.jrc.ec.europa.eu/products/gam/index.htm) and that contains information on the travel time to the nearest city with population of 50,000 inhabitants or more in a 30 arc seconds resolution. As expected due to their geographical isolation, all the selected mountainous regions are in remote locations that are characterized by a low accessibility. The average travel time in the selected regions is 168 minutes, the least accessible of them being Provincia Autonoma Bolzano/Bozen with an average travel time equal to 215 minutes. The median and mean travel time in the 367 NUTS2 regions of Europe that were considered in this analysis are respectively 107 and 140 minutes.

Figure 10 illustrates the dependencies between the socio-economic, biodiversity and ecosystem value indicators in the selected remote regions. Each of the axes in the spider charts represents one of the indicators, with the values of the indicators standardized between 0 and 100.

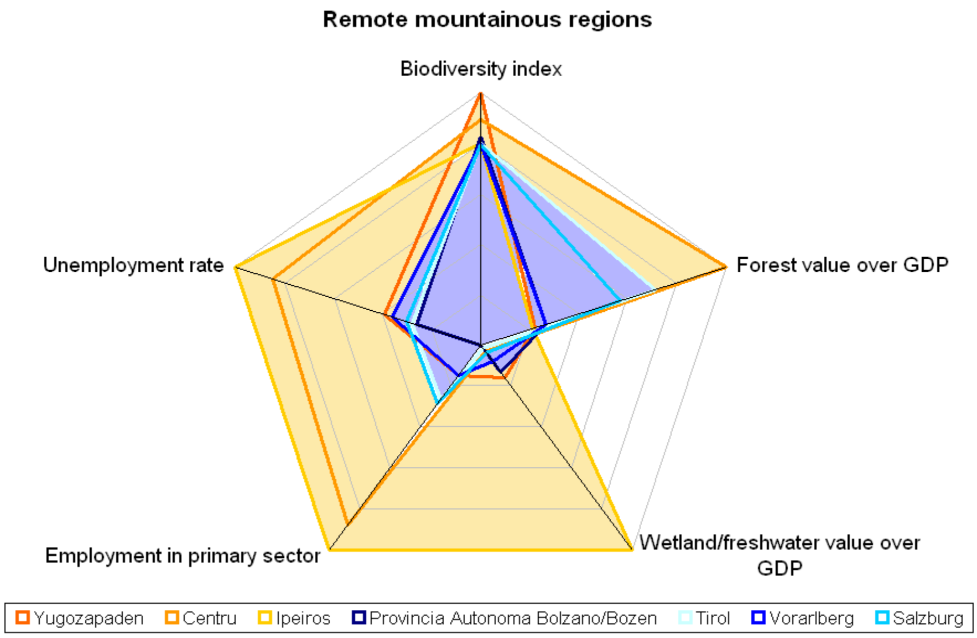


Figure 10. Linkage between ecosystem services value, biodiversity and socio-economic indicators in selected mountainous regions of Europe

The trends in the indicators in Figure 10 are qualitatively similar to what was found for rural regions, although the differences in some of the indicators are less marked. Unemployment rates and employment in the primary sector are higher in the considered poor remote regions and so are the values of the biodiversity indicator, although high biodiversity levels are found also in the high-income regions. Population density is relatively low in all considered regions and, on average, lower in low-income regions (72 inhabitants per square km versus 84 in high-income regions). On the other hand, the value of ecosystem services as percentage of the GDP is, on average, higher in low-income regions and is highest in Ipeiros for wetlands and freshwater ecosystems (15.26%) and in Centru for forest ecosystems (7.42%).

In general, the results for remote mountainous regions support the previous findings for rural areas in the sense that they confirm that poor communities are more reliant on ecosystem services and biodiversity than less vulnerable ones. The comparison with rural regions, however, highlights how remote mountainous regions are more homogeneous in terms of biodiversity levels, population density and ecosystem service values.

5 Conclusions and Policy Recommendations for the EU

In this paper, we have shown that the correlation between biodiversity, ecosystem services and the security of human livelihoods is complex and extremely varied across different economies in Europe. A spatial mapping of selected indicators of biodiversity, ecosystem services and human livelihoods demonstrates that large disparities exist in the degree of dependency on ecosystem services and, subsequently, in the levels of vulnerability to changes in or losses of biodiversity and the respective impacts in the provision of ecosystem services. There is also an imbalance for those most affected by, yet least able to respond to, the loss of ecosystem goods and services as well as the inequality in the global distribution of derived benefits. Notwithstanding the direction of causalities, it is the poorer segments of society that are both assumed to be most vulnerable to, and affected by, biodiversity degradation.

Our results show that the composition of the ecosystem service value for the selected European countries, calculated as percentage of GDP, vary across different countries and, more importantly vary among country-income categories, including high-income, medium-income and low-income categories. Among high-income countries, Finland and Sweden show the highest value of ecosystem services with respect to the national GDP. This is partly due to the large total area of freshwater wetland ecosystems in these countries, which, despite the low per-hectare values. Secondly, the value of forest provisioning services in Sweden and Finland are particularly high, reflecting the fact that forestry is a widely practiced activity in these countries. In middle-income countries, relatively high values of forest ecosystems are found in countries that are landlocked or with a short coastline, such as the Czech Republic and Slovenia, while in the remaining countries high values are provided by wetlands and freshwater ecosystems and coastal recreation. In low-income countries, ecosystem service values tend to be high particularly for forests and, in Bulgaria and Croatia, freshwater wetland ecosystems. The high values of wetland ecosystems in Bulgaria and Croatia reflect the relatively high per-hectare values and the low GDP in those countries.

The paper also explored the relationship between ecosystem services, biodiversity and income-related vulnerability in more detail within Europe. First, we focus our analysis in rural agricultural areas and investigate the link between the livelihood of the rural poor, biodiversity and the provision of ecosystem services. In this context, we proposed to identify the possibility contours, which we define as social vulnerability contours maps that relate human livelihoods, biodiversity richness and the level of ecosystem services. Among the three income categories, the narrowest boundaries are found in high-income countries. With the exception of Austria, France and Switzerland, the biodiversity levels are lower than the average values in middle and low-income countries. Moreover, the contribution of agricultural activities to the countries' economy is generally low, with the exception of Finland, where agriculture added value accounts for 3% of the GDP and 37% of the population lives in rural areas. In addition, ecosystem service values generally provide a small contribution to the economy of high-income countries, with the notable exception of Sweden and Finland where they account for 14% and 11% of the country's GDP. In middle-income countries one can notice an enlargement of the boundaries, with the added value of agriculture, rural population and biodiversity levels increasing compared to high-income countries. On the contrary, the largest possibility contours are found however in low-income countries where the highest levels of agricultural added value (10% in Romania), unemployment rate (11.1% in Slovakia) are found, suggesting a higher vulnerability of these economies to socio-economic and environmental shocks. Significantly, the highest values of biodiversity (91.3 in Bulgaria) and ecosystem service value over GDP (30% in

Croatia) are also found in low-income economies. This suggests a large potential for biodiversity, mediated through the provision of ecosystem goods and services, to act as a positive stimulus for the countries' economy, create employment, and contribute to the livelihood and welfare of the populations.

Second, we focused our attention in a more explicit spatial scale and investigate the all NUTS2 regions in Europe with the highest density of agricultural land-use. For the calculation, all the grid cells identified as "agricultural areas" in Corine were considered, including arable land (i.e., non-irrigated, permanently irrigated and rice fields), permanent crops (i.e., vineyards, olive groves, fruit trees and berry plantations), pastures, and heterogeneous agricultural areas (i.e., annual crops associated with permanent crops, complex cultivation patterns, land principally occupied by agriculture with significant areas of natural vegetation, and agro-forestry areas). Among regions with agricultural land-use density of 70% or higher, the three NUTS2 regions with the lowest and highest GDP per capita in 2007 were selected. The three rural poor regions identified are Del-Alfold and Eszak-Alfold in Hungary, and Lubelskie in Poland. In addition, and for the sake of a running a comparative analysis, the three rural regions with highest GDP per capita values among the regions with a strong agricultural land-use density are also selected. We refer to Southern and Eastern Ireland, Berkshire, Buckinghamshire and Oxfordshire in the United Kingdom, and Groningen in the Netherlands. The dependencies between the socio-economic, biodiversity and ecosystem value indicators in the selected rural regions differ substantially between the two groups of regions, despite the fact that both groups represent rural agricultural areas. In low-income regions, both the employment in the primary sector as a share of total employment and the overall unemployment rate are higher, suggesting that these areas are particularly vulnerable to socio-economic changes and environmental degradation. The low employment rate in high-income agricultural regions may be explained by the high level of mechanization of agricultural practices in these areas. On the other hand, biodiversity levels are substantially higher in low-income regions and the value of forest ecosystem services is particularly high when compared to the total GDP of these regions. This supports the hypothesis that the economic structure of vulnerable rural regions of Europe – such as the selected low-income, agricultural regions – is more strongly dependent on biodiversity and the provision of ecosystem services than that of richer areas, even if remote and predominantly agricultural.

Finally, we also investigate the role of biodiversity in the definition of social vulnerability contours maps by focusing our analysis in rural communities living in remote regions. Here, we focus on two types of remoteness: first we consider mountainous regions of Europe, as case-study for geographical remoteness, and second we look at distance from major cities as an indicator of the social dimension of accessibility. The results for remote mountainous regions support the previous findings, and respective social vulnerability contours maps, for rural areas in the sense that they confirm that poor communities are more reliant on ecosystem services and biodiversity than less vulnerable ones. The comparison with rural regions, however, highlights how remote mountainous regions are more homogeneous in terms of biodiversity levels, population density and ecosystem service values. However, unemployment rates and employment in the primary sector are higher in the considered poor remote regions and so are the values of the biodiversity indicator, although high biodiversity levels are found also in the high-income regions. Finally, population density is also lower in all considered regions and lower, on average, among the low-income regions. Communities living in regions with higher distances from major cities were also found to be more vulnerable than populations in more accessible regions. This is largely due to their lack of access to or the prices and affordability of substitute products and services. Isolation additionally limits coping strategies to deal with a deterioration of environmental services. Further, the location of rural households affects their potential to access markets or other sources of income from off-farm employment opportunities in neighboring urban areas.

Our finding confirms the earlier assumption that a biodiversity rich area is generally associated with a higher dependence on biodiversity and the provision of ecosystem services, which suggests that the local communities are more vulnerable to changing environment and losing biodiversity. Based on our definition of vulnerability and the socio-economic indicators used, people in low-income EU countries are more vulnerable than those in medium- and high-income countries. The following statistics are for the values of all of the socio-economic indicators in firstly high and then secondly low income countries: unemployment increased from 5.3 to 7.3%, rural percentage of the population from 22 to

37% and dependence of GDP from the agricultural sector from 1.5 to 5.9%. Ecosystem services account for 11.8% of the GDP in low-income countries in comparison with 3.6% for high-income countries. Specifically, the highest levels of agricultural added value (10% in Romania), unemployment rate (11.1% in Slovakia), biodiversity value (91.3 in Bulgaria) and ecosystem service value over GDP (30% in Croatia) were found in low-income countries, illustrating that the high levels of biodiversity could offer opportunities, if well managed, to improve the situation. Communities living in remote regions were also found to be more vulnerable than populations in more accessible regions. This is largely due to their lack of access to or the prices and affordability of substitute products and services. Isolation additionally limits coping strategies to deal with a deterioration of environmental services. Further, the location of rural households affects their potential to access markets or other sources of income from off-farm employment opportunities in neighboring urban areas.

Therefore, the complex linkages and trade-offs between biodiversity, ecosystem services, employment and the impacts on vulnerable groups do not allow for one single simple policy approach (no silver bullet!) to improve conditions both for nature and people. Moreover, the social aspects of biodiversity are not addressed by a specific policy, but rather constitute cross-cutting issues that affect a wide range of policies on different scales. Many other studies have shown that the protection of biodiversity and ecosystems cannot be restricted to nature protection policies only, but instead have to be mainstreamed across different policies and sectors. By expanding the scope to include the even more complex interactions between biodiversity and the enhancement of jobs and of livelihoods in vulnerable areas, the range of relevant policies becomes even larger.

Recent debate in the European Commission placed increased emphasis on the importance of green infrastructure for multi benefits to the economy[3]. Green infrastructure can be defined as the distribution of natural capital that benefits society through the provision of ecosystem services (TEEB, 2010), which may take the form of climate regulation, water purification, and space for recreation. Green infrastructure is likely to become a key component of the delivery of the new biodiversity target for 2020, and could play a decisive

[3]'EC workshop: towards a green infrastructure for Europe', March 2009. Workshop proceedings are available at: http://www.green-infrastructure-europe.org/

role in integrating biodiversity into other policies such as agriculture, forestry, water, transport and regional and cohesion policy[4], as it demonstrates the contribution that biodiversity can make to these policy areas. The debate has important implications for biodiversity as the provision of the services relies on the ecosystems being in good condition requiring intervention to ensure they are of an appropriate size, condition and not impacted by fragmentation.

In addition, EU regional policy aims to reduce the gaps in well-being between regions and ensure coherent and fair economic development within the EU. The policy is financed through structural funds and the cohesion fund and constitutes 35% of the EU budget for the spending period 2007-2013 (€348 billion)[5]. The funds finance a variety of measures, including transportation infrastructure, urban regeneration and rural development. While activities can cause significant deterioration of biodiversity through the fragmentation of landscapes and habitats (Kettunen et al, 2007), the funds provide important funding opportunities for biodiversity conservation such as the development of infrastructure linked to biodiversity and investments in Natura 2000. Projects must, however, demonstrate a contribution to the broader sustainable socio-economic development of the region in which they are based. Indeed, the prevention of environmental risks is one of the priorities of structural funds, offering the possibility for funding actions to maintain or restore the capacity of ecosystems to mitigate flooding, wild fires and drought risks (Kettunen et al, 2009). In other cases, opportunities exist for the investment in facilities to promote nature-based tourism, with potential positive impacts on economic development of disadvantaged areas and on biodiversity (see EEA, 2009).

Despite these opportunities, uptake of measures supporting biodiversity under structural and cohesion funds have been limited. This can be partly attributed to the bureaucracy and administration burden of accessing the funds (Torkler et al, 2008) and the lack of absorption capacity in recipient regions to utilise the funds (EEA, 2009). An additional issue is that the decision on how the funds are to be spent is made entirely at Member State level, which means that despite the opportunities that exist to fund biodiversity and social

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[4] http://ec.europa.eu/environment/nature/info/pubs/docs/greeninfrastructure.pdf
[5] http://europa.eu/scadplus/glossary/structural_cohesion_fund_en.htm

cohesion projects, there is no means at the EU level to ensure this happens. Moving forward, DG REGIO is likely to align the Cohesion fund more with the priorities of Europe 2020, which could have a negative impact for biodiversity which does not feature in the strategy (McConville and Gantioler, 2010).

The next financing period (2013-2019) still provides an opportunity to ensure that regional policy has a positive impact on biodiversity and social cohesion but it will require changes to the current financing process. This may include, as implemented in Austria, that structural funds should have no net negative impact on the environment (EEA, 2009). In addition, there could be clear ear-marking a proportion of the funds for the financing of biodiversity within the funds and there may be opportunities for increasing the Commission's oversight of the national implementation of the funds to ensure better allocation of financial support towards biodiversity. Ultimately, there will have to be a stronger case made for the ecosystem service benefits provided by nature, the protection of which may come from the mainstreaming of green infrastructure approaches to land management.

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