ESPON

EU-LUPA
European Land Use Patterns

Applied Research 2013/1/8

Annexes to the Interim Report | Version 3rd/June/2011

EUROPEAN UNION
Part-financed by the European Regional Development Fund
INVESTING IN YOUR FUTURE

List of authors

TECNALIA (Spain)
Gemma García
Efrén Feliú

UAB (Spain)
Jaume Fons Esteve

ALTERRA (The Netherlands)
Marta Perez Soba
Matthijs Danes
Gerard Hazeu
Michiel van Eupen
Sander Mucher

NORDREGIO (Sweden)
Rasmus Ole Rasmussen
Ryan Weber

IGSO (Poland)
Jersy Banski
María Bednarek

This report presents the interim results of an Applied Research Project conducted within the framework of the ESPON 2013 Programme, partly financed by the European Regional Development Fund.

The partnership behind the ESPON Programme consists of the EU Commission and the Member States of the EU27, plus Iceland, Liechtenstein, Norway and Switzerland. Each partner is represented in the ESPON Monitoring Committee.

This report does not necessarily reflect the opinion of the members of the Monitoring Committee.

Information on the ESPON Programme and projects can be found on www.espon.eu

The web site provides the possibility to download and examine the most recent documents produced by finalised and ongoing ESPON projects.

This basic report exists only in an electronic version.

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Annex I Collected data

Agriculture: Farm structure

Data set	Temporal	Missign ESPON ctries	Resolution/scale	Description	Source	Comments
Areas harvested	1990, 1991, 1992, 1993, 1994, 1995, 1996, 1997, 1998, 1999, 2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008	Iceland, Liechtenstein, Norway, Switzerland	NUTS2	Split by crop type (cereals, potatoes, sugar beet, oilseeds, fruit trees, olives, maize)	Eurostat	Incomplete coverage for some countries.
Harvested production	1990, 1991, 1992, 1993, 1994, 1995, 1996, 1997, 1998, 1999, 2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008	Iceland, Liechtenstein, Norway, Switzerland	NUTS2	Split by crop type (cereals, potatoes, sugar beet, oilseeds, fruit trees, olives, maize)	Eurostat	Incomplete coverage for some countries.
Net Value Added at Basic Prices	1990, 1991, 1992, 1993, 1994, 1995, 1996, 1997, 1998, 1999, 2003, 2004, 2005, 2006, 2007, 2008, 2009	Belgium, Iceland, Liechtenstein, Norway, Poland	NUTS2	output at basic prices minus intermediate consumption at purchaser prices. The basic price is the amount receivable by the producer from the purchaser for a unit of a product minus any tax on the product plus any subsidy on the product.	Eurostat	Incomplete geographic coverage and time series.
Size of agricultural holdings	2000, 2003, 2005, 2007		NUTS3	Number of agricultural holdings according to area: 5-10 10-20 20-30 30-50 >50	Eurostat	Incomplete coverage for some countries.
Total standard gross margin	2000, 2003, 2005, 2007	Iceland, Liechtenstein, Switzerland	NUTS3	SGMs are calculated per unit area of crops and per head of livestock, using standardised SGM coefficients for each type of crop and livestock. SGMs are representative of the level of profit that could be expected on the average farm under "normal" conditions.	Eurostat	
Yields	1990, 1991, 1992, 1993, 1994, 1995, 1996, 1997, 1998, 1999, 2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008	Iceland, Liechtenstein, Norway, Switzerland	NUTS2	Split by crop type (cereals, potatoes, sugar beet, oilseeds, fruit trees, olives, maize)	Eurostat	Incomplete coverage for some countries.

Agriculture: Livestock

Data set	Temporal	Missign ESPON ctries	Resolution/scale	Description	Source	Comments
Animal populations	1990, 1991, 1992, 1993, 1994, 1995, 1996, 1997, 1998, 1999, 2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008	Iceland, Liechtenstein, Norway, Switzerland	NUTS2	Disaggregated by type of livestock (pigs, bovine, sheeps)	Eurostat	Incomplete coverage for some countries.

Agriculture: Rural development

Data set	Temporal	Missign ESPON ctries	Resolution/scale	Description	Source	Comments
Agricultural area in less favoured area	2000, 2003, 2005, 2007	Iceland, Liechtenstein, Switzerland	NUTS3		Eurostat	
Total labour force in agriculture	2000, 2003, 2005, 2007	Iceland, Liechtenstein, Switzerland	NUTS3		Eurostat	Incomplete coverage for some countries.

Demography: Population structure

Data set	Temporal	Missign ESPON ctries	Resolution/scale	Description	Source	Comments
Population by sex and age	1990, 1991, 1992, 1993, 1994, 1995, 1996, 1997, 1998, 1999, 2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008		NUTS2		Eurostat	
Total population		Iceland, Liechtenstein	NUTS3		ESPON 2013 Basic indicators	
Total population	2000, 2001, 2002, 2003, 2004, 2005, 2006	Iceland, Liechtenstein	NUTS3		ESPON 2013 Basic indicators	

Demography: Natural changes

Data set	Temporal	Missign ESPON ctries	Resolution/scale	Description	Source	Comments
Fertiliy rates	1990, 1991, 1992, 1993, 1994, 1995, 1996, 1997, 1998, 1999, 2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008		NUTS2			
Life expectancy	1990, 1991, 1992, 1993, 1994, 1995, 1996, 1997, 1998, 1999, 2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008		NUTS2		Eurostat	

Transport: Accessibility

Data set	Temporal	Missign ESPON ctries	Resolution/scale	Description	Source	Comments
Accessibility to passenger flights	2008	Iceland, Liechtenstein, Norway, Switzerland	NUTS3		DG Regio	
Multimodal potential accessibility	2001, 2006		NUTS3		ESPON Territorialñ Observatory N2	
Potential accessibility by air	2001, 2006		NUTS3		ESPON Territorialñ Observatory N2	
Potential accessibility road	2001, 2006		NUTS3		ESPON Territorialñ Observatory N2	

Transport: Flows

Data set	Temporal	Missign ESPON ctries	Resolution/scale	Description	Source	Comments
Passenger trains on the TEN-T railway network	2005	Iceland, Liechtenstein, Norway, Switzerland	1 km * 1 km grid		DG Regio	
Stock of vehicles by category at regional level	1990, 1991, 1992, 1993, 1994, 1995, 1996, 1997, 1998, 1999, 2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008	Bulgaria, Cyprus, Czech Rep, Estonia, Hungary, Iceland, Latvia, Liechtenstein, Lithuania, Malta, Norway, Poland, Romania, Slovakia, Slovenia, Switzerland	NUTS2		Eurostat	Some countries does not hav ea complete time series.

Transport: Infrastructure

Data set	Temporal	Missign ESPON ctries	Resolution/scale	Description	Source	Comments
Major transport infrastructures	2009	Iceland, Liechtenstein, Norway, Switzerland			GISCO	

Energy & Environment: Resources

Data set	Temporal	Missign ESPON ctries	Resolution/scale	Description	Source	Comments
Solar energy resources	1981-1990	Iceland, Liechtenstein, Norway, Switzerland	NUTS3		DG Regio	
Wind power installed in Europe (onshore and offshore)	2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009	Iceland, Liechtenstein, Norway, Switzerland	NUTS0		European Wind Energy Association	Offshore plants are individually loacted by name in each country.

Energy & Environment: Vulnerability impacts

Data set	Temporal	Missign ESPON ctries	Resolution/scale	Description	Source	Comments
Vulnerability of NUTS 2 regions to climate change	2009	Iceland, Liechtenstein, Norway, Switzerland	NUTS2	Population affected by river floods; population living below 5 m; population aged 75+ and change in tropical nights; GVA in agriculture and fisheries; GVA in tourism and summer tourism climate index; changes in precipitation and temperature; mountain areas. Sources: JRC, Eurostat, EFGS, Oxford Economics, Nordregio, ICIS Maastricht University, REGIO-GIS	DG Regio	

Land Use: Land use and land cover types

Data set	Temporal	Missign ESPON ctries	Resolution/scale	Description	Source	Comments
CORINE Land Cover	1990, 2000, 2006	Switzerland	1*1 km grid	Land cover and land cover changes	EEA	Countries without full time coverage.
High resolution soil sealing	2007		100*100 m grid	continuous degree of soil sealing ranging from 0 - 100% in aggregated spatial resolution	EEA	

Land Use: Urban land use attributes and changes

Data set	Temporal	Missign ESPON ctries	Resolution/scale	Description	Source	Comments
GMES Urban Atlas	2007	Norway, Switzerland	1:10000	pan-European comparable land use and land cover data for Large Urban Zones with more than 100.000 inhabitants as defined by the Urban Audit.	EEA	

Land Use: Rural land use attributes and changes

Data set	Temporal	Missign ESPON ctries	Resolution/scale	Description	Source	Comments
High Nature Value Farmland	2006	Iceland, Switzerland	100*100 m grid	Percentage coverage of high nature value farmland. Calculation is based on * CLC 2006 data, * national expert rules (based on DEMs, special areas etc.), * european biodiversity data (Natura 2000 areas, IBAs, PBAs) and * national biodiversity data for selected countries). using the methodology developed by JRC/EEA for the first HNV-map based on CLC 2000 data.	EEA	
Natura 2000	2010	Austria, Iceland, Liechtenstein, Norway, Switzerland, United Kingdom	1:100000	Natura 2000 is an ecological network composed of sites designated under the Birds Directive (Special Protection Areas, SPAs) and the Habitats Directive (Sites of Community Importance, SCIs, and Special Areas of Conservation, SACs).		Natura 2000 sites from Austria have been left out of the present database as Austria has disagreed so far with the way of sharing the data.

Social affairs: Education

Data set	Temporal	Missign ESPON ctries	Resolution/scale	Description	Source	Comments
Early school leavers aged 18-24	2007-2009	Iceland, Liechtenstein, Norway, Switzerland	NUTS2		DG Regio	
Population aged 25-64 with low education	2008	Iceland, Liechtenstein, Norway, Switzerland	NUTS2		DG Regio	
Population aged 25-64 with tertiary education	2008	Iceland, Liechtenstein, Norway, Switzerland	NUTS2		DG Regio	

Economy: Aggregatd accounts

Data set	Temporal	Missign ESPON ctries	Resolution/scale	Description	Source	Comments
GDP at current market prices	1995, 1996, 1997, 1998, 1999, 2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009	Liechtenstein	NUTS3		Eurostat	
Net effect of taxes and public transfers	2007	Cyprus, Estonia, Greece, Iceland, Latvia, Liechtenstein, Lithuania, Luxembourg, Malta, Norway, Switzerland	NUTS2	Ratio of disposable income to primary income	DG Regio	
Tourists' overnight stays	1990, 1991, 1992, 1993, 1994, 1995, 1996, 1997, 1998, 1999, 2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008	Estonia	NUTS2		Eurostat	

Economy: Employment

Data set	Temporal	Missign ESPON ctries	Resolution/scale	Description	Source	Comments
Change in employment rate, 20-64, 2000-2008	2000-2008	Iceland, Liechtenstein, Norway, Switzerland	NUTS2		DG Regio	
Employment rate, 20-64, in 2008 and distance to the Europe 2020 target	2008	Iceland, Liechtenstein, Norway, Switzerland	NUTS2		DG Regio	
Employment rates by sex and age	1999, 2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008	Iceland, Liechtenstein, Switzerland	NUTS2		Eurostat	
Unemployement rates by sex and age	1999, 2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008	Iceland, Liechtenstein, Switzerland	NUTS2		Eurostat	

Economy: Production and cost per sector

Data set	Temporal	Missign ESPON ctries	Resolution/scale	Description	Source	Comments

Economy: Production and cost per sector

Data set	Temporal	Missign ESPON ctries	Resolution/scale	Description	Source	Comments
Labour productivity in industry and services	2007	Iceland, Liechtenstein, Norway, Switzerland	NUTS2		DG Regio	
Productivity growth through employment shifts between sectors, 2000-2007	2000-2007	Iceland, Liechtenstein, Norway, Switzerland	NUTS2		DG Regio	
Productivity growth within sectors, 2000-2007	2000-2007	Iceland, Liechtenstein, Norway, Switzerland	NUTS2		DG Regio	

Economy: Research and Innovation

Data set	Temporal	Missign ESPON ctries	Resolution/scale	Description	Source	Comments
6th Framework Programme, average funding per head	2002-2006	Iceland, Liechtenstein, Norway, Switzerland	NUTS2	Index, EU-27 = 100	DG Regio	
7th Framework Programme, average funding per head	2007-2010	Iceland, Liechtenstein, Norway, Switzerland	NUTS2	Index, EU-27 = 100	DG Regio	
Employment in high-technology sectors	2008	Iceland, Liechtenstein, Norway, Switzerland	NUTS2		DG Regio	
Human Resources in Science and Technology	2008	Iceland, Liechtenstein, Norway, Switzerland	NUTS2		DG Regio	
Patent applications to the European Patent Office (EPO)	2007	Iceland, Liechtenstein, Norway, Switzerland	NUTS2		DG Regio	
Total expenditure on R&D	2007	Iceland, Liechtenstein, Norway, Switzerland	NUTS2		DG Regio	

Annex II Policy review: objectives and targets

TOPIC	NAME	OBJECTIVES	POTENTIAL INDICATORS	THRESHOLDS	REFERENCE SOURCE	REGIONAL REFERENCE	TIME REFERENCE	SIGNIFICANCE FOR EU-LUPA
Regional Policy	Cohesion Policy 2007-2013	Cohesion Policy has one single objective: to **promote the** harmonious development of the Union and its regions. The policy supports this development with a clear investment strategy that **increases competitiveness, expands employment and improves well-being, and protects and enhances the environment.** This approach provides a close link to the Europe 2020 objectives of smart, inclusive and sustainable growth. While the overall objective is the same in all Member States and regions, Cohesion Policy provides more support for the less developed EU regions in line with the Union's strong commitment to solidarity and its Treaty aim of reducing regional disparities in levels of development. Cohesion Policy will continue to **foster territorial cooperation i**n its three dimensions (cross-border, transnational, and inter-regional). Urban problems either related to environmental degradation of social exclusion deserve a particular response and a direct involvement o fthe level of governments directly concerned.	EU 2020 Indicators Main challenges with territorial dimension: accelerating globalization and market integration, ageing and migration, climate change and changing energy paradigm	EU 2020 Targets	http://ec.europa.eu/regional_policy 5th Cohesion Report	NUTS 2	up to date 2010	Structural Funds Eligible areas in the EU under the Convergence Objective and the European Competitiveness and Employment Objective Identification of linckages between certain land use patterns and regions under the convergence objective
					ESPON 2.2.1 addressed the spatial impacts of Structural Funds with a particular focus on polycentricity and territorial cohesion in Europe. TERCO & INTERCO ESPON Projects	NUTS 2		Territorial impacts of structural funds. Cohesion Policy as driver of Land Use Changes
	The European Fund for Regional Development (EFRD)	**Convergence objective** is to promote growth-enhancing conditions and factors leading to real convergence for the least-developed Member States and regions.	Regionalization of EU27 according to Convergence objective	In EU-27, this objective concerns – within 18 Member States – 84 regions with a total population of 154 million, and per capita GDP at less than 75 % of the Community average, and – on a "phasing-out" basis – another 16 regions with a total of 16.4 million inhabitants and a GDP only slightly above the threshold, due to the statistical effect of the larger EU. The amount available under the Convergence objective is EUR 282.8 billion, representing 81.5 % of the total. It is split as follows: EUR 199.3 billion for the Convergence regions, while EUR 14 billion are reserved for the "phasing-out" regions, and EUR 69.5 billion for the Cohesion Fund, the latter applying to 15 Member States.	http://ec.europa.eu/regional_policy/funds/feder/index_en.htm	NUTS 2	2000-2006	Investments as potential driver of land use changes
		Regional Competitiveness and Employment objective aims at strengthening competitiveness and attractiveness, as well as employment, through a two-fold approach. First, development programmes will help regions to anticipate and promote economic change through innovation and the promotion of the knowledge society, entrepreneurship, the protection of the environment, and the improvement of their accessibility. Second, more and better jobs will be supported by adapting the workforce and by investing in human resources.	Regionalization of EU27 according to Convergence objective	In EU-27, a total of 168 regions will be eligible, representing 314 million inhabitants. Within these, 13 regions which are home to a total of 19 million inhabitants represent so-called "phasing-in" areas and are subject to special financial allocations due to their former status as "Objective 1" regions. The amount of EUR 55 billion – of which EUR 11.4 billion is for the "phasing-in" regions – represents just below 16% of the total allocation. Regions in 19 Member States are concerned with this objective.	http://ec.europa.eu/regional_policy/funds/feder/index_en.htm	NUTS 2	2000-2006	Investments as potential driver of land use changes
		European Territorial Co-operation objective will strengthen cross-border co-operation through joint local and regional initiatives, trans-national co-operation aiming at integrated territorial development, and interregional co-operation and exchange of experience.	Percentage of population living in in cross-border areas	The population living in cross-border areas amounts to 181.7 million (37.5 % of the total EU population), whereas all EU regions and citizens are covered by one of the existing 13 transnational co-operation areas. EUR 8.7 billion (2.5 % of the total) available for this objective is split as follows: EUR 6.44 billion for cross-border, EUR 1.83 billion for transnational and EUR 445 million for inter-regional co-operation.	http://ec.europa.eu/regional_policy/funds/feder/index_en.htm	NUTS 2	2000-2006	Investments as potential driver of land use changes
	Regional policies : the European Social Fund (ESF)	**Convergence objective** is to promote growth-enhancing conditions and factors leading to real convergence for the least-developed Member States and regions.	Regionalization of EU27 according to Convergence objective	In EU-27, this objective concerns – within 18 Member States – 84 regions with a total population of 154 million, and per capita GDP at less than 75 % of the Community average, and – on a "phasing-out" basis – another 16 regions with a total of 16.4 million inhabitants and a GDP only slightly above the threshold, due to the statistical effect of the larger EU. The amount available under the Convergence objective is EUR 282.8 billion, representing 81.5 % of the total. It is split as follows: EUR 199.3 billion for the Convergence regions, while EUR 14 billion are reserved for the "phasing-out" regions, and EUR 69.5 billion for the Cohesion Fund, the latter applying to 15 Member States.	http://ec.europa.eu/regional_policy/funds/feder/index_en.htm	NUTS 2	2000-2006	Investments as potential driver of land use changes
		Regional Competitiveness and Employment objective aims at strengthening competitiveness and attractiveness, as well as employment, through a two-fold approach. First, development programmes will help regions to anticipate and promote economic change through innovation and the promotion of the knowledge society, entrepreneurship, the protection of the environment, and the improvement of their accessibility. Second, more and better jobs will be supported by adapting the workforce and by investing in human resources.	Regionalization of EU27 according to Convergence objective	In EU-27, a total of 168 regions will be eligible, representing 314 million inhabitants. Within these, 13 regions which are home to a total of 19 million inhabitants represent so-called "phasing-in" areas and are subject to special financial allocations due to their former status as "Objective 1" regions. The amount of EUR 55 billion – of which EUR 11.4 billion is for the "phasing-in" regions – represents just below 16% of the total allocation. Regions in 19 Member States are concerned with this objective.	http://ec.europa.eu/regional_policy/funds/feder/index_en.htm	NUTS 2	2000-2006	Investments as potential driver of land use changes
	Regional policies :Cohesion Fund	**Convergence objective** is to promote growth-enhancing conditions and factors leading to real convergence for the least-developed Member States and regions.	Regionalization of EU27 according to Convergence objective	In EU-27, this objective concerns – within 18 Member States – 84 regions with a total population of 154 million, and per capita GDP at less than 75 % of the Community average, and – on a "phasing-out" basis – another 16 regions with a total of 16.4 million inhabitants and a GDP only slightly above the threshold, due to the statistical effect of the larger EU. The amount available under the Convergence objective is EUR 282.8 billion, representing 81.5 % of the total. It is split as follows: EUR 199.3 billion for the Convergence regions, while EUR 14 billion are reserved for the "phasing-out" regions, and EUR 69.5 billion for the Cohesion Fund, the latter applying to 15 Member States.	http://ec.europa.eu/regional_policy/funds/cf/index_en.htm	NUTS 2	2000-2006	Investments as potential driver of land use changes

Rural development	**Rural Development policy 2007-2013**	Council Regulation (EC) No. 1698/2005. Under this Regulation, rural development policy for 2007 to 2013 is focused on three themes (known as "thematic axes"). These are: * improving the competitiveness of the agricultural and forestry sector; * improving the environment and the countryside; * improving the quality of life in rural areas and encouraging diversification of the rural economy. The Strategic Guidelines for Rural Development 2007-2013 consider that rural development policies must complement other policies, such as cohesion and employment policies, while also playing an important role in the sustainable development of rural areas and in the achievement of a more balanced territorial model within the European Union.	**To be identified**	**to be defined**	http://ec.europa.eu/agriculture/rurdev/index_en.htm	NUTS 2 (?)	2007-2013 On 2010 midterm review of the EU Rural Development Policy	Territorial Impact of agricultural policies on the environment and land uses. CAP and Rural Development Policy as driving forces behind land use changes and dynamics
	Common Agricultural Policy (CAP)	The initial objectives were set out in Article 39 of the Treaty of Rome: 1. to increase productivity, by promoting technical progress and ensuring the optimum use of the factors of production, in particular labour; 2. to ensure a fair standard of living for the agricultural Community; 3. to stabilise markets; 4. to secure availability of supplies; 5. to provide consumers with food at reasonable prices. The CAP recognised the need to take account of the social structure of agriculture and of the structural and natural disparities between the various agricultural regions and to effect the appropriate adjustments by degrees. The CAP needs reforming (2008-2013): so as to better address the challenges of: food security; climate change and sustainable management of natural resources; and keeping the rural economy alive. • to help the farming sector become more competitive and to deal with the economic crisis and increasingly unstable farm-gate prices. • to make the policy fairer, greener, more efficient and more effective and more understandable. From the financial perspective, the CAP along side the Cohesion Funds, is the most important policy measure of the EU.	Measures to maintain grasslands, restore wetlands and peat lands, low or zero tillage, to reduce erosion and allow for the development of forests. Agriculture and forestry are also providing the resources for bio-energy and industrial feedstocks are addressed in teh CAP legislative proposals for 2013, of which the positive impacts have not yet been taken into account in the analysis.	**to be defined**	http://www.europolitics.info/sectoral-policies/agriculture-a-fisheries.html?view=contenu	See ESPON 2.1.3: Territorial impact of CAP and Rural Development Policy	2008-2013	
Energy policy	**Energy policy for a competitive Europe:** The Treaty of Lisbon places energy at the heart of European activity. It effectively gives it a new legal basis which it lacked in the previous treaties (Article 194 of the Treaty on the Functioning of the European Union (TFEU)). The aims of the policy are supported by market-based tools (mainly taxes, subsidies and the CO2 emissions trading scheme), by developing energy technologies (especially technologies for energy efficiency and renewable or low-carbon energy) and by Community financial instruments. Furthermore, in December 2008 the EU adopted a series of measures with the objective of reducing	Renewal energy	Renewable potential: Map 16 Wind potential on NUTS 0 (source EWEA, Meteotest, WASP www.wasp.dk) Map 22 Biomass potential at NUTS 3 in 2002 (GJ)	EU 2020 Targets	http://ec.europa.eu/energy/index_en.htm	See ESPON 2.1.4. Territorial trends of energy services and networks and territorial impact of EU energy policy	2002	Evaluation of Land Use Efficiency by means of the correlation between land use change patterns and trends with regional performance
		Energy efficiency	Map 34 Number of Regional Energy Agencies by NUTS 2. Source: European Commission, ManagEnergy Initiative Table 7 Summary of main energy features for new Member States	**to be defined**				
		Security of supply	**To be identified**	**to be defined**			2002	
		Technology and innovation	**To be identified**	**to be defined**			2002	
		Trans-European Networks (TEN)	Energy infraestructures: - Making Europe's electricity grid fit for 2020 - Diversified gas supplies to a fully interconnected and flexible EU gas network - Ensuring the security of oil supply - Roll-out of smart grid technologies	On 17 November 2010, the European Commission has adopted the Communication "Energy infrastructure priorities for 2020 and beyond - A Blueprint for an integrated European energy network"	http://ec.europa.eu/energy/infrastructure/strategy/2020_en.htm	See TIPTAP - Territorial Impact Package for Transport and Agricultural Policies (July 2008- October 2009) under Priority 1 of the ESPON 2013 Programme	2010	Infraestructures as driving forcers behind land use changes and dynamics
Transport policy	**Transport Policy**	Transport is one of the European Union's (EU) foremost common policies. It is governed by Title VI (Articles 90 to 100) of the Treaty on the Functioning of the European Union. Since the Rome Treaty's entry into force in 1958, this policy has been focused on removing borders between Member States and thus contributing to the free movement of individuals and of goods. Its principal aims are to complete the internal market, ensure sustainable development, extend transport networks throughout Europe, maximise use of space, enhance safety and promote international cooperation. The Single Market signalled a veritable turning point in the common policy in the area of transport. Since the 2001 White Paper, which was revised in 2006, this policy area has been oriented towards harmoniously and simultaneously developing the different modes of transport, in particular with co-modality, which is a way of making use of each means of transport (ground, waterborne or aerial) to its best effect. Trans-European Networks (TEN): Development of the TENs is contributing to economic and social cohesion. The requirements of the peripheral regions have been taken into account in this development, and the emphasis placed on airports on islands and in remote areas. The next step is to enhance the role of ports so as to assist the integration of shipping into a global network. It is also necessary, in the peripheral regions, to undertake complementary investment in secondary networks, in order that those regions may gain maximum benefit from the TENs.	See Cohesion and Transport policy http://europa.eu/legislation_summaries/transport/bodies_objectives/l24207_en.htm Land take by transport infrastructure (http://www.eea.europa.eu/data-and-maps/indicators/land-take-by-transport-infrastructure-1)		http://ec.europa.eu/transport/index_en.htm		Revision of Transport Policy post-2010;	Transport as driving force for land use changes
	Green Paper: Towards a new culture for urban mobility	This Green Paper is the product of wide public consultation initiated in 2007. It opens up a second consultation process which lasts until 15 March 2008. With urban mobility being an asset for growth and employment, as well as an essential condition for a sustainable development policy, the Commission will use the consultation undertaken to subsequently propose an overall strategy in the form of an action plan. The target audience for the consultation process is vast: it includes people living in towns and cities, transport users, transport company employers and employees, industry, public authorities and relevant associations. The resulting strategy will also be supported by the experience acquired by the Commission in this field with the CIVITAS initiative and with the 1995 Green Paper and its communication on "a Citizensâ€™ Network". A central idea of the forthcoming strategy is the need to integrate the various urban mobility policies in a single approach. Examples of European added value could be to: * Promote the exchange of good practice at all levels: local, regional, national and European; * Underpin the establishment of common standards and harmonisation; * Offer financial support to those who are in greatest need of such support; * Encourage research, the application of which would enable an improvement in mobility; * Simplify legislation, if necessary. The Commission proposes to encourage the emergence of a real "urban mobility culture"	For this purpose, the Green Paper identifies five challenges: - Improve fluidity in towns - Reduce pollution - Intelligent urban transportation - Accesibility - Safety and security The Green Paper also stresses the need to elicit an urban mobility culture by means of education, training and raising awareness.		http://europa.eu/legislation_summaries/transport/bodies_objectives/l24484_en.htm		2007	Transport policy and urban sprawl
	White paper: European transport policy for 2010	This document aims to strike a balance between economic development and the quality and safety demands made by society in order to develop a modern, sustainable transport system for 2010. The Commission has proposed 60 or so measures to develop a transport system capable of shifting the balance between modes of transport, revitalising the railways, promoting transport by sea and inland waterway and controlling the growth in air transport. In this way, the White Paper fits in with the sustainable development strategy adopted by the European Council in Gothenburg in June 2001. The European Community found it difficult to implement the common transport policy provided for by the Treaty of Rome. The Treaty of Maastricht therefore reinforced the political, institutional and budgetary foundations for transport policy, inter alia by introducing the concept of the trans-European network (TEN). The Commission's first White Paper on the future development of the common transport policy, published in December 1992, put the accent on opening up the transport market. Ten years later, road cabotage has become a reality, air safety standards in the European Union are now the best in the world and personal mobility has increased from 17 km a day in 1970 to 35 km in 1998. In this context, the research framework programmes have been developing the most modern techniques to meet two major challenges: the trans-European high-speed rail network and the Galileo satellite navigation programme. However, the more or less rapid implementation of Community decisions according to modes of transport explains the existence of certain difficulties, such as: * unequal growth in the different modes of transport. Road now takes 44% of the goods			http://europa.eu/legislation_summaries/transport/bodies_objectives/l24007_en.htm		2010	Transport policy and territorial cohesion

Environmental Policy	GENERAL		The European Environment Agency (EEA): Indicators and fact sheets about Europe's environment		http://www.eea.europa.eu/data-and-maps/indicators/#Outlook	Unknown	NA	
	Climate Change	EU policies on climate change adaptation are directly relevant to current and future land-use practices and economic sectors depending on this. EU Climate Change policy key objectives: mitigation throughout reduction of CO2 emissions and adaptation strategies	Renewal energy production	20% of energy to come from renewable sources by 2020	http://www.eea.europa.eu/themes/climate/policy-context	Unknown	2007	
			Greenhouse gas emissions	Reduce greenhouse gas emissions to 20% by 2020.	http://www.eea.europa.eu/themes/climate/policy-context	Unknown	2007	
		UNFCCC Kyoto protocol promotes among others practices that reduce emissions of methane and nitrous oxide from agricultural land.						
	Water Framework Directive 2000/60	Integrated river basin management for Europe. The key objectives of the WFD are the following:	**to be identified:** in relation to mitigation of floods and droughts	**to be defined**	http://ec.europa.eu/environment/policies_en.htm	Unknown	2000	
	EU Floods Directive	Flooding caused by the construction of impervious surfaces (e.g. buildings and roads) and provoked by extreme weather events is addressed by a new European Floods Directive. Directive 2007/60/EC on the assessment and management of flood risks entered into force on 26 November 2007. This Directive now requires Member States to assess if all water courses and coast lines are at risk from flooding, to map the flood extent and assets and humans at risk in these areas and to take adequate and coordinated measures to reduce this flood risk. With this Directive also reinforces the rights of the public to access this information and to have a say in the planning process. The directive requires flood risk mapping and affects land use through flood management plans for affected floodplain areas	**to be identified:** in relation to mitigation of flood risk	**to be defined**	http://ec.europa.eu/environment/water/flood_risk/index.htm	Unknown	2007	Identification of environmental challenges derived form land use patterns that should be addressed by policy recommendations Land use changes is one of the key drivers of environmental change. Land use impacts on climate, biodiversity and ecosystems services. It can also cause degradation adn pollution of water, soil and air: It has a major role in climate change at the global, regional and local scales, by increasing the release of CO2 to the atmosphere when soils and natural vegetation are disturbed. But also with regard to the emissions of other green house gasses, especially methane (by alteration of surface hydrology and elimination of forest cover), and nitrous oxide (through agriculture) On the other hand environmental policy is a driver for land use changes in Europe and also The cross-cutting nature of land use is emphased by the Environmental policies
	Coastal zone policy	Integrated Coastal Zone Management (ICZM) The main objective is to improve the planning, management and use of Europe´s coastal zones, which promotes sustainable management through co-operation and integrated planning, involving all the relevant players at the appropriate geographic level. During 2006 and the beginning of 2007 the Commission reviewed the experience with the implementation of the EU ICZM Recommendation. The Commission Communication of 7 June 2007, COM(2007)308 final presents the conclusions of this evaluation exercise et sets out the main policy directions for further promotion on ICZM in Europe: Commission Communication on the evaluation of Integrated Coastal Zone Management (ICZM) in Europe, COM(2007)308 final of 7 June 2007	**to be identified**	**to be defined**	http://ec.europa.eu/environment/iczm/home.htm	Unknown	2007	
	EU Landfill Directive	The aim of the Directive is to provide for measures, procedures and guidance to prevent or reduce as far as possible negative effects on the environment, in particular the pollution of surface water, groundwater, soil and air, and on the global environment including the greenhouse effect, as well as any resulting risk to human health, from landfilling of waste, during the whole life-cycle of the landfill. This is to be achieved through stringent operational and technical requirements on the waste and landfills.	Landfill waste levels	(the EU Landfill Directive requires states to reduce landfill waste by 50% from 1995 levels by 2013 and 65% by 2020).	http://ec.europa.eu/environment/policies_en.htm		1999	
	Nature conservation and Environmental Protection	NATURA 2000 network and LIFE programme contains provisions which put particular emphasis on links with spatial development and, in particular, land use. The EU-wide designation of protected areas is intended to establish a coherent integrated biological network.which intervene in land use.	Spatial distribution of Natura 2000 sites- LIC´s & ZEPA´s. Correlation between land use changes and Natura 2000 network	**to be defined**	http://www.natura.org	ESPON 2.4.1 interpreted the CORINE Land Cover data, combined socio-economic data, information on infrastructure and data of the Natura 2000 network and proposed a feasible Spatial information (vector) NUTS 3	up to date 2010	

TOPIC	NAME	OBJECTIVES	POTENTIAL INDICATORS	THRESHOLDS	REFERENCE SOURCE	REGIONAL REFERENCE	TIME REFERENCE	SIGNIFICANCE FOR EU-LUPA
Sustainable development Strategies	**EU Strategy for Sustainable Development**	Sustainable development is linked to a succesful management of land use. The EU's climate change and energy policies are evidence of the impact that sustainable development strategy has had on the political agenda. The EU has started to integrate the sustainability dimension in many other policy fields also. Climate change and clean energy, Sustainable transport, Sustainable consumption and production, Conservation and management of natural resources, Public heal,Social inclusion, demography and migration, Global poverty and sustainable development challenges, Education and training, Research and development, Financing and economic instruments Main goals: - Contributing to a rapid shift to a low-carbon and low-input economy, based on energy and resource-efficient technologies and sustainable transport and shifts towards sustainable consumption behaviour; - Intensifying environmental efforts for the protection of biodiversity, water and other natural resources. Evidence shows that the destruction of biodiversity is continuing at a worrying rate. Degradation of ecosystems not only reduces the quality of our lives and the lives of future generations, it also stands in the way of sustainable, long-term economic development; - Promoting social inclusion. The most vulnerable in society are at risk of being the most badly hit by the economic crisis and its effects may linger longest for them unless effective measures are provided. - Strengthening the international dimension of sustainable development and intensifying efforts to combat global poverty.	The Sustainable Development Indicators (SDIs) are used to monitor the EU Sustainable Development Strategy (EU SDS) in a report published by Eurostat every two years. They are presented in ten themes. **Headline indicators** Of more than 100 indicators, eleven have been identified as headline indicators. They are intended to give an overall picture of whether the European Union has achieved progress towards sustainable development in terms of the objectives and targets defined in the strategy. For a more complete picture it is necessary to look at the progress of all indicators within a theme. - Growth rate of real GDP per capita - Resource productivity - Population at-risk-of-poverty or exclusion - Employment rate of older workers - Healthy life years and life expectancy at birth, by gender - Greenhouse gas emissions - Share of renewable energy in gross final energy consumption - Energy consumption of transport relative to GDP - Common bird index - Fish catches taken from stocks outside safe biological limits - Official development assistance as share of gross national incor	EU 2020 Strategy thresholds could be used	http://ec.europa.eu/environment/eussd/	NUTS 1 National level	1990 -2009 On 2010 midterm review of the EU Rural Development Policy	Evaluation of Land Use Efficiency by means of the correlation between land use change patterns and trends with regional performance
	Sustainable Development Strategies Country Profiles	Only to be explored at case study level	Only to be explored at case study level	Only to be explored at case study level	European Sustainable Development Network http://www.esdn.eu/?k=country%20profiles	NUTS 1 National level	n/a	Evaluation of Land Use Efficiency by means of the correlation between land use change patterns and trends with regional performance
	Supra-national SD Strategy Processess	Only to be explored at case study level	Only to be explored at case study level	Only to be explored at case study level	Agenda 21 for the Baltic Sea Region - Baltic 21 http://www.baltic21.org/attachments/b21_main_report__no._1_98____english.pdf	Supra- national level (important for cross-border areas)	1998	Evaluation of Land Use Efficiency by means of the correlation between land use change patterns and trends with regional performance
		Only to be explored at case study level	Only to be explored at case study level	Only to be explored at case study level	Mediterrean Strategy for Sustainable Development http://www.mzopu.hr/doc/Mediterranean_str_28022006.pdf	Supra- national level (important for cross-border areas)	2005	Evaluation of Land Use Efficiency by means of the correlation between land use change patterns and trends with regional performance
		Only to be explored at case study level	Only to be explored at case study level	Only to be explored at case study level	Nordic Strategy for Sustainable Development http://www.norden.org/pub/ovrigt/baeredygtig/uk/ANP2004782.pdf	Supra- national level (important for cross-border areas)	2005	Evaluation of Land Use Efficiency by means of the correlation between land use change patterns and trends with regional performance
Territorial development	**European Spatial Development Perspective (ESDP)**	Long term sustainability of Europe´s land use The objectives of the ESDP are in line with the three following fundamental goals of European policy: - economic and social cohesion; - conservation of natural resources and cultural heritage; and - more balanced competitiveness of the European territory. 1. development of a balanced and polycentric urban system and a new urban-rural relationship; 2. securing parity of access to infrastructure and knowledge; and 3. sustainable development, prudent management and protection of nature and cultural heritage.	See ESPON project 2.3.1	**To be defined** **EU Average suggested**	http://ec.europa.eu/regional_policy/sources/docoffic/official/reports/som_en.htm	The objectives set out in the ESDP should be pursued by the European institutions and government and administrative authorities at national, regional and local level.	1999	Evaluation of Land Use Efficiency by means of the correlation between land use change patterns and trends with regional performance
	Territorial Agenda of the European Union (TAEU)	The Ministers of the European Union responsible for spatial planning and development, on the occasion of the Informal Ministerial Meeting on Urban Development and Territorial Cohesion, held under the German EU Presidency in Leipzig on 24 / 25 May 2007, agreed on the Territorial Agenda of the European Union (TA) and entrusted Portugal with the task of preparing the First Action Programme (AP1) for its implementation. This agreement culminates a process of cooperation between the Ministers aimed at establishing a common policy framework for addressing territorial matters within the European Union. In June 2006, a dialogue with the major stakeholders was started, giving the TA a broad basis of consensus. The TA takes on and relates in different ways to several other relevant EU policy documents. Key aims are: Strengthen territorial cohesion - development of a balance and polycentric urban system; Strengthing polycentric development and Innovation throughout networking of cities and regions; new forms of partnerships and territorial governance between rural and urban areas; - securying partity access to knowledge and infraestructure; promote regional clusters of competition and innovation in Europe; strenghen trans-european networks - sustainable development, prudent management and protection of nature and cultural heritage; trans-eurpean risk management including the impacts of the climate change; strenghen ecological structures and cultural resources as the added value for development		**To be defined** **EU Average suggested**	http://www.eu-territorial-agenda.eu	European institutions and government and administrativeauthorities at national, regional and local level.	2007-2011	Evaluation of Land Use Efficiency by means of the correlation between land use change patterns and trends with regional performance
	Action programme for the implementation of the Territorial Agenda of the European Union	Solidarity between regions and territories The adoption of this principle reinforces solidarity between States and regions and expresses the commitment to apply a cohesive and integrated approach adapted to territorial diversity when influencing or deciding on the priorities and funding of territorial and urban development policies at European Union, national, regional and local levels. Multi-level governance The adoption of this principle expresses the commitment to structure proper channels of communication, participation and cooperation in order to make the territorial assessment, planning and management a fully democratic, transparent and efficient process. Integration of policies The adoption of this principle expresses the acknowledgement of the specific responsibilities of sectoral policy-makers and the will to cooperate with and influence them in order to ensure a stronger territorial and urban focus when conceiving and delivering the thematic policies. The goal is to better fine-tune specific thematic actions, to facilitate their coordination and to reduce undesired externalities. Cooperation on territorial matters The adoption of this principle recognises the importance to develop and support interregional, transnational and cross-border cooperation initiatives, aimed to actively promote territorial integration. Territorial cooperation must consider the territorial and urban dimensions of economic and social development and include the EU neighbouring countries, namely in the context of EU Programmes for European Territorial Cooperation Subsidiarity The adoption of this principle states that the full and efficient achievement of the aims of the Territorial Agenda can best be pursued	Action Plan 1, currently under implementation.The main purpose of the First Action Programme (AP1) is to provide a framework to facilitate the implementation of the Territorial Agenda.First Action Programme takes in consideration the review of the Territorial Agenda in the first half of 2011	**To be defined** **EU Average suggested**	http://www.eu-territorial-agenda.eu	European institutions and government and administrativeauthorities at national, regional and local level.	2007	Evaluation of Land Use Efficiency by means of the correlation between land use change patterns and trends with regional performance
	The Lisbon Treaty	The Lisbon Strategy aims at improving the competitiveness of the European economy in parallel with a clear commitment to the European social model and to the management of environmental pressures and conflicts. The Lisbon Strategy emphasises the objectives of growth and jobs, setting out a large number of measures and goals in a wide range of different areas. While to date territorial cohesion is not explicitly considered within the objectives of the Lisbon Strategy, its evaluation stresses the relevance of the territorial approach and the role of the regional and local administrative levels in achieving the Lisbon's objectives First Action Programme for the Implementation of the Territorial Agenda of the European Union and goals. A multi-level and coordinated approach between the European, national and regional/local levels, in line with the subsidiarity principle, is seen as a key factor of success for territorial governance, an issue that is central and cross-cutting in the implementation of the Territorial Agenda. The Lisbon Strategy is a dynamic strategy in which sustainability has been taken on board (climate change, energy, financial and social sust With the adoption of the Lisbon Treaty, territorial cohesion is added to the goals of economic and social cohesion. This new element adds ar • It emphasizes the territorial dimension of access to services of general economic interest; • It underlines the importance of environmental sustainability; • It underscores the importance of functional geographies, of the problems of territories with specific geographical features, of the role of city • It strengthens the role of territorial cooperation and highlights the potential of macroregional strategies. The Lisbon Treaty (2007) made sustainable development a key objective for the EU and, in 2010, the EU renewed a number of environment	See ESPON Project 3.3 y TO 3. Indicators: - GDP/capita - GDP/person employed - employment rate of 15-64 (EU 2020 range 20-64) - employment rate of elderly - gross expenditure on research and development - dispersion of regional unemployment rates - long-term unemployment rate. - Regional Unemployment, 2008 - R&D Expenditure as Percentage of GDP, 2006 - Composite Economic Lisbon Performance, 2006; Change in Composite Lisbon Performance 2000-2006 - Tertiary Educated People in Labour Force, 2007 - Share of Renewables in Gross Final Consumption, 2005 - Wind Power Potential, 2005	Defined by ESPON Project 3.3 y TO 3. Average of all individual quartiles of performance of seven regionalised Lisbon short list indicators	http://bookshop.europa.eu/is-bin/INTERSHOP.enfinity/WFS/EU-Bookshop-Site/en_GB/-/EUR/ViewPublication-Start?PublicationKey=FXAC07306	NUTS 2	2009	Evaluation of Land Use Efficiency by means of the correlation between land use change patterns and trends with regional performance

			Wind Power Potential, 2005					
	Gotteborg objectives	The Gothenburg Strategy defines a number of key environmental objectives and target dates, both political and legislative. Major priorities include climate change, sustainable transport, public health and natural resources management. These areas are most relevant to the territorial challenges and priorities set in the Territorial Agenda.		Defined by ESPON Project 3.3 y TO 3 Average of all individual quartiles	http://bookshop.europa.eu/is-bin/INTERSHOP.enfinity/WFS/EU-Bookshop-Site/en_GB/-/EUR/ViewPublication-Start?PublicationKey=FXAC07306	NUTS 2	2009	Evaluation of Land Use Efficiency by means of the correlation between land use change patterns and trends with regional performance
	Europe 2020 strategy	Europe 2020 is the EU's growth strategy for the coming decade. In a changing world, we want the EU to become a smart, sustainable and inclusive economy. These three mutually reinforcing priorities should help the EU and the Member States deliver high levels of employment, productivity and social cohesion. Five ambitious objectives - on employment, innovation, education, social inclusion and climate/energy	The strategy provides the following indicators: - Employment rate by gender, age group 20-64 - Gross domestic expenditure on R&D (GERD) - Greenhouse gas emissions, base year 1990 - Share of renewables in gross final energy consumption - Energy intensity of the economy (proxy indicator for Energy savings, which is under development) - Early leavers from education and training by gender - Tertiary educational attainment by gender, age group 30-34 - Population at risk of poverty or exclusion (union of the three sub-indicators below) - Persons living in households with very low work intensity - Persons at risk of poverty after social transfers - Severely materially deprived persons	Provided by the strategy itself These targets are representative, not exhaustive. They represent an overall view of where the Commission would like to see the EU on key parameters by 2020. They do not represent a "one size fits all" approach. Each Member State is different and the EU of 27 is more diverse than it was a decade ago. Despite disparities in levels of development and standards of living the Commission considers that the proposed targets are relevant to all Member States, old and newer alike.	http://europa.eu/press_room/pdf/complet_en_barroso___007_-_europe_2020_-_en_version.pdf	NUTS 1 National level	2010	Evaluation of Land Use Efficiency by means of the correlation between land use change patterns and trends with regional performance

TOPIC	NAME	OBJECTIVES	POTENTIAL INDICATORS	REFERENCE SOURCE	TIME REFERENCE	SIGNIFICANCE FOR EU-LUPA
Cohesion policy and territorial development	Green Paper on Territorial Cohesion	The green paper constitutes an open debate on territorial cohesion, in response to the demands from the European Parliament, the ministerial meeting in Leipzig in 2007 and the contributions that many stakeholders made during the public consultation on the 4th Cohesion Report. The paper also builds on the Territorial Agenda and its Action Programme, during 2007. The goal a better and shared understanding of territorial cohesion and its implications for policy.	Territorial diversity of the EU is seen as a vital asset that can contribute to the sustainable development of the EU as whole.To turn this diversity into strength, we have to address territorial cohesion through focusing on new themes, new sets of relationships binding EU territories at different levels and new forms of cooperation, coordination and partnerships. These ideas constituted the main issues for the proposed debate. * Viewing cohesion from a territorial angle calls attention to themes such as sustainable development and access to services. Also underlining that many issues do not respect administrative boundaries and may require a coordinated response from several regions or countries, while others need to be addressed at a local or neighbourhood level. Building on the experience of the European Territorial Cooperation objective we can now look at the ways to further improve the co-operation between regions within the Union and with the neighbouring regions outside. * An integrated place-based approach pursued by Cohesion Policy is ideally suited to respond to complex and strongly embedded issues, such as regional development but in order to maximise synergies better coordination with sectoral policies is necessary. Territorial cohesion also stresses the added value of partnership with a strong local dimension, which ensures that policies are designed and implemented with local knowledge.	http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2008:0616:FIN:EN:PDF	2008	Policy context Policy relevance of the indicators used within the project for the characterization of land uses in EU and identification of potential indicators to evaluate territorial performance
	Conclusions of the 5º Cohesion report	Cohesion policy could play an crucial role in the context of the current economic crisis and to guarantee the compliance with the EU strategy 2020. Although the cohesion policy has already significantly reduced economic, social and environmental disparities within the EU it has been observed that it could be more effective.	The most relevant issues addressed are the following: - the cohesion policy needs to be closely coordinated with the Europe 2020 strategy. - be more focused on few key priorities closely linked to EU 2020 to be more effective, especially in the more developed regions, be more selective. - it would be necesary an ex-ante definition of clear an measurable objectives, targets and indicators (per member programe) - on-going evaluation (monitoring) to assess performance towards these objectives. The idea is strenghening performance throughout incentives and conditions. - strength territorial cohesion, already addressed by the Lisbon treaty along side the goals of economic and social cohesion, with particular emphasis on the role of cities, local development and the macro-regional strategies. The comission intends to adopt a Common Strategic Framework delineating a comprehensive investment strategy, which translates the targets and objectives of Europe 2020 into investment priorities for Cohesion policy, covering structural funds, the cohesion fund, european fisheries fund and the european agricultural fund for rural development. Each member state would present their overall strategy for cohesion policy in line with the national reform programmes and the thematic and country specific recommendations for Europe 2020. The Coordination of structural funds is crucial but not enough. The commision intends also to significantly strenghthen the involvement of other EU policies in preparing the strategic documents	http://ec.europa.eu/regional_policy/sources/docoffic/official/reports/cohesion5/index_en.cfm	2010	
	EEAC conference 2010 on sustainable land use	The EEAC believes that the concept of "sustainable land use" is a crucial component for sustainable development, as it involves integrating the different uses that are being made of natural resources and their interaction within relevant scales. It also provides new insights on how the governance of natural resources can be improved – at the landscape or other appropriate territorial levels (such a watersheds) – as part of balancing the involvement of multiple interests. We therefore recommend that the concept of "sustainable land use" should form one of the main topics to be taken forward within the context of the EU Sustainable Development Strategy.	Sustainable land use depends on functioning governance structures and adequate policies at all levels Land use has a cross-cutting nature so apart from Environment policies other EU policies have implications for sustainable land use The CAP is a crucial policy field in relation to sustainable land use. Sustainable land use is not yet sufficiently incentivised in such a way that farmers, foresters and other land managers and workers are adequately rewarded for the protection and enhancement of biodiversity, climate change adaptation and mitigation and the provision of water management services. Scientific methodology and datasets required EU Strategy on Green Infrastructure after 2010, as a key tool to address the ecosystem services dimension of biodiversity	http://www.eeac-net.org	2010	
	A roadmap for moving to a competitive low carbon economy in 2050	Intergovernmental work done by Belgium for the Territorial Agenda and the revised Territorial Agenda itself expected to be ready spring 2011. Transition towards a competitive low carbon economy. It represents a roadmap for possible action up to 2050 which could enable the EU to deliver greenhouse gas reductions in line with the EU objective of reducing GHG by 80-95% by 2050.	This will build on the Established EU energy policy and the EU 2020 Strategy. It oulines the need for raising land use productivity sustainably: by improved agricultural and forestry practices can increase the capacity of the sector to reduce GHG and preserve and sequester carbon on soils and forests. This can be achieved for instance through targeted measures to maintain grasslands, restore wetlands and peat lands, low or zero tillage, to reduce erosion and allow for the development of forests. Agriculture and forestry are also providing the resources for bio-energy and industrial feedstocks.	http://ec.europa.eu/clima/policies/roadmap/index_en.htm	2011	
Urban dimension	Leipzig Charter for an integrated sustainable urban development;	The Leipzig Charter builds on a process of cooperation aimed at strengthening urban development in the European context. With the Leipzig Charter the Ministers agreed on common principles and strategies for an integrated approach to urban development policy and on the need for action in socially and economically deprived urban areas as well as in cities as a whole. The complementarities between the Leipzig Charter and of the Territorial Agenda are addressed in First Action Programme. The Leipzig charter is a document of the member states, that commit themselves to: - initiate a political debate in their states on how to integrate the proposals and strategies of the Leipzig charter on sustainable EU cities into national, regional and local development policies - to use the tool of integrated urban developmont and the related governance for its implementation and stablish any necesary framework at national level - to promote the establishment of a balance territorial organization based on European polycentric urban structure	Making greater use of integrated urban development policies approaches. Strategies for action: - creating and ensuring high quality public spaces - modernizing infraestructure networks and improving energy efficiency - proactive innovation and educational policies Special attention to deprive neighbourhoods. Strategies for: - upgrading the phisical environment - strenghthen the local economy and the local labour market policy - proactive education and trainning policies for youngs and children - promotion of efficient and affordable public transport	http://www.eu2007.de/en/News/download_docs/Mai/0524-AN/075DokumentLeipzigCharta.pdf	2007	Policy relevance of the Urban dimension Identification of policy challenges
	Promoting sustainable urban development in Europe - April 2009,	DG Regio reports on the urban dimension The Commission communication to the Council and the Parliament "Cohesion Policy and cities: the urban contribution to growth and jobs in the region" (COM (2006) 385, 13.07.06) stresses that cities concentrate both needs and opportunities. While attracting investments and jobs and supporting innovation, entrepreneurship and the knowledge economy, cities face important problems in the context of the evolution of the global economy: unemployment, migration, social exclusion, increasing disparities within cities. New forms of territorial governance are required to foster a better integrated approach and a flexible cooperation between different territorial levels.		http://ec.europa.eu/regional_policy/sources/docgener/presenta/urban2009/urban2009_en.pdf	2009	
	Fostering the urban dimension: Analysis of the Operational Programmes co-financed by the European Regional Development Fund 2007-2013 - November 2008			http://ec.europa.eu/regional_policy/sources/docoffic/2007/working/urban_dimension_en.pdf	2008	
	The urban dimension in Community policies for the period 2007-2013 - February 2010.			http://ec.europa.eu/regional_policy/sources/docgener/guides/urban/index_en.htm	2010	
	Thematic strategy on the urban environment	The Thematic Strategy on the Urban Environment was adopted by the Commission on 11 January 2006. The Strategy is accompanied by an Impact Assessment covering its social, economic and environmental consequences. The Strategy is based on the results of extensive consultations with a wide range of stakeholders. Consultations began in 2002 with expert working groups on different issues, a large meeting with stakeholders and research reports. See here for details. An interim Communication "Towards a Thematic Strategy on the Urban Environment" was adopted in February 2004 to seek the views of stakeholders on the ideas under consideration. To develop further some of the key ideas contained in the interim Communication, expert working groups were established in 2004 to consider technical issues for environmental management plans, sustainable urban transport plans and for future priorities for research and training. An additional public consultation exercise was held in autumn 2005. Throughout the development of the Thematic Strategy, the EU Expert Group on the Urban Environment has also been consulted.	The main actions under the strategy are: Guidance on integrated environmental management and on sustainable urban transport plans. The guidance will be based on cities' experiences, expert views and research, and will help ensure full implementation of EU legislation. It will provide sources of further information to help prepare and implement action plans. Training. A number of Community programmes will provide opportunities for training and capacity-building for local authorities to develop the skills needed for managing the urban environment. Moreover, support will be offered for local authorities to work together and learn from each other. These should be exploited both by the Member States and local authorities. Support for EU wide exchange of best practices. Consideration will be given for the establishment of a new European programme to exchange knowledge and experience on urban issues under the new Cohesion Policy. The Commission will closely cooperate with Member States and local authorities. This work will be based on a pilot network of focal points on urban issues (the "European Knowledge Platform") which offers advice to local authorities across Europe. Commission internet portal for local authorities. The feasibility of creating a new internet portal for local authorities on the Europa website will be explored to provide better access to the latest information.	http://ec.europa.eu/environment/urban/thematic_strategy.htm	2006	Policy context with regard to urban environment
	Sixth Environment Action Programme of the European Community 2002-2012	The European environment – state and outlook 2010: synthesis The SOER 2010 Synthesis provides an overview of the European environment's state, trends and prospects, integrating the main findings of SOER 2010.	The key issues addressed are: - Climate change: impacts. vulnerability and adaptation - Nature and biodiversity:natural capital and ecosystems. Land conversion drivers biodiversity loss and degradates soil functions - Natural resources and waste. natural resources management and its links to other enviromental and socio-economic issues - Environmental health and quality of life - EU Environmental challenges in the global context - Future Environmental priorities	http://www.eea.europa.eu/soer/synthesis/synthesis	2010	Thematic assessment on Land Use provides in put on: State and trends (land cover changes and urban land-take based on CLC 2000-2006) Impacts (land use intensity, greenhouse gas sinks, impacts of environmental change, recreational and cultural aspects of land use) Responses (regional planning, examples of targeted policy instruments, policy challenges and prorities)

Environmental dimension	Thematic strategy on the sustainable use of natural resources	European economies depend on natural resources, including raw materials and space (land resources). The EU thematic strategy on the sustainable use of natural resources includes space as a resource. It applies to areas of land and maritime space that are needed for production purposes (e.g. minerals, timber, food) and for various socio-economic activities. These interests are often competing for the same territorial resource. It aims to launch a debate on a framework for using resources which supports the objectives of the Lisbon strategy and the EU's sustainable development strategy.	The relations between resource use and environmental impact are only partially known at present. Furthermore they change with time, for example, as a result of technical or social developments. Differences in regional conditions and use patterns need also to be considered. In addition, environmental impacts related to the use of different resources vary widely. So, initially the strategy has to determine which resources at any given time are of biggest concern, e.g. the resources with the greatest potential for environmental improvement, taking into account technological possibilities and socio-economic aspects. To perform the functions described above, and to take account of continuously evolving patterns of environmental impacts of resource use, the strategy will comprise three strategic elements that will apply continuously throughout its life: Knowledge gathering The entire life-cycle of resources, from their extraction, through their use in the production of goods and services and the subsequent use phase, to the waste phase, gives rise to environmental impacts. Any given raw material can take numerous different pathways through the economy. Aluminium, for example, can be transformed into goods as diverse as window-frames, aircraft bodies and beverage cans, and these all interact in very different ways with the environment. Knowledge about these pathways and impacts is presently dispersed between many actors, and significant gaps exist. The Resources Strategy has to ensure that knowledge is readily available to decision-makers and that gaps are being filled. Policy assessment The use of natural resources is influenced by numerous environmental policies, including for example strategies on the marine environment, soil protection, biodiversity and the urban environment, as well as climate change policy, the water framework directive and many others. In addition, many non-environmental policies strongly influence resource use - sometimes unintentionally. Examples include fiscal, transport, agricultural and energy policies. However, there is currently no mechanism for assessing how far policy-choices in these different areas are compatible with the overall aim of decoupling economic growth from the impacts of resource use. The Resources Strategy will make these assessments, raise awareness of potential trade-offs, and suggest alternatives wherever possible. Policy integration To bring the strategy to life, concrete actions will need to be taken on the basis of the information generated by the previous two strategic elements. This will involve political judgements on the relative importance of different impacts and environmental targets, taking into account wider sustainable development considerations and identifying measures with the greatest potential for environmental improvement of resource use. The Resources	http://ec.europa.eu/environment/natres/	2005	Potential challenges in relation to land use consumption as natural resource

Annex III Pilot case for The Netherlands

ANNEX III TO THE INTERIM REPORT

LAND USE FUNCTION METHODOLOGY IN EU-LUPA

VERSION 06 May 2011

Marta Pérez-Soba, Matthijs Danes, Gerard Hazeu, Michiel van Eupen and Sander Mücher, Alterra Wageningen UR

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Methodology for assessment of regional land use performance based on Land Use Functions in the ESPON EU-LUPA project

Marta Pérez-Soba, Matthijs Danes, Gerard Hazeu, Michiel van Eupen and Sander Mücher, Alterra Wageningen UR

Version 6 May 2011

1. Why using Land Use Functions in LUPA?

The main objective of the EU LUPA project is to *provide a consistent methodology to analyse comparable information about European regions based on data from different sources and different levels […] integrating physical dimension (land cover) with social-economic (land use) and environmental, in order to understand and obtain a clear view on land use changes […] identifying main challenges […] and defining policy options to cope with those challenges.*

An **integrated assessment** of land use policies implies simultaneous consideration of all spatially relevant aspects of economic sectors and human activities that are linked to land (Helming et al. 2008). These include agriculture and forestry as the main traditional economic sectors, nature conservation and rural tourism as mainly land conserving activities, and settlement, transport and energy infrastructure as mainly urbanised land uses. All of these sectors and activities compete for land resources, so any policy change affecting one land use has the potential to induce changes in the others (Plummer 2009).

Sustainable land use implies a balanced consideration of the range of social, economic, and environmental goods and services provided by the land uses in a certain region/landscape (Wiggering et al., 2006; Pérez-Soba et al., 2008). It also implies a careful consideration of long term attributes of resilience and robustness that are to maintain underlying ecosystem processes. In an attempt to operationalise sustainable development for the case of land use, the concept of mutlifunctionlity was introduced (Wiggering et al., 2006). The underlying rationale for **multifunctional land use** is to consider effects of any land use action interactively. Commodity production is analysed in the context of its negative and positive externalities in a spatial system. This interpretation of multifunctionality relates the supply of land use goods and services to the societal demands for land use goods and services and allows assessing the value that multifunctional land use has for society (Helming et al., 2008). Understanding sustainable development as a discourse based, deliberative process

(WCED, 1987), this multifunctionality concept can be used as an estimate for sustainability assessment of land use (Pérez-Soba et al, 2008).

The Land Use Functions (LUFs) conceptual framework is a functional analysis on how changes in land use (partly driven by policies) impact on the multiple functions attached to land use, which in turn affect sustainability and stock and quality of natural resources. The LUFs concept responds to the EU policy need for integrated impact assessment considering the three main dimensions of sustainability, i.e. economic, environmental and social. The LUFs concept enables the translation of a broad range of economic, environmental and social indicators into an integrated regional assessment.

The LUFs concept was developed in the FP6 SENSOR project (Pérez-Soba et al., 2008; Paracchini et al. 2011) and it has been implemented in other projects since then (König et al., 2010; Reidsma et al., 2011).

The main objectives of the LUFs framework in EU LUPA are:

- To assess the impacts of land use change in a comprehensive way and not based on the partial views provided by individual indicators: multi-criteria analysis
- To estimate the impact of land use changes on sustainability, measured as integration of the economic, social and environmental dimension
- Enhance the knowledge on the number and quality of the land use functions present in a region and therefore the degree of existing multifunctionality

This document describes the adaptation of the original LUFs methodology to the specific EU-LUPA objectives.

2. Definition of Land Use Functions

Land Use Functions (LUFs) express the goods and services that the use of the land provides to human society that are of economical, ecological and socio-cultural value and likely to be affected by policy changes.

In EU-LUPA six LUFs have been identified considering the following criteria:

- The main uses of the land in Europe are represented (agriculture and forestry as the main production sectors, nature conservation and rural tourism as land conserving activities, and settlement, transport and energy infrastructure as urbanised land uses);
- Ensure that all three dimensions of sustainability (economic, environmental and societal) have an equal representation;
- The functions are likely to be affected by European policies.

Two key LUFs have been defined for each sustainability dimension and are listed in Table 1. They are named as mainly economic, environmental and societal because the borders between the three dimensions are not sharp, e.g. provision of work is mainly societal but can be considered as well among the economic functions.

Table 1 The six Land Use Functions in EU-LUPA

Sustainability dimension	LUF	Land Use Functions	Issues included
Mainly societal	LUF1	Provision of work	Employment provision for all in activities based on natural resources
	LUF2	Provision of Leisure and recreation	Recreational and cultural services, including cultural landscapes and green spaces in urban areas
Mainly economical	LUF3	Provision of food and energy	Land-dependent production of food, timber and biofuels
	LUF4	Provision of housing and transport and energy infrastructure	*Building of artificial surfaces*: settlements (residential areas, offices, industries, etc.), transport infrastructure (roads, railways, airports, harbours) and *Land-independent production*: energy infrastructure (wind and solar energy parks, etc.)
Mainly environmental	LUF5	Provision of abiotic resources	Regulation of the supply and quality of air, water and minerals
	LUF6	Provision of biotic resources	Factors affecting the capacity of the land to support biodiversity (genetic diversity of organisms and habitats)

3. Methodology

The LUFs methodology is described in this section. It consists of the following steps:

Step 1: Selection of suitable indicators

The goal of this step is to define a common and concise set of impact indicators, that enable to measure quantitatively or qualitatively a change in the performance of the LUFs. For example, soil sealing is an impact indicator for LUF 4 (Provision of housing and transport and energy infrastructure), since any changes in its values will have impact on this specific LUF.

The selection of the impact indicators is based on a number of **criteria**:

a) Availability: the indicators should be available at least for two time steps, being considered the first time step as the reference; in EU-LUPA the changes in land use will be mainly based on changes observed in CLC, and therefore the time period selected is 1990 - 2000 - 2006;
b) Spatial resolution: in principle preference is given to indicators available at NUTS 3 or higher spatial resolution; it should be always possible to upscale the date to a lower resolution;
c) Balance between the three sustainability dimensions: the indicators should be associated to the three dimensions of sustainability, e.g. economic, environmental and societal and their number should be approximately the same for each dimension to keep a balanced approach;
d) Relevance for the assessment of changes in LUFs in the area of study: for example, the set of environmental indicators should reflect main trends in the area of study regarding water, soil, air and biodiversity;
e) Redundancy: it should be avoided selecting key indicators that were redundant in some way, i.e. describing trends in the same issue. For example, habitat eutrophication is directly caused by deposition of NH_3 and therefore habitat eutrophication and NH_3 are redundant.
f) Spatial coverage: the indicators should be available for all EU-27 and if possible for the ESPON space countries, also on the regional level.

The availability of data for all EU-27 deserves special attention, particularly when a more detailed regional level (like NUTS 3) is required. Not for all data the availability on this level is guaranteed. A (partly) solution to this problem could be to use non-harmonised data.

The results of the selection of impact indicators should be presented in an Excel sheet table. The indicators should be structured according to the sustainability dimension and EU policies which impact could be assessed.

Per indicator a fiche will be prepared that will be included as Annex at the end of this report (not in the current version), elaborating the details of the indicator, like definition, spatial and temporal scales, , data source and indication of the quality.

Step 2: Definition of the links of the indicators with the LUFs

The specific links between the selected indicators and the LUFs should be defined by a group of experts using *a generic table* similar to that shown in Figure 1 that lists and quantifies the contribution of each indicator to each LUF, including the confidence of the expertise based on quality of the dataset (if possible adding a literature reference justifying it) and finally identifying potential EU policies that may have an effect on the indicator (this last column will be filled in based on the findings of WP 2.5).

Figure 1 Impact indicators showing the change in performance in LUFs

Indicator code	Indicator name	Score	Justification for score	Confidence of expertise	Potential EU policies that may impact the indicator

Values are assigned to the link between each indicator and the LUFs, which describe the effect on sustainability, i.e. whether it has a positive or a negative impact on that LUF (Pérez-Soba et al., 2008). The contribution of each indicator to each LUF has to be defined separately since the same indicator can have at the same time a positive relation to one LUF and a negative one to a different LUF, and this must be reflected in the direction the scale min-max is assigned to indicators in each LUF during the normalisation process. For example, high soil sealing related to building may have a positive impact on LUF1 Provision of Work, and negative for LUF6 Provision of Biotic Resources. Therefore the maxima are attached to high soil sealing values in the first case, to low soil sealing values in the second. It is measured as a score.

The score ranges from -1 to +1 as follows:

1 = the indicator hinders (-) or enhances (+) the land use function in a very significant way. For example, the indicator 'nights spent in touristic accommodations' has a positive link with LUF2 Provision of Leisure and recreation, because an increase in nights spent in touristic accommodations means the leisure and recreation activities will be enhanced. On the other hand, the indicator 'area harvested' has a negative link with LUF5 Provision of abiotic resources, because an increase in area harvested means that the land used for agricultural activities is larger and therefore the provision of water and minerals resources is decreased.

0 = irrelevant, i.e. the relationship between the indicator and the LUF does not allow one to infer on the consequences that a change in the indicator value could have on the LUF , i.e. no direct link is known between the indicator and the LUF or maybe there are some impacts but they counterbalance each other. For example, the indicator 'pesticide use' is irrelevant for LUF 1 Provision of work.

The summary of contributions of indicators to the six LUFs should be presented as shown in in Table 2. Detailed tables have been produced for the test case presented in section 4 of this document, and are shown in Appendix 1. They describe the conceptual contribution of each selected indicator to each of the six LUFs where clear links were identified. The generic

tables present the scores associated to the contribution as well as the scientific justification and the confidence on the scoring.

Table 2 Summary of cross-linkages between the selected indicators and the six LUFs (for definition of LUFs, see section 2).

Indicator code	Indicator name	LUF1	LUF2	LUF3	LUF4	LUF5	LUF6

Step 3: Assessment of the importance of each indicator for the sustainability of the region

The regional dimension of the assessment results from the recognition that not all indicators may be relevant in all regions, e.g. the indicator 'Forest fire risk' is unlikely to be relevant in a region with a very low proportion of forest land cover. In effect, this step reflects the uncertainty and regional differences that need to be taken into account in the assessment.

This step provides the regional dimension to the framework by evaluating for each region considered in the analysis, the potential importance that each impact indicator may have on the land use sustainability. The regional dimension of sustainability assessment is at the heart of the of EU-LUPA. The approach reflects the considerable variety of situations that exist within the ESPON space and consists of a weighting of individual indicators within each of the regions considered. It combines information as to whether (i) the land use change pressure actually does affect the region, (ii) if it does, are we likely to see impact in the region and finally (iii) if there is impact, does it affect sustainability in the region.

It is well accepted that changes in indicators - that is measurements of something in the economy, environment or society – may be of different importance in relation to our efforts to assess the changes in phenomena (such as land use). In other words, it means that some 'things' are more important for the phenomena we are concerned than others. Therefore, weighting of different indicators is a normal procedure in Environmental Assessment and Strategic Environmental Assessment, and indeed finds its place in EU Impact Assessment. However, agreeing on the weighting is difficult. It can be imposed 'top-down' by policy makers/administrators and their advisory scientists, or generated 'bottom-up' by stakeholders. Ideally, one might have different weighting systems derived from different sources such as expert ('Delphi') panels, stakeholder valuation workshops, internet valuation, etc. and present them in final outcomes to assess the risk. We have chosen to limit ourselves to expert panels.

The description of the decision rules used by the experts is transparently done in individual fact-sheets, which include the 'importance' weighting showing how significant an issue (measured by the indicator) is in that region. It is an expert-based value judgment on what impact it would have on sustainability in the region if that indicator was to have an unacceptable value based on the current knowledge. The rule base determines the potential impact of change in an indicator for a particular region, and should be guided by supporting references describing the core bio-geographical (e.g. climate, altitude, relief, land use) and socio-economic (e.g. GDP, population, unemployment) characteristics of each region. For example, forest fire risk is deemed of low importance in a region with a small forest area, and a low population density, i.e. where the impact of a forest fire will be low. Conversely, Nitrogen and Phosphorus inputs are considered important in regions where agriculture dominates land use, and where the level of nutrients is already high. The detailed description should not be exhaustive and therefore for some indicators other sources explicitly concerning the impact of the indicator have been used. For example, some indicators, particularly the economic ones, are considered of equal importance in all regions. Care should be taken to minimise co-correlation of factors determining the rule base and those from which the indicator values themselves were derived.

The regional importance scores take values between 1 and 3 as follows: 1 (not important at all, or very low importance), 2 (of some importance), 3 (of great importance). Indicators may show multiple potential impacts across LUFs, therefore the rule-base needs to be accommodated to potential impacts on a number of different sectors. The rules are defined such that importance scores of 1 are only assigned where it is clear that there is no current importance AND that this is not likely to become important in the future, in order to preserve the validity of the assessment framework to future change. The rule base could be independently validated by a group of external experts in a workshop. The panel of experts can be selected according to criteria from recent practice of impact assessments. The regional importance scores should be summarized in a table as shown in Table 3 below, while full description of the rule bases and the scientific justification should be given separately (example shown in Appendix ??.

Table 3 Example table to showing how the regional importance scores (1 to 3) are indicated for each selected indicator in the regions of analysis.

Region code	Region name	ENV 01	ENV 02	ENV 03	ECO 01	ECO 02	ECO 03	SOC 01	SOC 02

Step 4: Assessment of sustainability limits

The fourth step in the assessment process is the expert identification of regional specific 'sustainability limits' (thresholds or similar references) for each indicator. The sustainability limits are used in EU-LUPA to assess the territorial performance. If indicator values are above the sustainability limit, it is assumed that the performance of the functions linked to these indicators will be affected, which in turn will impact at the performance of the studied region.

The notion of sustainability limit

The principle underlying sustainability assessment within EU-LUPA is the use of the notion of threshold *sensu lato*. Dealing with discontinuities in processes, the threshold concept has been recognised by ecology and ecological economists as a key feature to study changes in ecological processes and non-linear modelled economy-environment interactions (Muradian, 2001).

Sustainability limits are defined as the unacceptable damage of a pressure on a social, economic or environmental system based on current knowledge. The analytical background for this approach is further described by Bertrand et al. (2008). This review shows that while some notions are common to the three pillars of sustainability, there are also important differences between the environmental notion of threshold and its socio-economic counterpart. To account for these differences, one may distinguish *threshold-limits* based on established threshold relationships or breakpoints, mainly applicable for the environmental dimension of sustainability, and *target-limits* referring to political objectives or social preferences, more relevant for the social and economic pillars. The two can meet in the notion of Limits of Acceptable Change, which can include both thresholds and targets set for a range of ecological, social and economic objectives, should those objectives be set by stakeholders. The review also recognises that in reality many relationships in environmental, social and economic systems are not based on thresholds. Firstly, relationships between pressure and impact can be linear, secondly, in many cases, the complexity of the relationship makes it impossible to identify discontinuities and finally the existence or nature of relationship may vary with spatial and temporal scales. The concept of threshold is more complex from a cultural perspective where the analysis of perception and use of groups of people (i.e. consensus) is usually the preferred approach.

The sustainability limits are scientifically sound and spatially explicit, and refer to the impact of the indicators on each LUF and for each region considered (e.g. for each NUTS3 region). The rationales for identification of the sustainability limits can be based (i) on policy targets, (ii) on statistical distributions of indicator current values, or (iii) on scientific values. They can be quantitative (e.g. policy target that the European average is the optimum level –target- to achieve; or qualitative (e.g. forest fire risk = Low, Medium, High). Values provided as sustainability limits are soundly based, traceable and scientifically justified.

The assessment of sustainability limits has previously proved to be challenging concerning mainly two issues. Firstly, it is difficult to derive limits for socio-economic indicators in the same way as for environmental indicators. We can estimate quite correctly which level of nitrate in water supply might be toxic, but it is more complex to define at what point the number of nights spent in touristic accommodations threatens the sustainability of local nature, culture, history, etc. Secondly, there is a large heterogeneity in the ESPON territory that makes it difficult to define accurately regional limits based on the current data availability.

The concept of sustainability limits has limitations when implemented for all indicators for the whole of the ESPON space. For some of the indicators the limits can be derived from political limits or targets (e.g. national level targets for emission reductions of NO_x and NH_3 emissions). For some indicators, no specific threshold or even target can be defined; they can only be defined in terms of higher values being more sustainable or less sustainable. In effect, it means that the concept of threshold would be used in its most simplistic or general form in EU-LUPA.

Within the LUFs framework, sustainability limits need to be identified for each indicator.

Methods for setting indicator's sustainability limits

The impact indicators selected for the LUFs assessment framework may fall into four main types with respect to the setting of limits of acceptable change. Each type and the indicators conforming to that type are described briefly below. The limit has to be interpreted with respect to the defined range for normalisation (see next section). Sustainability limits need to be defined with respect to the main pillar they belong to. For example, if soil sealing is considered as mainly an environmental (biodiversity) impact indicator, the range for soil sealing should be defined such that the more soil sealing, the less sustainable, even though more soil sealing is more sustainable for LUFs relating to employment.

<u>Type 1: Limit given by comparison with a statistical distribution reference measure</u>

For example: *Nitrogen surplus, phosphorus surplus, pesticide use* : The limit can be defined as the median of the statistical distribution of values in the baseline year of data.

Type 2: Limit given by a specific value for the region

For example: *Ammonia (NH3) emission from agriculture* and *Nitrogen dioxide (NO2) emissions*: These two indicators have limits based on national emissions targets, downscaled from the percentage changes required at national level and applied to the regional emissions for each NUTS region.

Assessing sustainability of LUFs

Within the LUF framework, both indicator values and limits are processed through the weighting matrix (see final step of the methodology). Interpretation of whether LUF values are more or less sustainable can only be achieved by comparing individual LUF scores with the aggregated limit value. Values that are above the limit show that the aggregated LUF score for that LUF is sustainable, and values that are below the limit show that the aggregated LUF score for that LUF is not sustainable. However, this does not mean that individual indicators contributing to that LUF are all above the limit.

Step 5: Normalisation of the indicators and sustainability limit values

One of the requirements for processing multiple indicators within an aggregation framework is that all are reduced to the same scale, with common units (Nardo et al., 2005). Thus all indicators must be normalised, preferably to a continuous numerical scale, in order to allow mathematical procedures such as linear-additive aggregation to be performed. Two normalisation approaches are considered for this aggregation framework. The first is a normalisation with respect to the range of indicator values and the sustainability limit, the second is a normalisation with respect to the impact on sustainability. The latter is not strictly 'normalisation' but should more accurately be referred to as a scaling procedure. The two methods are discussed below.

Normalisation of indicators is required not only for result presentation but also for thematic aggregation from single indicators to LUFs. This needs to take into account the impact of a particular indicator on a Land Use Function. For example, the indicator 'soil sealing' has a positive impact on the Provision of Work Function, but a negative impact on the 'provision of biotic resources' Function. For this reason, the normalization of an indicator is conducted separately for each link of an indicator to a LUF, so that different impacts with respect to sustainability can be accommodated. Discrete, or qualitative indicators, or those with rule-based classes e.g. classes of risk, can also be normalized, using a rule-based approach which assigns discrete values within the normalization range to each class. The sustainability limit is treated in the same way, where appropriate. A corollary of this method is that it is the normalized indicators which are aggregated, not the indicator values themselves. This avoids scaling issues, since indicator results are effectively translated into units of sustainability which are scale-independent.

Once that the indicator values are normalised, it is possible to compare the analysed quantitative and qualitative changes in indicators for the different years, with the respective sustainability limits. If the indicator value is below the limit, then we will assume that the performance of the function linked to the indicator will not be affected. On the contrary, if the limit has been exceeded for a specific indicator, its contribution to the function will be changed. As a result, the effect of a change on the land use sustainability of a region will be described by the changes caused in its LUFs, which is a comprehensive and integrated description of changes observed in each single indicator. For example, if the predicted value of N surplus for a region is 60 kg N/ha y-1 which is above the sustainability limit of 50 kg N/ha y-1, then the performance of the LUFs linked to this indicator will be affected - in this specific case hindered - i.e. provision of abiotic resources, and provision of biotic resources.

1. Normalisation within range of indicator values

This method normalises the indicator value and the sustainability limit within a given range. The normalised values for both are then compared in order to make interpretations about whether a given value is sustainable or not. The range within which indicator values and sustainability limits are normalised should include the sustainability limit and both current and potential future indicator values. In order to maximise 'signal', i.e. information about whether the current state is improving or declining with respect to the sustainability limit, the range should be as narrow as possible. For example, if unemployment usually varies between 20% and 4%, scaling it between 100% and 0% is not appropriate. However, it should also be flexible enough to incorporate likely change. There is a trade-off here and it may be desirable to truncate the range to omit outliers if they do not provide additional useful information. For example, a lake of pH 4 is as unfit for supporting a healthy fish population as a lake of pH 2 and therefore the normalised range can be truncated at pH 4.

Although the normalisation procedure is based on a range of values, it should be consistent with respect to interpretation of the normalised score for sustainability. Therefore, it should incorporate the information as to whether high values are most sustainable or least sustainable. As an example, unemployment rate (highest values are least sustainable) would be normalised in the opposite direction to services of general interest (lowest values are least sustainable) with respect to sustainability for provision of work.

2. Scaling with respect to impact on sustainability

In this approach, the sustainability limit is intrinsic to the scaling procedure, and the indicator is scaled with respect to the sustainability limit *a priori*. Values are scaled either side of zero, representing the sustainability limit, and are positive for indicator values which are sustainable, and negative for indicator values which are unsustainable. The underlying

principle is that the indicator is scaled according to units of equal sustainability, rather than equal intervals of indicator values. The point is illustrated in Figure 2 below, where the scaling retains much of the sustainability information in non-linear response functions, which link the pressure to the damage caused. Using an economic example, a 6 % improvement in inflation rate from 60 % to 54 % clearly is not the same in terms of sustainability as an improvement from 10 % to 4 %. A further advantage of this scaling system is that scaled results are immediately interpretable with respect to the sustainability limit.

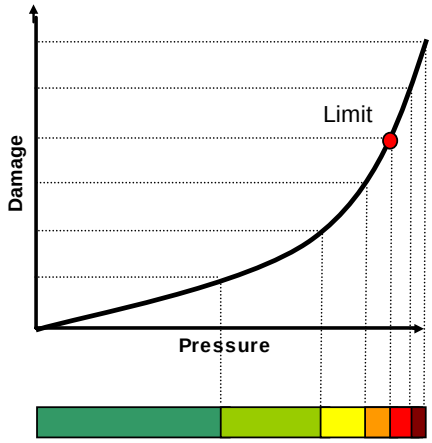


Figure 2 Example showing the range divided into equal classes of damage, for a non-linear relationship

In both approaches the option to truncate ranges to maximise signal can be utilised. In addition, both approaches can be adapted to fit a wide range of indicator types, necessary for an integrated framework such as the one described here. A more complex example is a modal response function, as in Figure 3, where there is an optimum for sustainability, with sustainability limits and declining sustainability at values to either side. Net migration is an example of this form of relationship where both very high immigration and high emigration may be deemed unsustainable, with some optimum level lying in between.

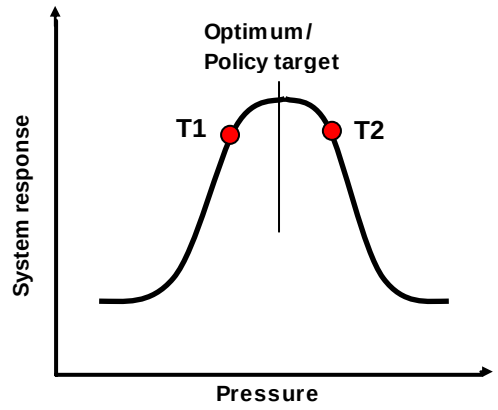


Figure 3 Example showing a modal indicator relationship, for example, where the optimum or target sustainability is defined according to a policy target or by a statistical distribution of values. T1 and T2 represent lower and upper sustainability limits

Visualisation of normalised scores under both approaches is presented in Figure 4. For illustrative purposes, the normalisation by range (Figure 4a) is given a nominal scale of 0 (least sustainable) to 10 (most sustainable), while the scaling according to sustainability (Fig 4b) is given a scale from -3 (least sustainable) to +3 (most sustainable). Both systems can accommodate changes in the underlying sustainability limits, with subtle differences. In Figure 4a, this would be evident by a re-scaling of the indicator score, which would then move closer to or further away from the limit line, which would not change. In Figure 4b, only the position of the limit line would move. This is visually preferable if the emphasis is on interpreting the effects of changes in the limits themselves. The principal difference between the two approaches is that the first is a true mathematical normalisation, where the interpretation of sustainability occurs afterwards and is done by the user. This requires little explanation, and all major assumptions about sustainability or otherwise are made by the user themselves. In the second approach, the information on sustainability is part of the normalisation procedure itself, and the central point of the scale (the zero level) corresponds to the sustainability limit of each indicator. The disadvantage is that it requires either detailed knowledge of the nature of the damage-response function or a set of expert-derived assumptions in order to accurately re-scale according to units of damage (or sustainability). This information needs to be conveyed to the end-user so that the interpretation of sustainability is transparent and understood.

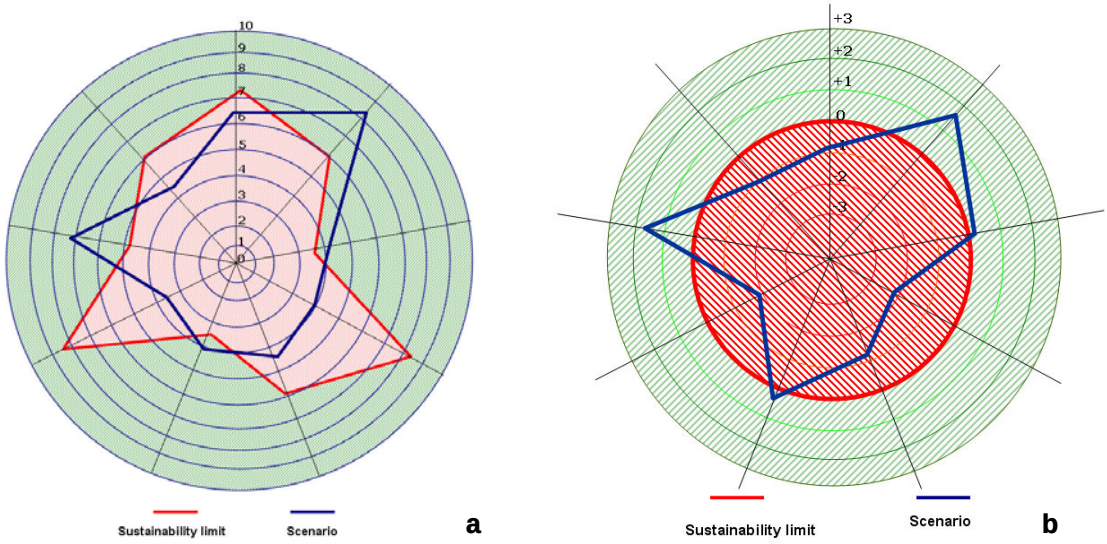


Figure 4 Options for normalisation of indicators: showing a) Normalisation according to indicator range, with a nominal 0 to 10 scale representing increasing sustainability, and b) Scaling according to equal units of sustainability relative to a sustainability limit, with a nominal -3 to +3 scale representing increasing sustainability

Both options are equally valid, however the method of normalising according to range is suggested as more appropriate for EU-LUPA, as it is more suited to wider use where there is less opportunity to explain the underlying assumptions. The equation used for normalisation of indicators is then the following:

$$I_{NORM} = \frac{x - \min}{\max - \min} * 10$$

where x is the value of the performance of the indicator under a given situation, and min and max are the ends of the normalization range, corresponding to minimum and maximum sustainability.

Step 6: Integrated regional impact assessment

The final step is the integrated assessment of the impact of land use change on the sustainability of the land of a region. It is based on the summary output for each LUF provided in steps 1 - 5. The integrated weighing of all the indicators, which limits have been exceeded or not provides a comprehensive description of changes observed in the indicators, which in turn shows the overall consequences (stimulating, hindering or none) for the LUFs. It is mainly based in the integrated weighing of all the indicator values and sustainability limits is described below in the aggregation scheme, as published in Paracchini et al (2009).

The aggregation scheme

Aggregation can be performed in compensatory or non-compensatory frames. In the first case the weights have the meaning of trade-offs (Jeffrey, 2004), therefore a decrease in a LUF value is considered comparable to an increase in one or more other LUF values. Due to the complexity and multiple dimensions of the impacts to be assessed, in the approach described in this paper the decision is taken to leave the analysis of trade-offs to the end user, since it would be impossible to assess *ex-ante* if conflicts between all possible targets exist. Therefore, a solution that holds some characters of non-compensation is sought. The basic aggregation framework is presented in Figure 5.

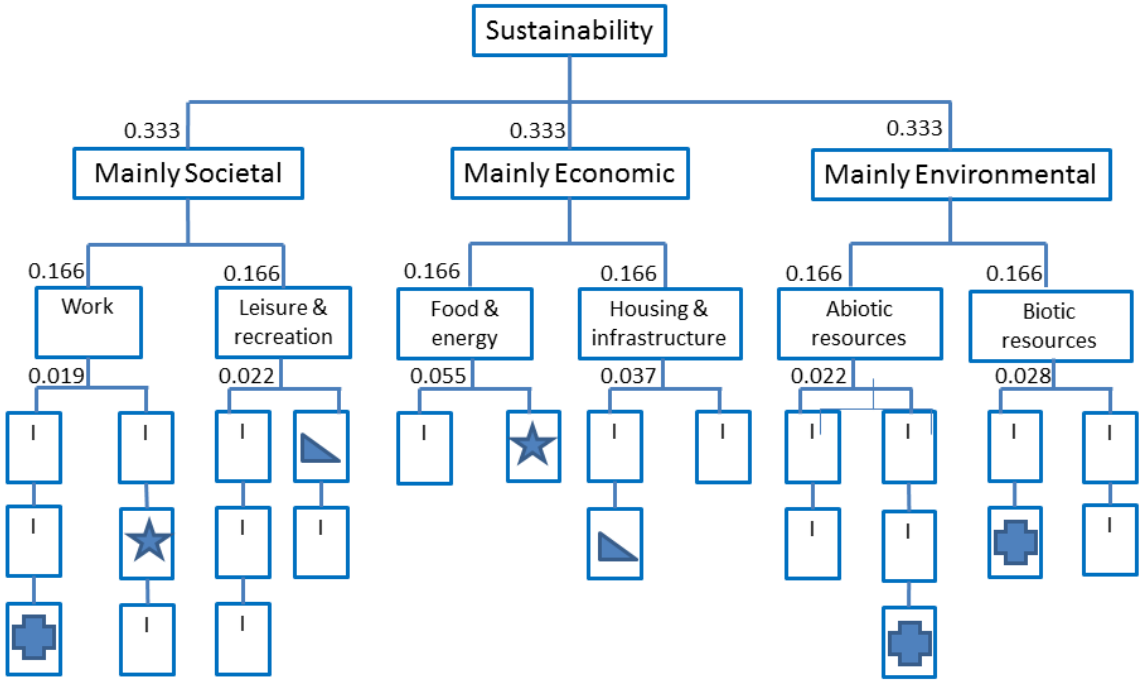


Figure 5 Basic aggregation scheme, after Paracchini *et al.* (2008). The symbols represent individual indicators contributing to more than one LUF

In such a hierarchical scheme the six LUFs are grouped in twos, according to the three dimensions of sustainability, and indicators are each assigned to one LUF. In order to deal with the compensability problem in linear aggregation, and with the problem of assigning weights in a context of social choice, as suggested by Munda (2004) the value of the weighs attached to each LUF is decided *a-priori* and LUFs are considered to be equally weighted. The

indicator weights are then derived by dividing the LUF weight by the number of indicators concurring to it. The method therefore remains compensatory within a LUF, but not among the LUFs. It is the end-user of the system, i.e. the policy maker at the EU level, who makes the decisions on the possibility of accepting trade-offs between LUFs.

In practice, the requirements of the system are complex. The LUFs do not refer uniquely to a dimension of sustainability, but have a "prevalent" social, economic or environmental character, acknowledging that the pillars of sustainability are not isolated, but involve numerous cross-linkages (mostly social, mostly economic and mostly environmental), as shown in Figure 5.

In this aggregation framework, three additional characteristics apply:

a. Each indicator can concur to more than one LUF (as shown in Figure 5);

b. The indicator link to a LUF can be positive or negative, stronger or weaker;

c. Each indicator may perform differently according to the geographical/environmental/socio/economic context in which it is measured.

All these elements must be taken into account when building the aggregation frame, and concur in solving the open questions:

- how is spatial variability of the European environmental/socio/economic context taken into account;
- how is sustainability included in the aggregation frame.

The system uses three weighting components to achieve this multi-dimensional, regional assessment, and is organised in a way that the aggregated values of indicators produce a final LUF score on the same 0 – 10 scale. In the same way the sustainability limits are normalised and aggregated to produce an aggregate limit for the LUF, against which LUF scores for a policy option are compared. The three weights are used as follows:

w1 – Number and type of indicators contributing to each LUF

Figure 5 shows that aggregation of indicators to LUFs is performed on a compensatory basis, in which the contribution of each indicator is weighted according to the number of indicators concurring to a LUF, and the indicator inherent importance (addressing issues of redundancy between indicators) and the balance of indicators across the three sustainability pillars. This is the first of three weighting factors: **w1**, and is calculated as follows:

$$\mathbf{w1 = intrinsic\ indicator\ weight \times pillar\ balance\ weight \times 1/\ n_{LUF}} \qquad (1)$$

where n_{LUF} is the number of indicators concurring to the LUF.

Intrinsic weights should be shown as in the example in Table 4 below. The importance of some individual indicators may be down-weighted to account for issues of redundancy. For example, N and P surplus where both represent impact of the agricultural sector on water quality. However, the spatial pattern varies across Europe, so rather than select just one indicator and fail to adequately capture this impact, it can be decided to retain both, but to down-weight them equivalent to one indicator. Two sectors are represented for Value added per sector, agriculture and energy, therefore these can be also down-weighted to sum to one indicator. The second component to weight 1 takes into account the differences in number of economic, social and environmental indicators to achieve balanced representation between the three pillars of sustainability. These two components are combined to form weight 1. In the LUF framework, weight 1 is also adjusted separately for each LUF to take into account the number of indicators contributing to that LUF, ensuring LUF calculations are evenly balanced through the framework.

Table 4 Example showing how components combine to form Weight 1, balancing each indicator contribution to the LUF framework

Indicator code	Indicator	Intrinsic indicator weight (A)	Pillar balanced weight (B)	Product (A) x (B)	Balanced Weight 1
ECO_06.1	Labour productivity	1	0.25	0.25	0.3333
ECO_08.1a	Value added in agricultural sector	0.5	0.25	0.125	0.1667
ECO_08.1b	Value added in energy sector	0.5	0.25	0.125	0.1667
ECO_11.1	Growth rate or real GDP per capita	1	0.25	0.25	0.3333
	No. ECO indicators	**4**		**0.75**	**1**
SOC_01.1	Unemployment rate	1	0.2	0.2	0.2
SOC_03.1	Deviation of regional unemployment rates	1	0.2	0.2	0.2
SOC_03.2	Deviation of regional income	1	0.2	0.2	0.2
SOC_09.1	Net migration	1	0.2	0.2	0.2
SOC_11.1	Alteration in appreciated landscape heritage	1	0.2	0.2	0.2
	No. SOC indicators	**5**		**1**	**1**
ENV_01.1	Ammonia (NH3) emission from agriculture	1	0.1111	0.1111	0.1429

Indicator code	Indicator	Intrinsic indicator weight (A)	Pillar balanced weight (B)	Product (A) x (B)	Balanced Weight 1
ENV_01.2	Nitrogen dioxide (NO2) emissions	1	0.1111	0.1111	0.1429
ENV_02.1a	Nitrogen surplus	0.5	0.1111	0.0556	0.0714
ENV_02.1b	Phosphorus surplus	0.5	0.1111	0.0556	0.0714
ENV_03.2	Soil sealing	1	0.1111	0.1111	0.1429
ENV_04.1	Carbon sequestration	1	0.1111	0.1111	0.1429
ENV_06.2	Trends in farmland birds	0.5	0.1111	0.0556	0.0714
ENV_06.6	Pesticide use	0.5	0.1111	0.0556	0.0714
ENV_09.1	Forest fire risk	1	0.1111	0.1111	0.1429
	No. ENV indicators	**9**		**0.78**	**1**

w2 – Strength and sign of indicator impact on LUF performance

Expert panels of internal and external experts can assign values to the link between each indicator and the LUFs. Such weights are attributed in close relation to the indicators' sustainability ranges. Weight 2 describes the impact on sustainability, i.e. whether it has a positive or a negative impact on that LUF. Since these indicator weights can show positive or negative relations, great attention must be paid to the meaning attached to minima and maxima per each indicator in the normalisation frame. As explained above the same indicator can have a positive relation to one LUF and a negative one to a different LUF, and this must be reflected in the direction the scale min-max is assigned to indicators in each LUF during the normalisation process (i.e high GDP may be good for LUF provision of work and bad for LUF provision of biotic resources, therefore the maxima are attached to high GDP values in the first case, to low GDP values in the second).

This is the second of three weighting factors: **w2**, taking discrete values from -1 to +1.

w3 – Regional importance of the indicator

Weight 3 reflects the importance of each indicator at a regional level. Once more a panel of experts need to define a set of indicator-specific rules to determine the importance of an indicator in separate regions. For example, *forest fire risk* is deemed of low importance in a region with a small forest area, and a low population density, i.e. where the impact of a

forest fire will be low. Some indicators, particularly the economic ones, are considered of equal importance in all regions. Care needs to be taken to minimise co-correlation of factors determining the rule base and those from which the indicator values themselves were derived. This is the third of three weighting factors: **w3**, taking discrete values from 0 (not relevant) to +3 (strong importance).

Together, the information in these weighting scores is used in the aggregation framework to address the issues a) to c) listed above, since they represent how much a LUF is sensitive to a change in a specific indicator and how much the relevance of a LUF changes across the European regions considered.

4. Test of the LUFs methodology for the Netherlands

In order to test the LUF methodology it was decided in an internal EU-LUPA meeting in Roskilde to apply it to the Netherlands. Initially it was decided to consider NUTS 3 regions as the unit of assessment. However, after revising the number of indicators available at NUTS 3 level, and having in mind that a minimum of 12 indicators should be available to apply meaningfully the LUF methodology, it was decided to use NUTS 2 level as the spatial unit for the assessment. The 12 NUTS 2 regions of the Netherlands are mentioned in Table 5.

Table 5 Region codes and names of the NUTS 2 regions considered in the test case for the Netherlands

Region code NUTS 2	Region name
NL11	Groningen
NL12	Friesland (NL)
NL13	Drenthe
NL21	Overijssel
NL22	Gelderland
NL23	Flevoland
NL31	Utrecht
NL32	Noord-Holland
NL33	Zuid-Holland
NL34	Zeeland
NL41	Noord-Brabant

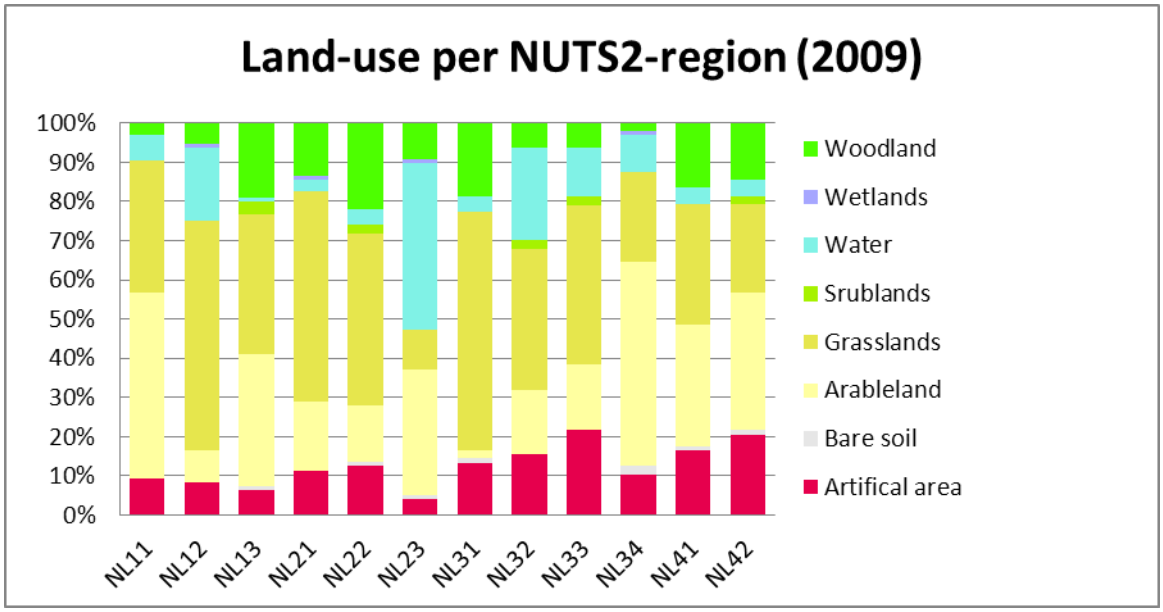
NL42	Limburg (NL)

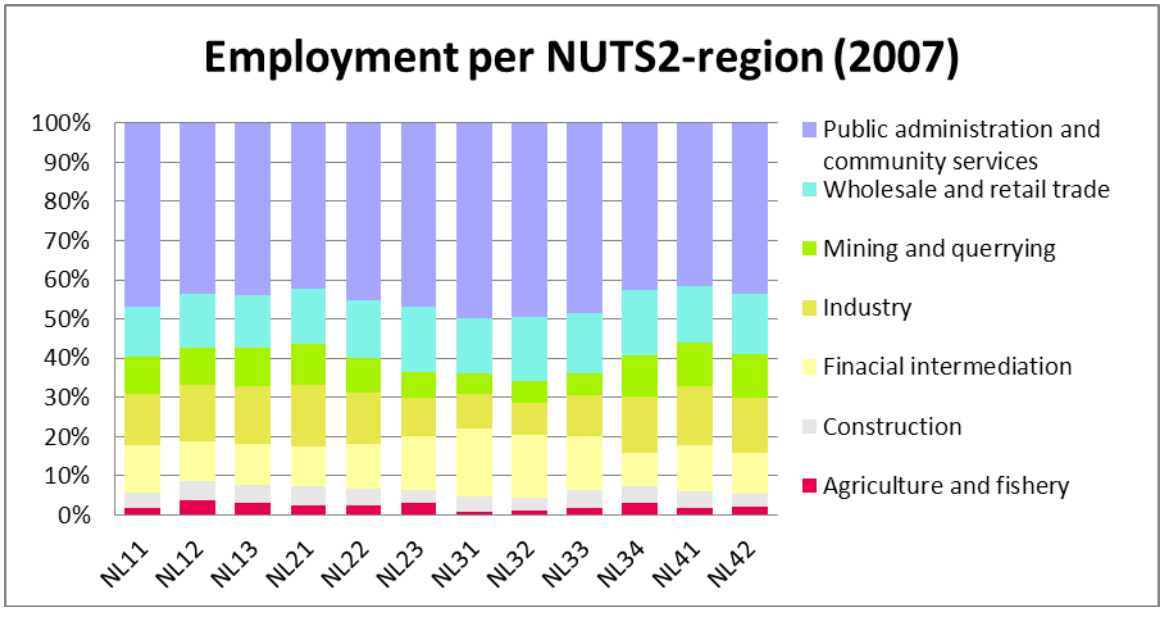
The objective of the exercise was:

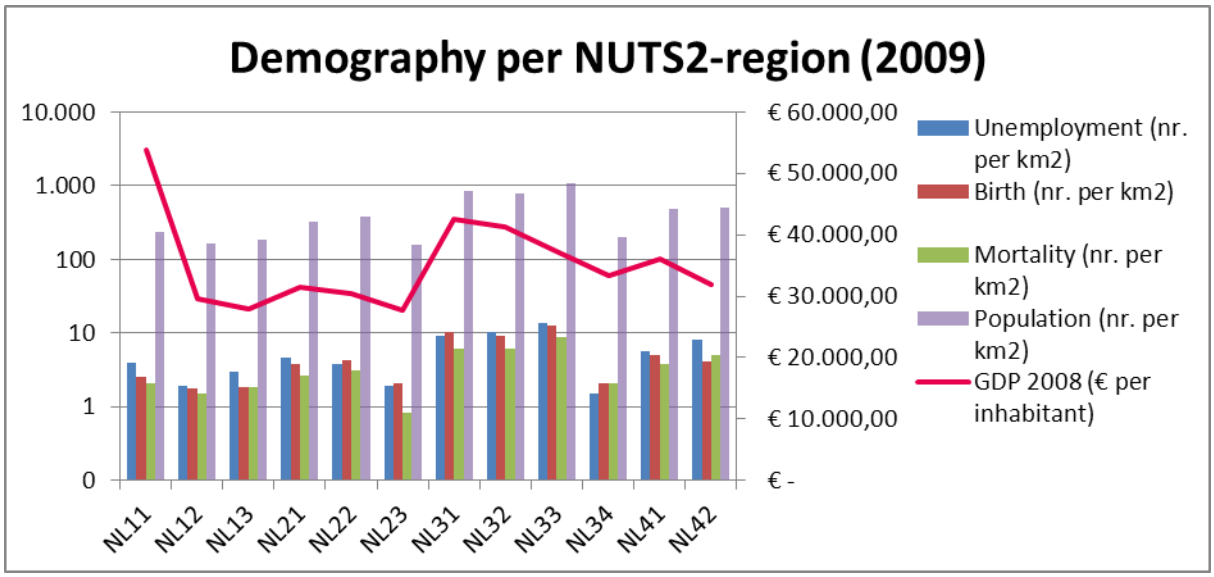
- To assess the suitability of the LUFs methodology in EU-LUPA for assessing the impacts of land use change between 2000 and 2006 (suing as basis the changes in CLC) in a comprehensive way and not based on the partial views provided by individual indicators: multi-criteria analysis;
- To estimate the impact of land use changes on sustainability, measured as integration of the economic, social and environmental dimension;
- To identify the number and quality of the land use functions present in the twelve Duct provinces and therefore the degree of existing multifunctionality

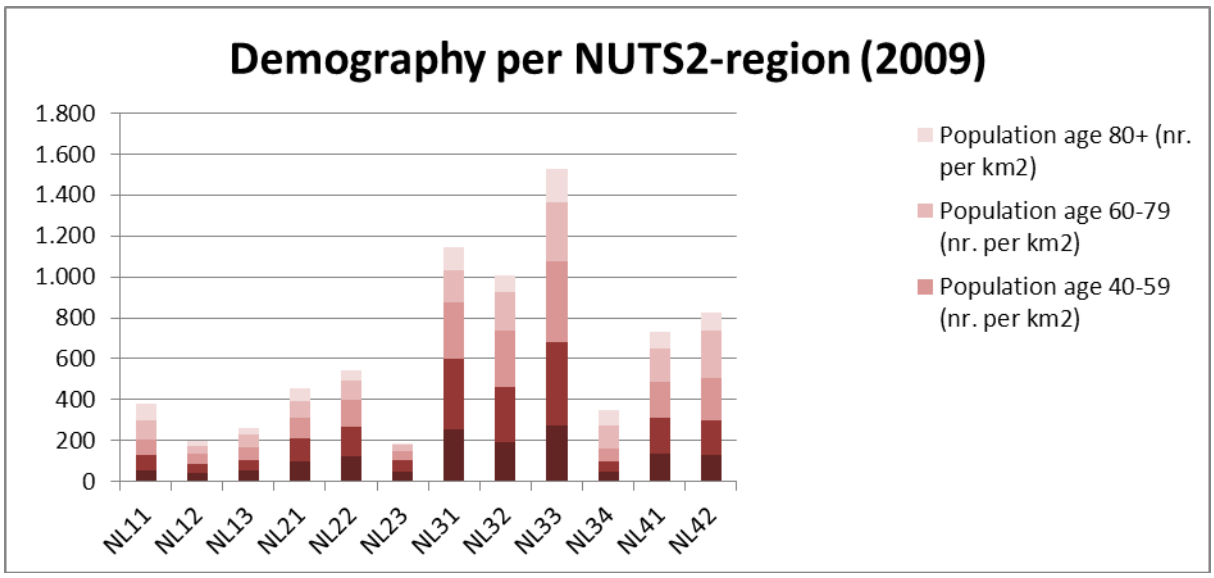
Detailed description of the 12 Dutch provinces (NUTS 2 regions) for supporting the LUFs Assessment

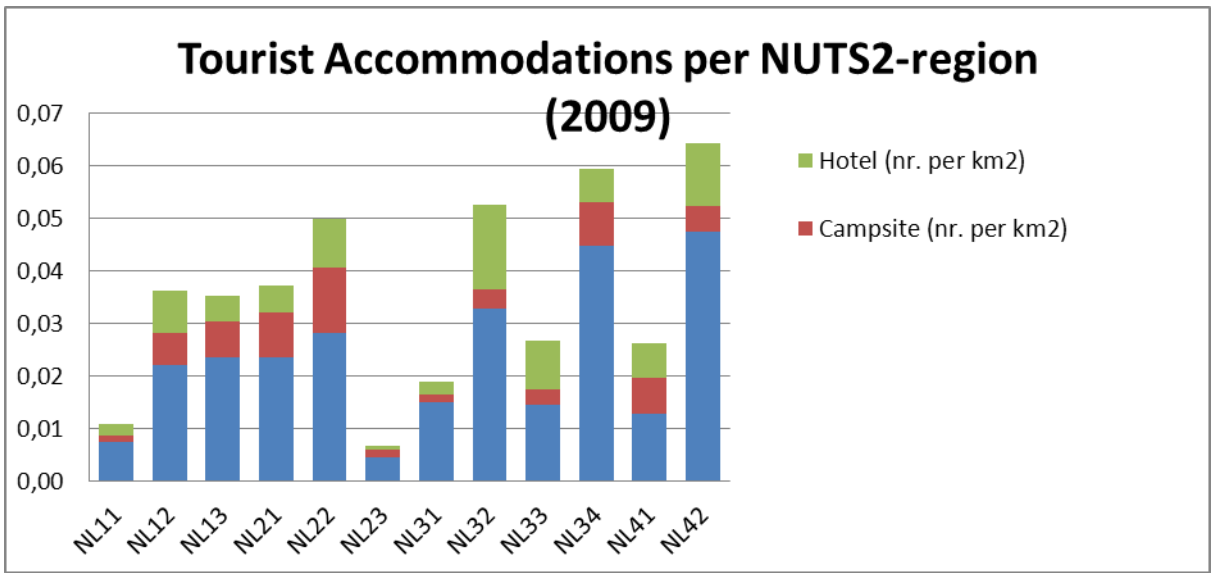
The objective of this activity was to describe in an easy to use and attractive way the key bio-physical and socio-economic variables describing the 12 Dutch provinces. The graphs provided were used by the Alterra experts when filling in the regional tables linking indicators to Land Use Functions.

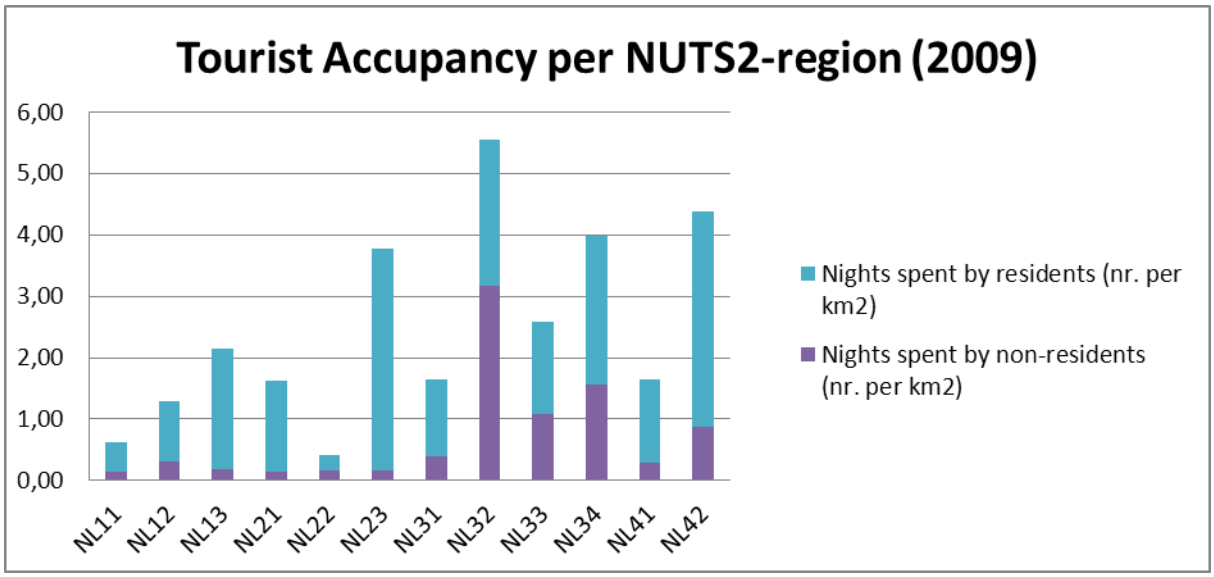


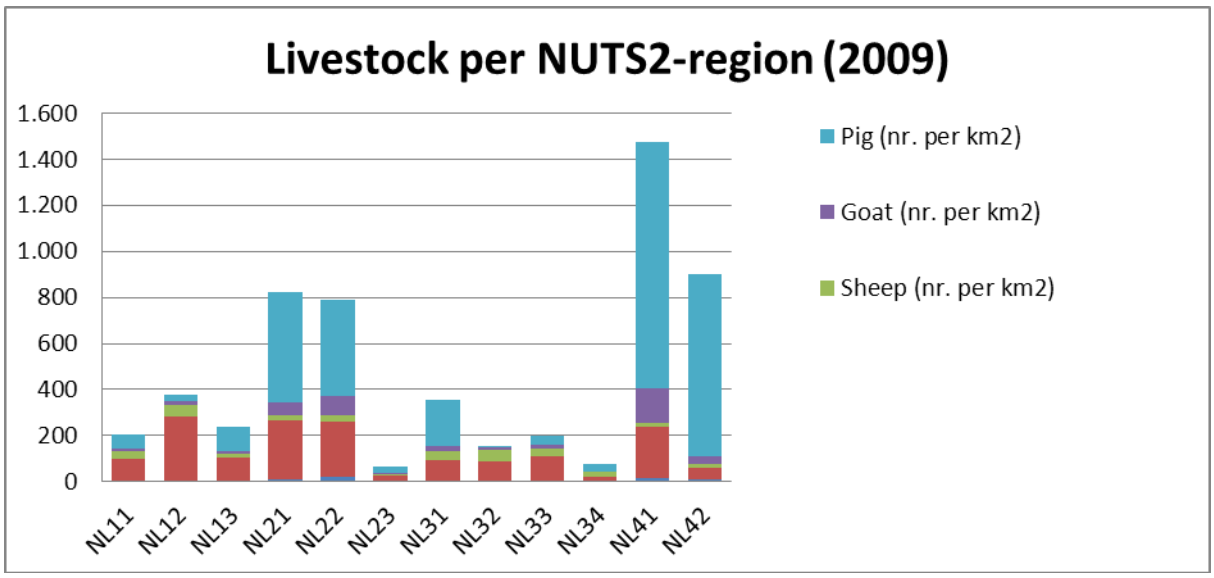


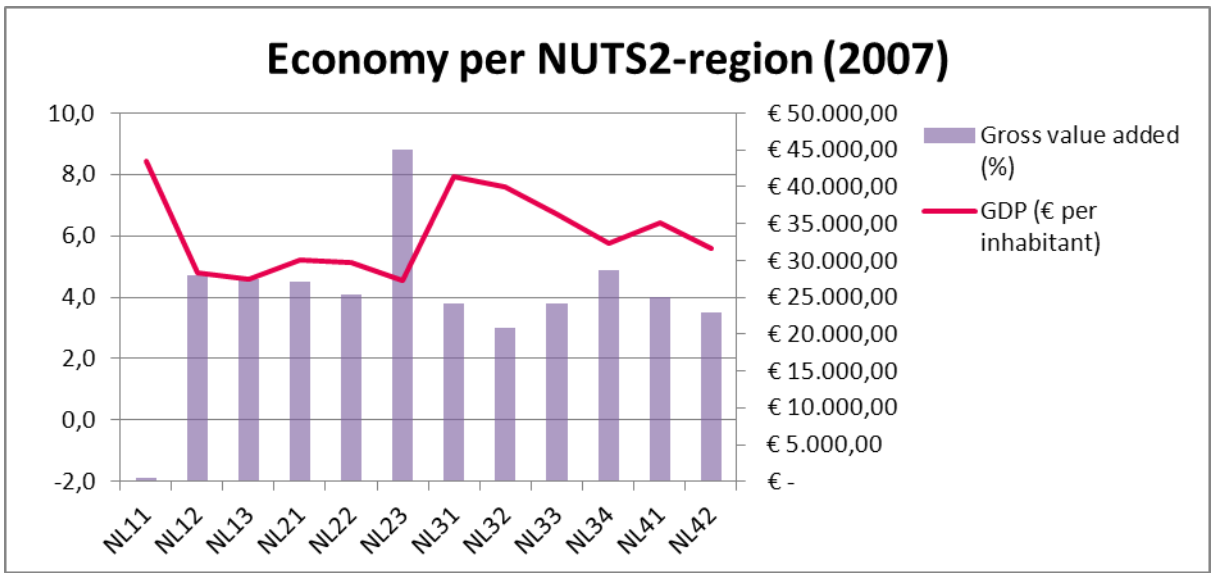

Demography per NUTS2-region (2009)
10.000
1.000
100
10
1
0
€ 60.000,00
€ 50.000,00
€ 40.000,00
€ 30.000,00
€ 20.000,00
€ 10.000,00
€ -
NL11
NL12
NL13
NL21
NL22
NL23
NL31
NL32
NL33
NL34
NL41
NL42
Unemployment (nr. per km2)
Birth (nr. per km2)
Mortality (nr. per km2)
Population (nr. per km2)
GDP 2008 (€ per inhabitant)


Demography per NUTS2-region (2009)
1.800
1.600
1.400
1.200
1.000
800
600
400
200
0
NL11
NL12
NL13
NL21
NL22
NL23
NL31
NL32
NL33
NL34
NL41
NL42
Population age 80+ (nr. per km2)
Population age 60-79 (nr. per km2)
Population age 40-59 (nr. per km2)


Tourist Accommodations per NUTS2-region (2009)
0,07
0,06
0,05
0,04
0,03
0,02
0,01
0,00
NL11
NL12
NL13
NL21
NL22
NL23
NL31
NL32
NL33
NL34
NL41
NL42
Hotel (nr. per km2)
Campsite (nr. per km2)


Tourist Accupancy per NUTS2-region (2009)
6,00
5,00
4,00
3,00
2,00
1,00
0,00
NL11
NL12
NL13
NL21
NL22
NL23
NL31
NL32
NL33
NL34
NL41
NL42
Nights spent by residents (nr. per km2)
Nights spent by non-residents (nr. per km2)


Livestock per NUTS2-region (2009)
1.600
1.400
1.200
1.000
800
600
400
200
0
NL11
NL12
NL13
NL21
NL22
NL23
NL31
NL32
NL33
NL34
NL41
NL42
Pig (nr. per km2)
Goat (nr. per km2)
Sheep (nr. per km2)


Economy per NUTS2-region (2007)
10,0
8,0
6,0
4,0
2,0
0,0
-2,0
€ 50.000,00
€ 45.000,00
€ 40.000,00
€ 35.000,00
€ 30.000,00
€ 25.000,00
€ 20.000,00
€ 15.000,00
€ 10.000,00
€ 5.000,00
€ -
NL11
NL12
NL13
NL21
NL22
NL23
NL31
NL32
NL33
NL34
NL41
NL42
Gross value added (%)
GDP (€ per inhabitant)

Step 1: Selection of suitable indicators

The following sources were reviewed for indicator selection: EUROSTAT database, EU-LUPA database and FP6 FARO-EU project database.

Justification for the selection of the indicators

The indicators were selected following the criteria described in step 1. In principle preference was given to indicators available at NUTS 3. However, only enough indicators were found at NUTS 2 level.

- Economic indicators

Gross domestic product (GDP) and value added per sector were selected as they were considered important by all experts. Value added per sector is represented by the total and specifically for agriculture which were the only two for which data are available.

- Social indicators

Unemployment rate and Net migration were selected as the experts formulated a strong request of indicators on equity. They met criteria a), b), c) and d) can be calculated at NUTS2.

- Environmental indicators

Environmental indicators are difficult to find at NUTS 2 level and therefore the list is shorter than originally expected. Soil sealing was included to represent soil quality impact issues.

In conclusion, the final list of indicators considered in the test case is presented in Table 6. It consists of 15 indicators, namely 7 economic indicators, 5 social indicators and 5 environmental indicators. The imbalance between indicators from the three sustainability dimensions is compensated using the 'weight 1' which incorporates an intrinsic indicator weight (see step 6).

Table 6 List of 15 indicators that were finally selected for the LUFs framework in the Netherlands. The spatial resolution is NUTS 2. The indicators are grouped according to the sustainability dimension to which they are mainly linked.

Indicator code	Indicator name
ECO_01	Value added per sector (total)
ECO_01a	Value added per agriculture
ECO_2	GDP ppp
ECO_3	Nights spent (tourism)
ECO_4	Transport networks (lot of artificial areas, minimum is 2)

ECO_5	Agricultural accounts
ECO_06	Area harvested
SOC_1	Unemployment rate
SOC_2	Net migration
SOC_3	Services of general interest
SOC_05	Household with broadband
SOC_6	Population density
ENV_01	Soil sealing
ENV_02a	Agricultural area in protected area
ENV_02b	Green areas
ENV_02c	Green areas close to residential areas (Based on percentage of artificial area)
ENV_05	Livestock density (current livestock density and area of pastures)

Step 2: Definition of the links of the indicators with the LUFs

The summary of contributions of indicators to the six LUFs is presented in Table 7. It shows a reasonable spread of indicators across the LUFs with most indicators contributing to more than one dimension of sustainability. Detailed tables (Appendix 1) describe the conceptual contribution of each selected indicator to each of the six LUFs where clear links were identified. The generic tables present the scores associated to the contribution as well as the scientific justification and the confidence on the scoring.

Table 7 Summary of cross-linkages between the 15 selected indicators and the six LUFs. The full analysis is provided in Appendix 1 of the document

Indicator code	Indicator name	LUF1	LUF2	LUF3	LUF4	LUF5	LUF6
ECO_01	Value added per sector (total)	1	1		1		
ECO_01a	Value added per agriculture			1			

ECO_2	GDP ppp	1	1		1	1	1
ECO_3	Nights spent (tourism)	1	1				
ECO_4	Transport networks (lot of artificial areas, minimum is 2)	1	1			-1	-1
ECO_5	Agricultural accounts			1			
ECO_06	Area harvested			1		-1	
SOC_1	Unemployment rate	-1		-1	-1		
SOC_2	Net migration	1			1		
SOC_3	Services of general interest	1			1		
SOC_05	Household with broadband				1		
SOC_6	Population density	1			1	-1	-1
ENV_01	Soil sealing	1		-1	1	-1	-1
ENV_02a	Agricultural area in protected area	1					
ENV_02b	Green areas		1				
ENV_02c	Green areas close to residential areas (Based on percentage of artificial area)				1		

ENV_05	Livestock density (current livestock density and area of pastures)		-1	1			

Step 3: Assessment of the importance of each indicator for the sustainability of the region

The description of the decision rules used by the experts will be done in individual fact-sheets if the methodology is accepted. They will include the 'importance' weighting showing how significant an issue (measured by the indicator) is in that Dutch province. The rule base determines the potential impact of change in an indicator for a particular region, and was based by the supporting descriptions of the 12 provinces presented at the start of this section 4, with land use and socio-economic (e.g. GDP, population, unemployment).

The regional importance scores take values between 1 and 3 as explained in section 3. The regional importance scores are summarised in Table 8, while full description of the rule bases and the scientific justification should be given separately (example shown in Appendix 2.

Table 8 The regional importance scores (1 to 3) are indicated for each selected indicator in the regions of analysis

Indicator code	Indicator name	Twelve Dutch provinces (NUTS 2 regions)											
		NL11	NL12	NL13	NL21	NL22	NL23	NL31	NL32	NL33	NL34	NL41	NL42
		Groningen	Friesland	Drenthe	Overijssel	Gelderland	Flevoland	Utrecht	Noord-Holland	Zuid-Holland	Zeeland	Noord-Brabant	Limburg
ECO_01	Value added per sector (total)	2	2	2	2	2	2	2	2	2	2	2	2
ECO_01a	Value added per agriculture	3	3	2	2	2	3	2	3	2	3	3	2
ECO_2	GDP ppp	2	2	2	2	2	2	2	2	2	2	2	2
ECO_3	Nights spent (tourism)	1	2	2	2	3	1	2	3	2	3	2	3
ECO_4	Transport networks (lot of artifical areas, minimum is 2)	2	2	2	2	2	2	3	3	3	2	2	3
ECO_5	Agricultural accounts	3	3	2	2	2	3	2	3	2	3	3	2
ECO_06	Area harvested	3	2	2	2	2	3	1	3	1	3	3	2
SOC_1	Unemployment rate	2	2	2	2	2	2	2	2	2	2	2	2
SOC_2	Net migration	3	2	2	2	2	2	2	2	2	3	2	3
SOC_3	Services of general interest	2	2	2	2	2	2	2	2	2	2	2	2
SOC_05	Household with broadband	2	2	2	2	2	2	2	2	2	2	2	2

SOC_6	Population density	1	1	1	2	2	1	3	3	3	1	2	2
ENV_01	Soil sealing	1	2	1	1	2	2	3	3	3	1	3	2
ENV_02a	Agricultural area in protected area	2	2	2	2	2	2	2	2	2	2	2	2
ENV_02b	Green areas	2	2	2	2	2	2	2	2	2	2	2	2
ENV_02c	Green areas close to residential areas (Based on percentage of artifical area)	1	1	1	2	2	1	2	2	3	1	2	3
ENV_05	Livestock density (current livestock density and area of pastures)	2	3	2	3	3	1	2	2	2	1	3	3

Step 4: Assessment of sustainability limits

This step has not yet been performed, awaiting for the acceptance of the methodology. The work regarding this step is linked to WP2.3 Land Use Performance and Efficiency. For this test case we have used the average value as reference to assess the performance of the regions.

Step 5: Normalisation of the indicators and sustainability limit values

The equation used for normalisation of indicators is the following:

$$I_{NORM} = \frac{x - \min}{\max - \min} * 10$$

where x is the value of the indicator, and min and max are the minimum and maximum values of the whole range for the year 2000.

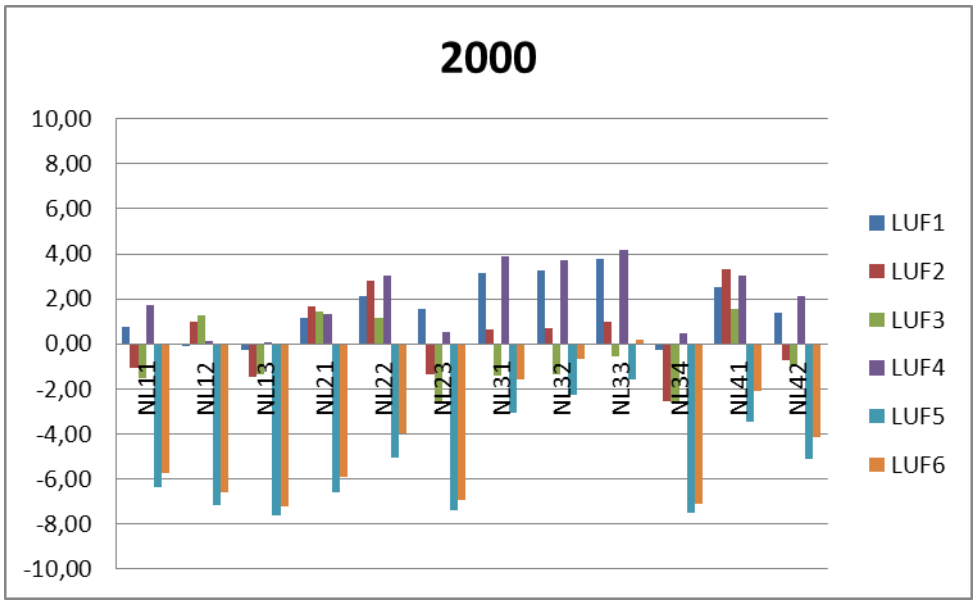
These calculations are available in Excel sheets.

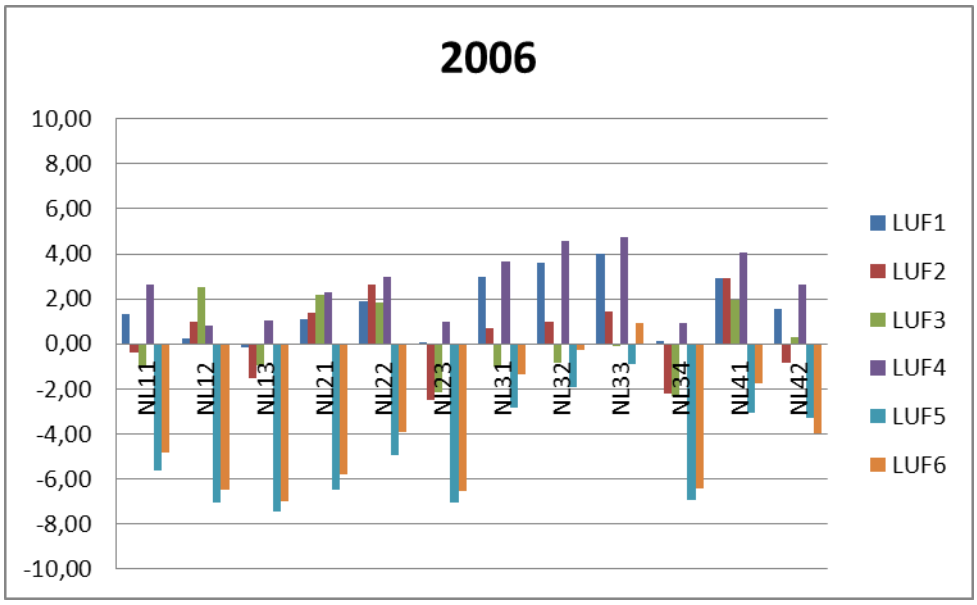
Step 6: Integrated regional impact assessment

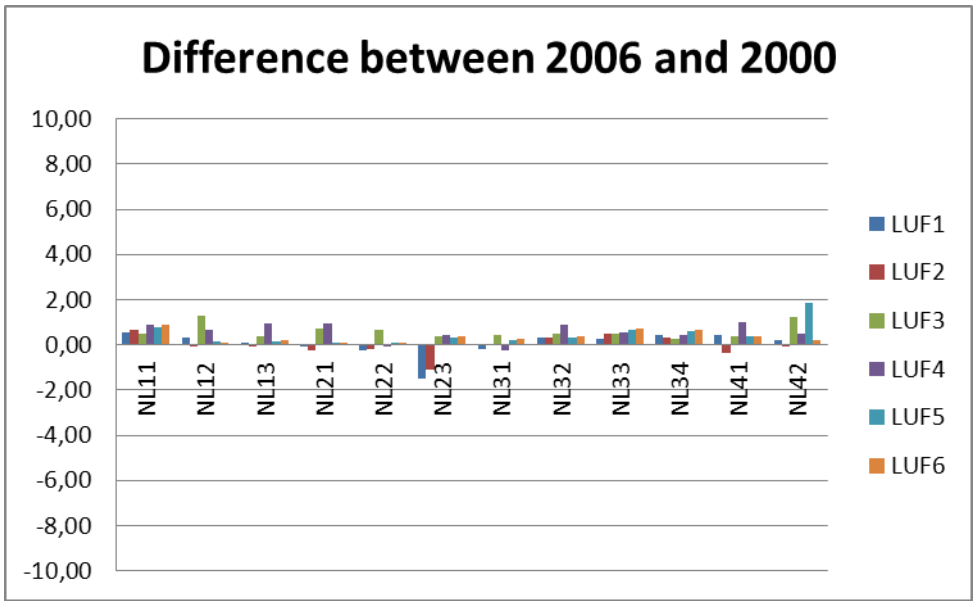
The LUFs methodology has been successfully implemented, as it is shown in the following series of figures showing the variation in the impacts that the land use change that took place between 2000 and 2006 had on the six Land Use Functions in the 12 Dutch provinces.

These first set of three figures shows the values of the six LUFs for each province in 2000 and 2006, and the difference between both years. In general terms, it shows how the economic functions are performing well, whereas the societal and especially the environmental have mainly negative values, which is in accordance to the predictions of the experts.

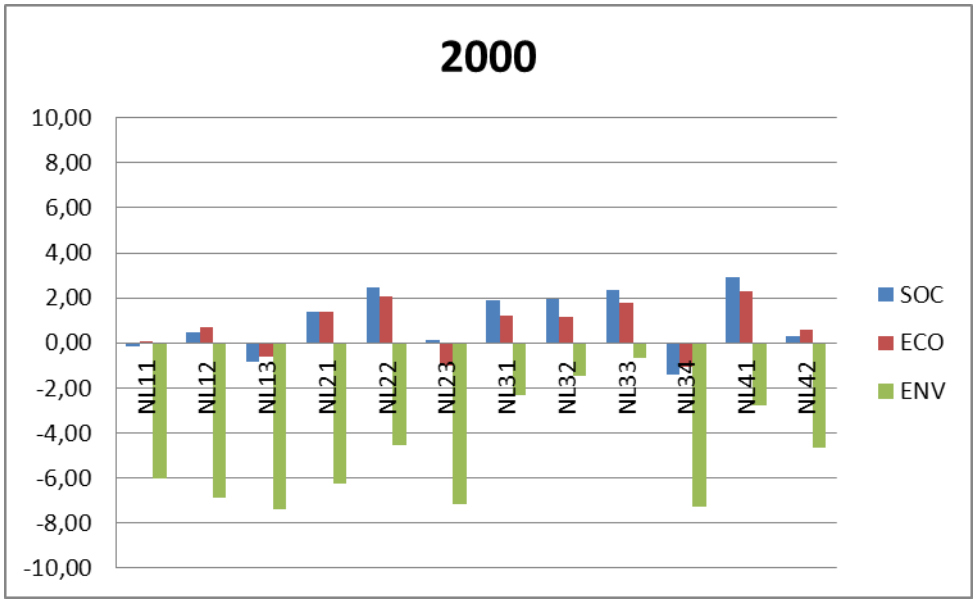
Its shows as well how small are the differences between 2000 and 2006, which is in accordance to the small changes observed in the CLC classes between the two years for the Netherlands. Still there are important differences between the regions, e.g. the three richest regions of the NL (NL 31, NL32 and NL33) have higher values in the economic LUFs

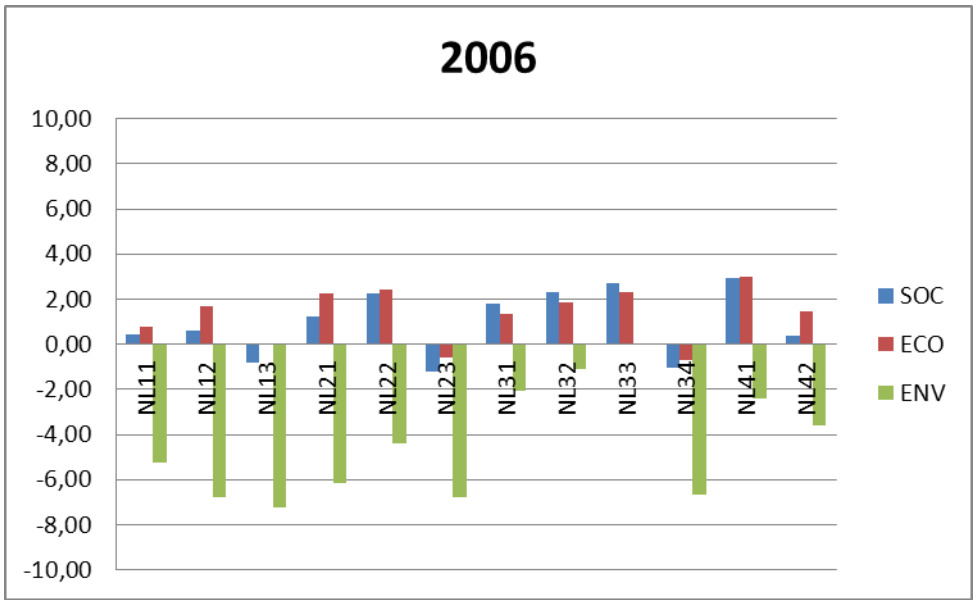

2000
10,00
8,00
6,00
4,00
2,00
0,00
-2,00
-4,00
-6,00
-8,00
-10,00
NL11
NL12
NL13
NL21
NL22
NL23
NL31
NL32
NL33
NL34
NL41
NL42
LUF1
LUF2
LUF3
LUF4
LUF5
LUF6

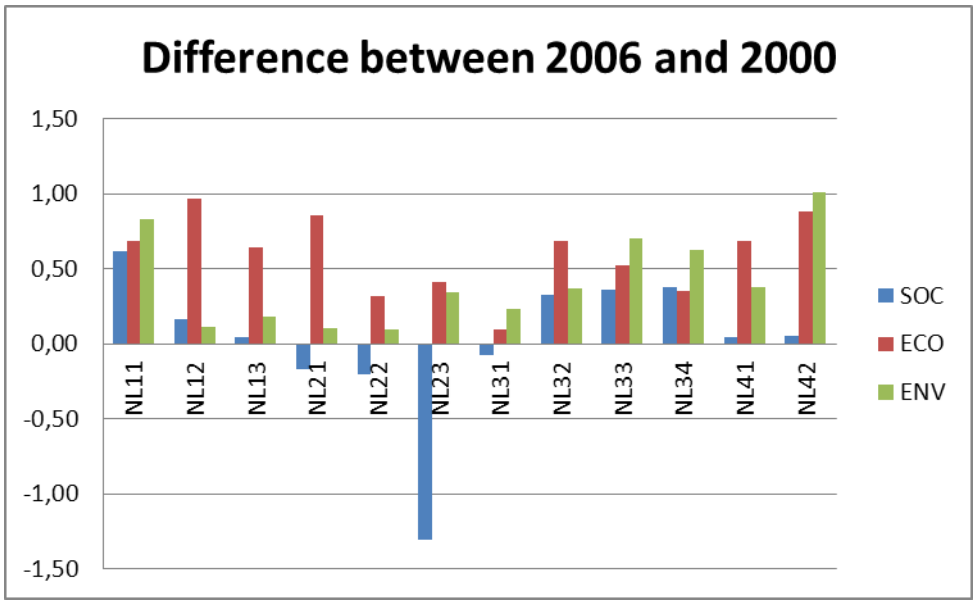

2006
10,00
8,00
6,00
4,00
2,00
0,00
-2,00
-4,00
-6,00
-8,00
-10,00
NL11
NL12
NL13
NL21
NL22
NL23
NL31
NL32
NL33
NL34
NL41
NL42
LUF1
LUF2
LUF3
LUF4
LUF5
LUF6


Difference between 2006 and 2000
10,00
8,00
6,00
4,00
2,00
0,00
-2,00
-4,00
-6,00
-8,00
-10,00
NL11
NL12
NL13
NL21
NL22
NL23
NL31
NL32
NL33
NL34
NL41
NL42
LUF1
LUF2
LUF3
LUF4
LUF5
LUF6

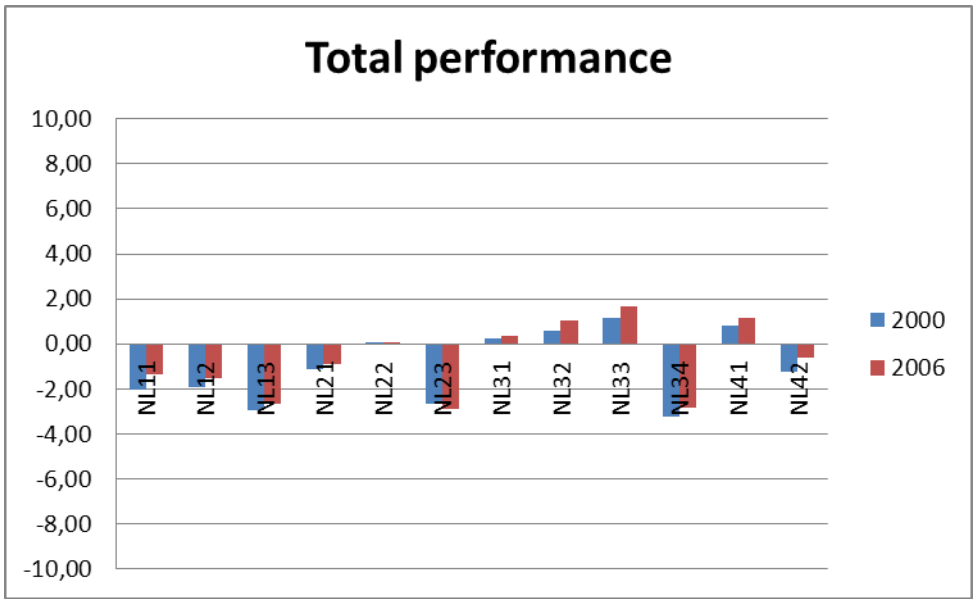
These second set of three figures shows the aggregation of the six LUFs into the three sustainability dimensions for each province in 2000 and 2006, and the difference between both years. In general terms, it shows how the economic and social functions are performing well, whereas the environmental dimension has negative values in all the provinces, , which is in accordance to the predictions of the experts.







This last figure shows the total performance of each province in 200 and 2006, by aggregating the three sustainability dimensions. It shows how all the provinces have increase their performance in 2006 compared to 2000, and the regions of Utrecht, North Holland, South Holland, and North Brabant are performing in general above the average whereas the other eight provinces have a total performance below the average.



Additional maps could be created in the future to provide a spatial visualisation of the results. Further evidence confirming the results is needed.

5. Conclusions

This report describes the methodology of the LUFs adapted for the EU-LUPA project and its application to the Netherlands. The preliminary results indicate that the methodology is feasible and the results are plausible.

If the methodology will be accepted by the EU-LUPA team, then further work is needed regarding:

- the further search of new indicators
- the description of the number of functions per province (based on the results of the normalisation before the weighing)
- the relation of the possible links of the observed LC changes with the changes observed in the LUFs.
- Refinement in the definition of the sustainability limits

6. References

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Appendix 1: The indicators and their contributions to the six Land use Functions

Table a: Impact indicators contributing to LUF 1 *Provision of work*

Indicator	Impact issue	Score	Justification for score	Confidence of expertise
Value added per sector (80/ESTAT)	ECO8.1	1	Medium positive link: positive returns on investments	High
GDP ppp (1/ESTAT)	ECO11.1	2	Strong positive link: high growth rate of real GDP purchasing power parties per inhabitant are beneficial to the economy and to the society and means better preconditions to strengthen potentials in all economic and social LUFs	High
Unemployment rate (125 ESTAT)	SOC1.1	-2	Strong negative link: increase in unemployment rate means more tensions in labour markets and more problematic access to employment opportunities	High
Net migration (137/ESTAT)	SOC9.1	2	Strong positive link: positive migration balance means attractiveness for workers;	High
Agricultural area within protected areas[1]	SOC11.1	+1	Medium positive link: increase in agricultural area within protected areas means more jobs in the agricultural sector.	High
Soil sealing (CLC or HRSS layers)	ENV3.2	1	Medium positive link: Soil sealing occurs as a result of construction, which means provision of work in the construction sector. BE AWARE IN REGIONS WITH HIGH AGRICULTURAL AREA BECAUSE RURAL MIGRATION TO CITIES TO WORK IN THE CONSTRUCTION? Decrease in employment in agriculture due to increase in SS?.	Medium
Nights spent (Total/ 103 ESTAT)		2	Strong positive link: high number of nights means more jobs in the area;	High
Transport networks (105/ESTAT or ESPON accessibility indicator)		2	Strong positive link: higher accessibility means more jobs in the area;	High
Services of general interest (hospitals, schools, universities)		1	Medium positive link: higher nr of SIG means more jobs in the area; it could be also for people living there but not working	High

Gross expenditure on research and development (GERD)(88/ESTAT)		1	Medium positive link: higher investments resulting in more direct jobs and spin-off	

[1]Perhaps ESTAT/55 'Agricultural areas in less favoured areas'

Table b: Impact indicators contributing to LUF 2 *Provision of leisure and recreation activities*

Indicator	Impact issue	Score	Justification for score	Confidence of expertise
Value added per sector (80/ESTAT)	ECO8.1	1	Medium positive link: positive returns on investments	High
GDP ppp (1/ESTAT)	ECO11.1	1	Medium positive link: high growth rate of real GDP per capita means that more money is available for leisure; however, it also often means more congestion (bad for recreation)	High
Green areas	SOC11.1	+2	High positive link: increase in green areas means more areas for leisure	High
Cultural heritage sites (UNESCO)		+2	High positive link: increase in green areas means more areas for leisure	High
Cultural (cinemas, theaters, pubs, restaurants, SERGENI)		+2	High positive link: increase in green areas means more areas for leisure	High
Nights spent (Total/ 103 ESTAT)		2	Strong positive link: high number of nights means more jobs in the area;	High
Livestock density (57)		-2	Strong negative link: high intensity of agriculture means less attractiveness for recreation	High
Transport networks (105/ESTAT or ESPON accessibility indicator)		2	Strong positive link: higher accessibility has a positive impact on leisure;	High
Forest fire risks (ESPON)	ENV9.1	-1	Medium negative link: if the risk is high, it has a negative impact on landscape recreational amenities. Potential risk of death and respiratory problems.	High

Table c: M2 indicators contributing to LUF 3 *Food and energy production*

Indicator	Impact issue	Score	Justification for score	Confidence of expertise
Value added per sector (agriculture) (ESTAT/80)	ECO8.1	2	Strong positive link: increase in value added in agriculture means better valuation of agriculture potentials, in link with more efficiency and competitiveness of the sector	high
Value added per sector (energy) (ESTAT/80)	ECO8.1	1	Medium positive link: increase means potentials in land based renewable energy sources are more valuated	Medium (since modelled at country level)
Renewable energy (ask Berien)				
Agriculture accounts (ESTAT 56)		2	High positive link: the higher the subsidies, the higher the stimulus for farmers to increase the use of land	High
Unemployment rate	SOC 1.1	-1	Medium negative link as in countries with a high level of employment in the primary sector (say >= 10%) when unemployment increases the impact will fall mostly on agriculture and other sectors with land-based production	high
Soil sealing	ENV3.2	-2	In case of good quality agricultural soils, the sealing (covering the soil with concrete, urbanisation) results to rapid decrease of soil availability and thus reduces its production potential	high
Nitrogen and P input (ask Jan-Peter Lesschen)	ENV 6.6	2	Medium positive link. Increased use of N and P generally increases yields.	High
Area harvested (ESTAT/58)		2	High positive link: the higher the subsidies, the higher the area harvested, the higher the potential agricultural production	High
Forest fire risk (ESPON natural hazards)	ENV 9.1	-2	Forest fires strongly affect economic functions of forests such as production of timber and non timber forest products.	high

Table d: M2 indicators contributing to LUF 4 *Housing and transport and energy infrastructure*

Indicator	Impact issue	Score	Justification for score	Confidence of expertise
Value added per sector	ECO8.1	1	Medium positive link: positive returns on investments	High
GDP	ECO11.1	2	Strong positive link: high growth rate of real GDP per capita are beneficial to the economy and to the society and means better preconditions to strenghten potentials in all economic and social LUFs	high
Unemployment rate	SOC1.1	-1	Strong negative link: increase in unemployment rate has a negative impact on households income and consumer demand	high
Net migration	SOC9.1	1	Medium positive link:	Medium
Green areas within or close to residential zones	SOC11.1	1	Proximity to green areas has weak link to residential and no link to non-land based production function. In regions where the green areas are proxime, residential areas and services have higher value on the market.	Low
Soil sealing	ENV 3.2	2	One of the definitions of soil sealing is a covering (sealing) the soil trough building or construction work, it means the urban expansion and increase of space where residential, social and productive human activities could take place.	high
Household with broadband access (ESTAT 133)		2	Strong positive link;	
Services of general interest (hospitals, schools, universities)		1	Strong positive link: higher nr of SIG means more jobs in the area; it could be also for people living there but not working	High
Gross expenditure on research and development (GERD)(88/ESTAT)		1	Medium positive link: higher investments resulting in more direct jobs and spin-off	

Table g: M2 indicators contributing to LUF 5 *Provision of abiotic resources*

Indicator	Impact issue	Score	Justification for score	Confidence of expertise
GDP	ECO11.1	1	Strong positive link: high growth rate of real GDP per capita is beneficial to the economy and to the society with positive externalities for the environment.	high
NH3	ENV1.1	-2	Ammonia emissions affect negatively the quality of air, water and soil. Ammonia is a secondary particulate precursor affecting air quality. It can cause plant damage. In addition, deposition of nitrogen compounds from NH3 emissions can lead to increased concentrations of nitrate in ground and drinking water due to nitrate leaching. Finally, ammonia emissions increase the N depositon and can lead to eutrophication and acidification of soils (EEA 2001; Velthof et al. 2007).	High
NOx	ENV1.2	-2	Contributes directly to eutrophication of semi-natural habitats, together with NH3 emissions, and therefore loss in biodiversity and quality of habitats. Indirect effects include subsequent impacts on acidity and eutrophication of freshwaters through leach	High
N/P surplus	ENV 2.1	-1	Could have negative impact on quality of water resources	
Soil sealing	ENV 3.2	-2	In case of good quality agricultural soils, the sealing (covering the soil with concrete, urbanisation) results to rapid decrease of soil availability. Same implies also to availability of some raw materials. In some cases, the change of surface and ground water cycle as well as pollution connected with the ongoing urbanisation may result to decrease of water quality and availability.	high
Transport networks (105/ESTAT or ESPON accessibility indicator)		-2	Strong negative link: higher accessibility means more air/water pollution;	High
Pesticide use	ENV 6.6	-1	Direct negative link: pesticides impact on quality of water resources	High
Forest fire risk	ENV 9.1	-1	Forest fires could affect non production functions of forest (maintenance of water circulation, erosion prevention, desertification mitigation, microclimate maintenance, etc.) and decrease the availability of quality water, soil or air.	high
Area harvested (ESTAT/58)		-2	High negative link: the higher the subsidies, the higher the area harvested, the higher the potential agricultural production and risk for pollution	High

Table h: M2 indicators contributing to LUF 6 *Provision of biotic resources*

Indicator	Impact issue	Score	Justification for score	Confidence of expertise
GDP	ECO11.1	2	Strong positive link: high growth rate of real GDP per capita is beneficial to the economy and to the society with positive externalities for the environment.	high
NH3	ENV1.1	-2	Ammonia emissions increase the N atmospheric deposition, which causes nitrogen enrichment (eutrophication) of soil and surface waters, which in turn can lead to excessive algal blooms in coastal waters and a decrease in faunal and floristic species diversity in natural areas (EEA 2001, Velthof et al. 2007).	High
NOx	ENV1.2	-2	Contributes directly to eutrophication of semi-natural habitats, together with NH3 emissions, and therefore loss in biodiversity and quality of habitats. Indirect effects include subsequent impacts on acidity and eutrophication of freshwaters through leach	High
N/P surplus	ENV 2.1	-1	Negative impact on water quality with	
Soil sealing	ENV 3.2	-2	The increment of built up areas and transport infrastructures causes fragmentation of habitats and disruption of migration corridors for wildlife species	high
Transport networks (105/ESTAT or ESPON accessibility indicator)		-2	Strong negative link: higher accessibility means more disturbance in the area;	High
Pesticide use	ENV 6.6	-2	Strong negative impact on biodiversity	High
Forest fire risk	ENV 9.1	-2	Fires can lead to the fragmentation of forest habitats important for species. (note. This is not the case of natural fires, which are one of the elements of ecosystem regeneration)	medium

[1] **fragmentation: Is there an indicator available?**

Appendix 2: Examples of Rule bases and scientific justification for deriving Regional Importance Scores (weight 3)

2.1 Environmental indicators

ENV NOx emissions

Nitrogen dioxide (NOx) can have impacts on human health (e.g. respiratory problems) (Kampa & Castanas, 2006), can damage buildings via acid rain (Butlin, 1990), and is one source of atmospheric nitrogen (the other major source is ammonia) which when deposited can lead to eutrophication of natural habitats, and nitrate leaching into waterways (Achermann & Bobbink, 2003; Bobbink *et al.*, 1998). Thus its importance was calculated based on a combination of population density in a cluster (for human health and impacts on the built environment) and the proportion of habitats potentially sensitive to eutrophication and acidification – which was taken to include all land protected under NATURA 2000 designation (or similar data from CORINE Biotopes for those countries for which NATURA data were not available). Population density was obtained from the description of cluster regions (Annexe 1), taken as the upper limit of the range in which the median population density occurred (median of the distribution of values for all NUTSx regions in that cluster). The proportion of land under NATURA 2000 or similar designation was also calculated per Cluster region (Table 3.x).The basic rules for attributing a score in relation to these two descriptors were as follows:

- Impact on urban areas, based on Population density (Pop Dens):

IF Pop Dens < 50 THEN score 1 *(predominantly rural)*
IF Pop Dens 50 < x < 100 THEN score 2
IF Pop Dens > 100, score 3 *(large centres of population, or highly urbanised areas)*

- Impact on natural habitats, based on Proportion of protected land area (Prot Area):

IF Prot Area < 0.35 THEN score 1 *(25%ile)*
IF Prot Area 0.35 < x < 1.75 THEN score 2
IF Prot Area > 1.75 THEN score 3 *(75%ile)*

Most clusters have reasonably high population density somewhere within the region where NOx effects may occur, and all clusters will have some measure of sensitive natural habitats that should be protected from eutrophication. Therefore, these two scores were combined with a simple rule base to achieve a final score which is intended to highlight the importance of NOx in all regions except those which have very few centres of population and have very little habitat in need of protection from eutrophication. All scores are shown in Table 10 below. The rule base for calculating the final importance for NOx in each cluster was as follows:
If scores sum to 2, score 1
If scores sum to 3, score 2
If scores sum to 4 or more, score 3

Table 9 Descriptors of cluster regions used to assess the importance of NOx in the cluster regions

CR	Cluster Region name	Median population density	% of protected land area	Population density score	Protected area score	FINAL REGIONAL IMPORTANCE SCORE (NOx emissions)
1	Scandinavian mountains and valleys	10	0.07	1	1	1
2	Scandinavian Shield	10	0.39	1	2	2
3	Eastern Baltic Plains	39	1.98	1	3	3
4	Central Baltic Plains	19	1.30	1	2	2
5	South-East Baltic	79	2.28	2	3	3
6	Alpine Mountains and Valleys	149	0.11	3	1	3
7	North-West Atlantic	149	0.98	3	2	3
8	West Baltic/North Sea	299	0.30	3	1	3
9	North-Eastern Lowlands/Southern Baltic	149	0.22	3	1	3
10	North Sea Plains	299	1.95	3	3	3
11	Balkan Plains	79	3.46	2	3	3
12	Central Continental Lowlands	149	0.75	3	2	3
13	South Continental	79	1.74	2	2	3
14	Atlantic Plains	79	1.71	2	2	3
15	Central Atlantic Plains/Hills	299	0.26	3	1	3
16	Central Atlantic Hills	79	0.47	2	2	3
17	Central Atlantic Hills/Plains	79	0.28	2	1	2
18	Central Atlantic Lowlands	599	0.60	3	2	3
19	Northern Mediterranean Coastal/Hinterland	149	0.38	3	2	3
20	Central Pannonian Plains	79	3.45	2	3	3
21	East Pannonian Plains	79	1.67	2	2	3
22	North Pyrenean Margin	79	0.45	2	2	3
23	Atlantic Lusitanian Coast	149	0.33	3	1	3
24	West Mediterranean	149	0.52	3	2	3
25	Core Mediterranean	39	0.68	1	2	2
26	South-East Mediterranean	39	1.52	1	2	2

27	West Iberia and Mediterranean Islands	79	2.01	2	3	3

Impact issue: Water quality

2.2 Socio-economic indicators

Related to employment

Preliminary remarks

The methodology implemented in this document has been developed on the basis of the information written in the report "The detailed description of cluster regions" (Annexe 1). This information provided us with essential data to implement our process and finalise the framework. However, the range of socio-economic indicators and the spatial level at which these indicators were described forced us to make some simplifications both in terms of the decision rules applied and of the spatial level at which the assessment was carried out. This last point is particularly important because cluster regions are characterized by a high level of heterogeneity with regard to socio-economic indicators (Annexe 1). Our rationale is based on the recognition of two different kinds of indicators: general indicators and specific ones

General indicators

ECO6.1; ECO11.1; SOC1.1; SOC 3.1 and SOC 3. 2

They cover socio-economic contextual characteristics of the cluster regions that can favour (or hinder) the performances of the LUFs. Thus, they help examining the overall potentials of the LUFs based on the assumption that good economic and social conditions mean high potentials in terms of LUFs. General indicators are considered relevant for all the clusters and a score 2 is automatically assigned to general indicators in all the clusters.

Specific indicators

ECO8.1a and ECO8.1b

They assess the performances of the LUFs with regard to particular aspects which importance for each cluster has to be assessed. In order to identify the importance of the indicators in the 27 cluster regions we made use of a two-step assessment that starts with general indicators and then evaluates specific indicators. Consistently with what we have assumed, general indicators are considered relevant for all the clusters. Thus, score 2 was assigned to general indicators in all the clusters. Then, in those clusters where the level of the general indicator does not pass the threshold, as defined in table 10 of the Deliverable 3.2.2b (socio-economic aspects), we moved to examine specific indicators which may revel "hidden" problems. Otherwise, when the indicator passes the threshold we did not evaluate the importance of the specific indicators because a negative general assessment cannot be compensated by a positive assessment referred to particular aspects.

In order to assess the importance of specific indicators in cluster regions, it was assumed that they would be relevant when the sector they refer to is important for the economic structure of the cluster. This importance was evaluated with the following descriptors of cluster regions:

- The degree of relevance of the agricultural sector was assessed by using the proportion of arable cover in the cluster region.
- The degree of relevance of the energy sector was assessed by using GDP per capita, assuming the existence of a positive link between GDP and energy demand.

The Descriptor “arable land” was available in absolute terms. Thus, in order to identify decision rules, the statistical distribution of this descriptor was analysed and the criteria for the selection of the regions where agriculture is important sectors were defined with regard to the quartiles values. The importance of the sector was considered to be 0 if descriptor value was less than the first quartile, to be 1 if the descriptor value was comprised between the first and third quartile and to be 2 if the descriptor value was above the third quartile. The cut off values for each descriptor are presented below:

- Importance of the agriculture sector,

IF arable cover <13 THEN A = 0
IF 13 < arable cover < 38 THEN A = 1
IF arable cover > 38 THEN A = 2

As for the descriptor GDP per capita, rules for deciding on the importance of the indicator were as follows:

- Importance of energy sector

IF % area of cluster is in class ‘below 16000 $PPP per capita’ < 50 THEN A = 0
IF % area of cluster is in class ‘over 20000 $PPP per capita’ > 50 THEN A = 0
ELSE A = 1

Annex IV Case studies description

Region Thy-Mors								
Location within Europe 56.965 N; 8.67 E	Nordic	Western	East-Central	Mediterranen				
	X							
Type of location	Core	Transitional	Peripherral					
			X					
	Cross-border	Coastal	Mountain					
		X						
Size	Inhabitants (nb.)	Density (nb./ km$^{2)}$	Surface (km^2)	Pop. growth rate, 1990-2010 (increase/decrease/stabile)				
	65.000	2,5	3000	-10% permanent, +20% vacation				
Land use structure (%)	Artificial surface	Agricultural land	Forested land	Water bodies				
	4,4%	77,8%	14,8	3,0				
Major tendency in structure of land use in period 2000-2006 (2000=100%)	Artificial surface	Agricultural land	Forested land	Water bodies				
Increase (***A*** – above country level, ***B*** – below country level), E= equal	104,3 (E)			101,5 (A)				
Decrease (***A*** – above country level, ***B*** – below country level), E=Equal								
Stable		99,7 (E)	100,1 (A)					
Dominant land use changes 1990-2006	The Thy/Mors region is interesting in the aspect of multifunctional landscapes as the following activities are taking place: - Including the first Danish national park = protection of species as well as of pristine landscapes - Agriculture, with Mors as one of the most intensive producing areas in Denmark - A large number of renewable energy producers – both individual and park based windmills, a high production of biomass for power and district heating generation. One of the few geothermal sites in Denmark - The establishing of a Windmill testing site - Both large scale and small scale fisheries - Forestry - Tourism - Second homes Even the region is rural, the interaction with major cities not only in Denmark but also in Germany is obvious due to this region being among the most attractive places during summer.							
Description of land use changes (other important information)	1)							
Socio-economic level	GDP per head	Index of unemployment	Share of high educated inhab.	Degree of urbanization (densely/intermed./thinly				
	37.000 €	15% but very seasonal	Low, but very seasonable	Thinly				
Regional functions (2 – highly represented; 1 – represented; 0 – lack)	Agriculture	Forestry	Tourism and recreation	Settlement (Build up)	Industry	Others (administrative, education, etc.)		
	2	2	2	1	1	0		
Other qualitative description of region	A local population of 65.000 but the region visited by a large number of second home owners and tourists (Klitmøller being among the important windsurfing sites in Europe) triples or quadrubles the population in summer In relation to the aims of the case studies, this region will contribute by: 1) Verify and confirm proposed typology and identified processes and challenges. 2) Identify land use functions and undertake a "multifunctionality" assessment 3) Identify factors and drivers (natural and socio-economic) of land use changes and land use dynamics in details in different types of areas;							

	4) Give answer about mechanisms and trends (processes) of land use changes in local scale; 5) Identify challenges in those areas and defining policy recommendations to cope with those challenges on the basis of stakeholders opinion;
Major local and regional plan documents	Kommuneplan Thy Regionalplan Nordjylland http://ec.europa.eu/regional_policy/sources/docgener/studies/pdf/urban/stateofcities_2007.pdf

Localization on the map

http://nationalparker.skovognatur.dk/Thy/Kort/NationalparkThyKort.htm

Øresund								
Location within Europe 56.965 N; 8.67 E	Nordic	Western	East-Central	Mediterranen				
	X							
Type of location	Core	Transitional	Peripherral					
	X	X						
	Cross-border	Coastal	Mountain					
	X	X						
Size	Inhabitants (nb.)	Density (nb./ km$^{2)}$	Surface (km^2)	Pop. growth rate, 1990-2010 (increase/decrease/stabile)				
Land use structure (%)	Artificial surface	Agricultural land	Forested land	Water bodies				
	10%	52%	34%	4%				

Major tendency in structure of land use in period 2000-2006 (2000=100%)	Artificial surface	Agricultural land	Forested land	Water bodies
Increase (***A*** – above country level, ***B*** – below country level)	104,4 (A)			
Decrease (***A*** – above country level, ***B*** – below country level) E=Equal				
Stable		99,5 (E)	99,4 (B)	100,4 (E)

Dominant land use changes 1990-2006 (see Nordregio said nb. 23)	The Öresund region is very interesting in the aspect of land use typologies with urban sprawl interaction, and consequently also with multifunctional activities as the following are taking place: - Protected areas both on islands in the region, and on the Swedish mainland - Agriculture, with South Sweden being the most intensive producing areas in Sweden - A large number of renewable energy producers – both individual and park based windmills, on both land and sea. - In addition a high production of biomass for biogas, power and district heating generation. Especially on the Swedish side there are interactions and conflicts between agriculture and biomass production. - High mobility between the Swedish and the Danish side, and with the bridge being the most important commuting tool, especially from the Swedish side - Coastal communities where tourism and second homes from both sides are playing an important role The region is an excellent illustration of the urban sprawl problematique, and since the bridge was erected the implications of urbanization from one country (the Danish side) on the land use patterns in another country (on the Swedish side) is obvious.
Description of land use changes (other important information)	1)

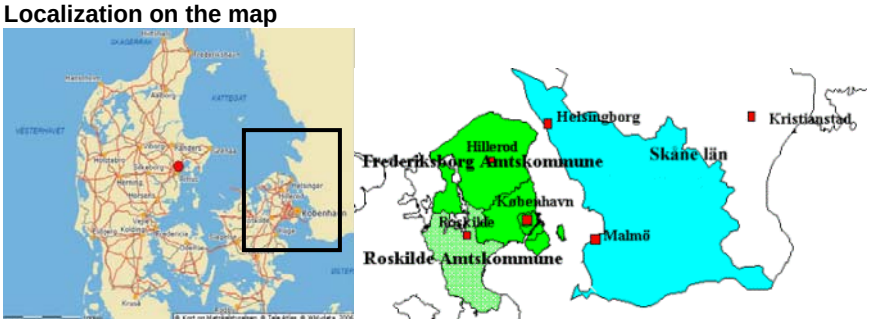
Socio-economic level	GDP per head	Index of unemployment	Share of high educated inhab.	Degree of urbanization (densely/intermed./thinly
	49.000 €	8,3	High	Intermediate

Regional functions (2 – highly represented; 1 – represented; 0 – lack)	Agriculture	Forestry	Tourism and recreation	Settlement (Build up)	Industry	Others (administrative, education, etc.)
	1	1	1	2	2	2

Other qualitative description of region	In relation to the aims of the case studies, this region will contribute by: 1) Verify and confirm proposed typology and identified processes and challenges. 2) Identify land use functions and undertake a "multifunctionality" assessment 3) Identify factors and drivers (natural and socio-economic) of land use changes and land use dynamics in details in different

	types of areas; 4) Give answer about mechanisms and trends (processes) of land use changes in local scale; 5) Identify challenges in those areas and defining policy recommendations to cope with those challenges on the basis of stakeholders opinion; 6)
Major local and regional plan documents	

Localization on the map



Region Chelm-Zamosc								
Location within Europe	Nordic		Western		East-Central		Mediterranen	
					x			
Type of location	Core		Transitional		Peripherral			
					x			
	Cross-border		Coastal		Mountain			
	x							
Size	Inhabitants (nb.)	Density (nb./ km$^{2)}$	Surface (km^2)	Pop. growth rate, 1990-2010 (increase/decrease/stabile)				
	644 007 (2010) 649318 (Eurostat)	69.3 (2006) 70.0 (Eurostat)	9 291 9290 (Eurostat)	decrease				
Land use structure (%)	Artificial surface	Agricultural land	Forested land	Water bodies				
	3,17	72,38	23,55	0,32 (+0,58 wet)				

Major tendency in structure of land use in period 2000-2006 (2000=100%)	Artificial surface	Agricultural land	Forested land	Water bodies
Increase (***A*** – above country level, ***B*** – below country level)	A (124,6)		A (103,6)	A (114,9)
Decrease (***A*** – above country level, ***B*** – below country level)		B (98,0)		
Stable				

Dominant land use changes 1990-2006 (see Nordregio said nb. 23)	Conversion from agricultural land cover to artificial and forested land
Description of land use changes (other important information)	1) stable increase of forested land 2) increase of artificial surface 3) domination of arable land in agricultural land 4) Diversified plant cultivation

Socio-economic level	GDP per head	Index of unemployment	Share of high educated inhab.	Degree of urbanization (densely/intermed./thinly
	5700 €	13.8 (2009)	-	thinly

Regional functions (2 – highly represented; 1 – represented; 0 – lack)	Agriculture	Forestry	Tourism and recreation	Settlement (Build up)	Industry	Others (administrative, education, etc.)
	2	2	2	0	0	1

Other qualitative description of region	1) poorly developed industry 2) low income households dependent on agriculture 3) untapped tourism potential 4) negative migration balance 5) unfavorable age and sex structure of population
Major local and regional plan documents	*Social Policy Strategy of Lubelskie Voivodship* [http://www.lubelskie.pl/index.php?pid=196]; *The 2020 Development Strategy for the Lublin Voivodship* [http://www.lubelskie.pl/index.php?pid=1093]; *The 2008-2015 Development Strategy for Chełm District* [http://www.powiat.chelm.pl/articles.php?lng=pl&pg=466] *The 2008-2015 Development Strategy for Zamość District* [http://www.bip.starostwo.zamosc.pl/page/776/84/strategia-rozwoju-powiatu-zamojskiego-na-lata-20.html]

Localization on the map

Fig. Main topographic elements in chelmsko-zamojski region

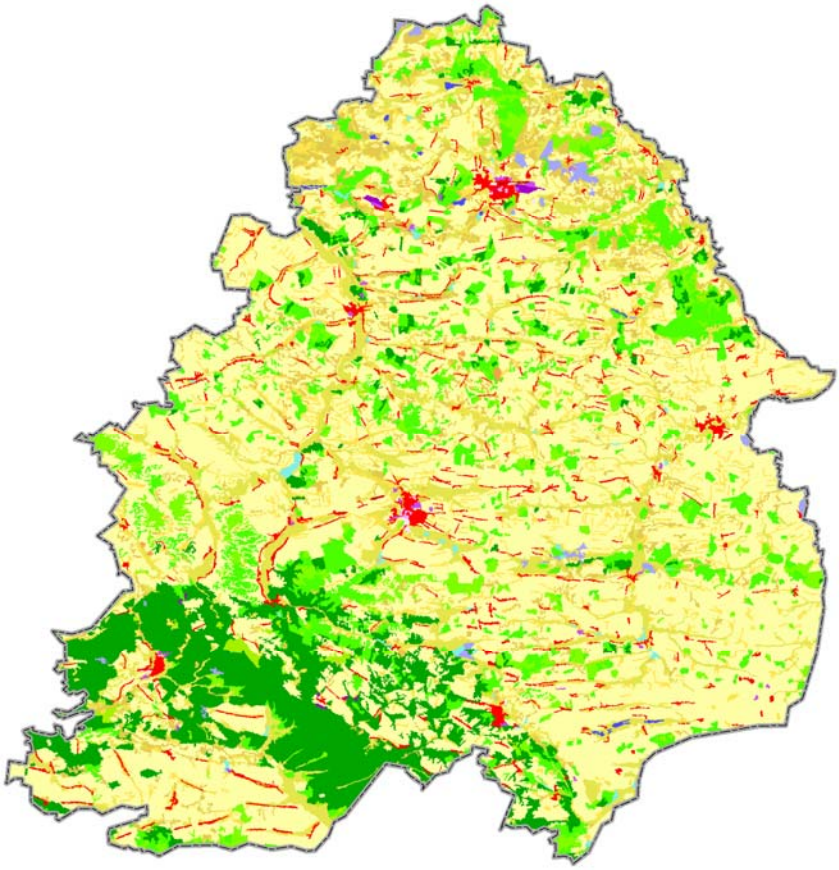


Fig. Chelmsko-zamojski region CLC, 2006

Region Jelenia Gora												
Location within Europe	Nordic		Western		East-Central		Mediterranen					
					x							
Type of location	Core		Transitional		Peripherral							
					x							
	Cross-border		Coastal		Mountain							
	x											
Size	Inhabitants (nb.)		Density (nb./ km$^{2)}$		Surface (km^2)		Pop. growth rate, 1990-2010 (increase/decrease/stabile)					
	574737 (2010) 578265 (Eurostat)		103.2 (2010) 103.8 (Eurostat)		5 570		stabile					
Land use structure (%)	Artificial surface		Agricultural land		Forested land		Water bodies					
	4,54		51,75		43,01		0,55 (+0,14 wet)					
Major tendency in structure of land use in period 2000-2006 (2000=100%)	Artificial surface		Agricultural land		Forested land		Water bodies					
Increase (***A*** – above country level, ***B*** – below country level)	A (145,7)				B (102,6)		A (113,4)					
Decrease (***A*** – above country level, ***B*** – below country level)			A (95,7)									
Stable												
Dominant land use changes 1990-2006 (see Nordregio said nb. 23)	large increase in the surface of the artificial and water body land cover and decrease agricultural land surface											
Description of land use changes (other important information)	1) slow stable increase of forested land 2) rapid increase of artificial surface (+45% in 2000-2006)											
Socio-economic level	GDP per head		Index of unemployment		Share of high educated inhab.		Degree of urbanization (densely/intermed./thinly					
	7 500 €		18.1 (2009)		-		intermediate					
Regional functions (2 – highly represented; 1 – represented; 0 – lack)	Agriculture		Forestry		Tourism and recreation		Settlement (Build up)		Industry		Others (administrative, education, etc.)	
	1		2		2		1		1		1	
Other qualitative description of region	1) high rate of unemployment 2) post-industrial area 3) natural environment pollution 4) the growing role of tourism in southern part of subregion and forestry											
Major local and regional plan documents	*The 2020 Development Strategy for the Lower Silesia Voivodship* [http://www.umwd.dolnyslask.pl/rozwoj-regionalny/strategia-regionalna-srwd/]; *Sustainable Development Strategy for the Jelenia Góra District* [http://www.starostwo.jgora.pl/pliki.html]											

Localization on the map

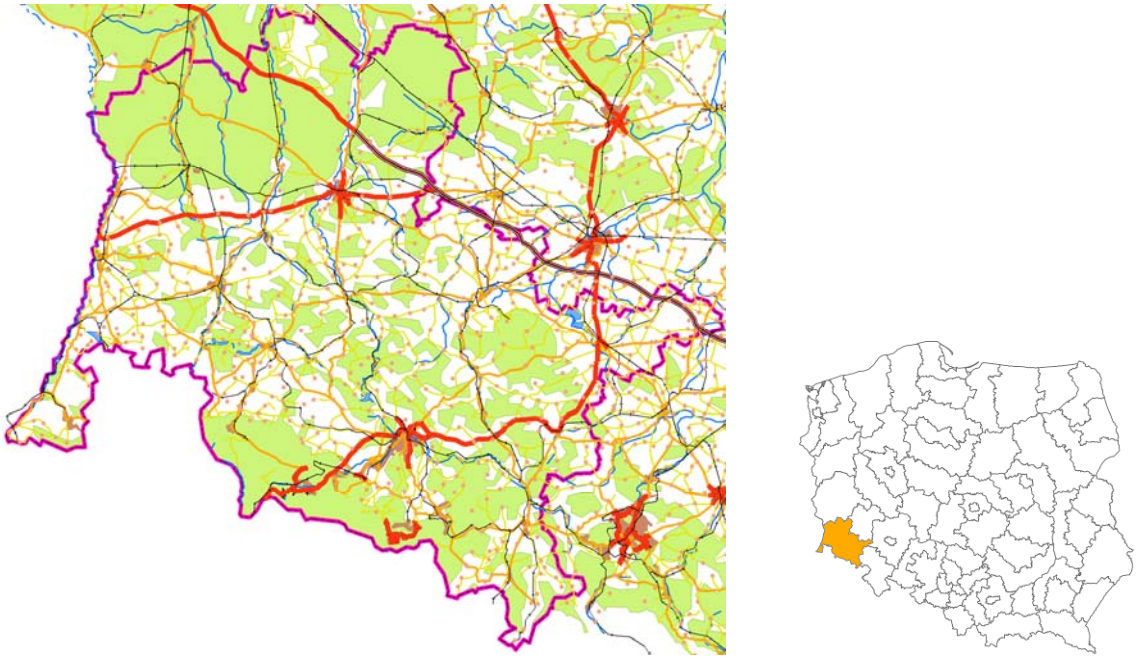


Fig. Main topographic elements in jeleniogorski region

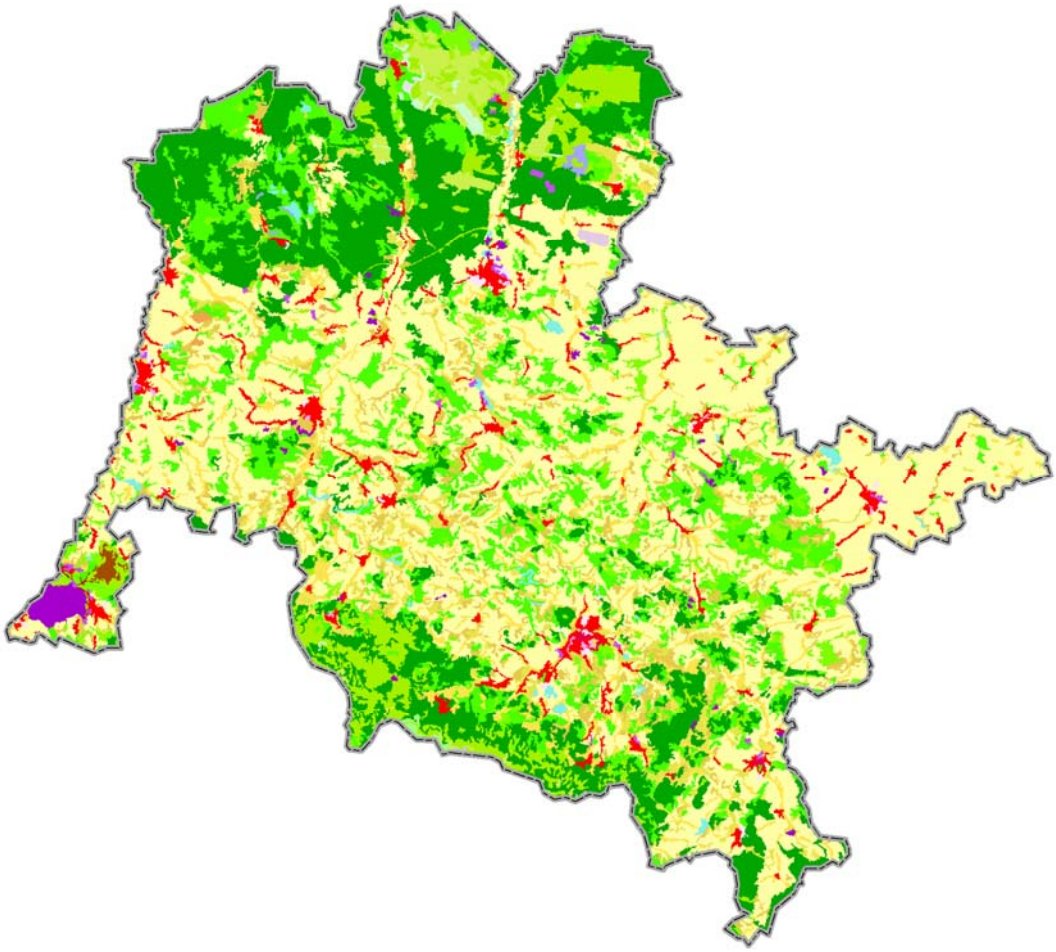
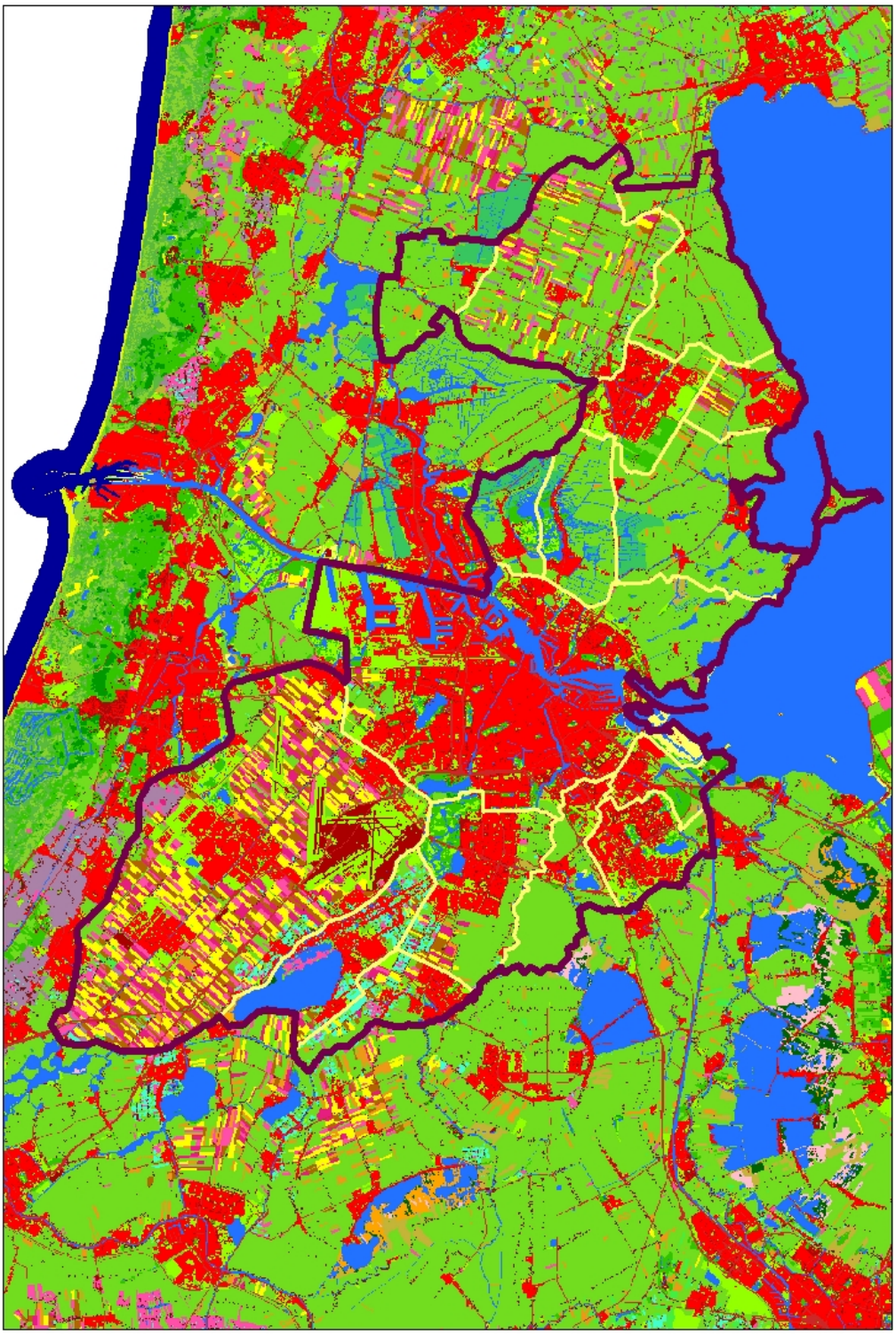


Fig. Jeleniogorski region CLC, 2006

Region Groot Amsterdam								
Location within Europe	Nordic	Western	East-Central	Mediterranen				
		X						
Type of location	Core	Transitional	Peripherral					
	x							
	Cross-border	Coastal	Mountain					
Size	Inhabitants (nb.)	Density (nb./ km$^{2)}$	Surface (km^2)	Pop. growth rate, 1990-2010 (increase/decrease/stabile)				
	1,235,514	1563	790	stabile				
Land use structure (%)	Artificial surface	Agricultural land	Forest & Nature	Water bodies				
	37.9	45.8	5.6	10.7				
Major tendency in structure of land use in period 2000-2006 (2000=100%)	Artificial surface	Agricultural land	Forested land	Water bodies				
Increase (***A*** – above country level, ***B*** – below country level)	111%							
Decrease (***A*** – above country level, ***B*** – below country level)		94%	90%	98%				
Stable								
Dominant land use changes 1990-2006 (see Nordregio said nb. 23)	Loss of agricultural land due to urbanization							
Description of land use changes (other important information)	1) Increasing fragmentation of remaining agricultural and semi-natural land. 2) Increasing land use intensity 3) Increasing population							
Socio-economic level	GDP per head	Index of unemployment	Share of high educated inhab.	Degree of urbanization (densely/intermed./thinly				
	52,857	5 % (2010)	-	Dense				
Regional functions (2 – highly represented; 1 – represented; 0 – lack)	Agriculture	Forestry	Tourism and recreation	Settlement (Build up)	Industry	Others (administrative, education, etc.)		
	1	1	2	2	2	2		
Other qualitative description of region	1) High rate of urbanization 2) Surrounding agriculture and semi-natural areas under high pressures 3) Increasing amount of infrastructure (e.g. highways) 4) Economic core area 5) High level of tourism 6) Many nationalities							
Major local and regional plan documents	1) Gemeente Op Maat – Amsterdam 2) Gemeente Op Maat – Aalsmeer 3) Gemeente Op Maat - Amstelveen 4) Gemeente Op Maat - Beemster 5) Gemeente Op Maat - Diemen 6) Gemeente Op Maat - EdamVoldendam 7) Gemeente Op Maat - GraftDeRijp 8) Gemeente Op Maat – Haarlemmermeer 9) Gemeente Op Maat – Landsmeer 10) Gemeente Op Maat – Oostzaan 11) Gemeente Op Maat –OuderAmstel 12) Gemeente Op Maat – Purmerend 13) Gemeente Op Maat – Uithoorn 14) Gemeente Op Maat – Waterland 15) Gemeente Op Maat – Zeevang 16) CBSindebuurt.doc							

Localization on the map

Fig. Main land use Groot Amsterdam (LGN6)



Region Eurocity Basque Bayonne- San Sebastián						
Location within Europe	Nordic	Western	East-Central	Mediterranean		
				x		
Type of location	Core	Transitional	Peripheral			
	Cross-border	Coastal	Mountain			
	x	x				
Size	Inhabitants (nb.)	Density (nb./ km$^{2)}$	Surface (km^2)	Pop. growth rate, 1990-2010 (increase/decrease/stable)		
	627841	694.07	904.58	0,09*		
Land use structure (%) (San sebastian Bayonne)	Artificial surface	Agricultural land	Forested land	Water bodies		
	4,4 4,2	23,8 50,8	71,5 44,7	0,3 0,3		
Major tendency in structure of land use in period 2000-2006 (2000=100%)	Artificial surface	Agricultural land	Forested land	Water bodies		
Increase (***A*** – above country level, ***B*** – below country level)	108 (B) 101 (B)					
Decrease (***A*** – above country level, ***B*** – below country level)		97,8 (B) 99,1 (B)	98,6 (B)			
Stable						
Dominant land use changes 1990-2006						
Description of land use changes (other important information)	The desire to live without frontiers and to co-operate across borders, means that sharing differences and diversity produces a new metropolitan reality that adds a new element to the features defining the identity that each of us already has. New squares, avenues, universities, beaches, promenades... will spring up out of the sum of those that already exist. Here are just two examples: the Eurocity will have a large square, the Main Square of the Eurocity, which will be the sum of the squares that already exist in our cities today. Our University won't have a single campus, but the university campus of the Eurocity will be the sum of the campuses that we already have. The same will happen with the beach, the coast, culture...					
Socio-economic level	GDP per head	Index of unemployment	Share of high educated inhab.	Degree of urbanization (densely/intermed./thinly		
	Gipuzkoa (2008): 31.951 Aquitaine (2008): 27322	4th trimester 2010: Pyrénées-Atlantiques: 8,1% Gipuzkoa: 7,8%	Gipuzkoa (2006): 12,46 Pyrénées-Atlantiques (2007): 11,1%			
Regional functions (2 – highly represented; 1 – represented; 0 – lack)	Agriculture	Forestry	Tourism and recreation	Settlement (Build up)	Industry	Others (administrative, education, etc.)
Percentage of Added Value Gipuzkoa (2008)	1		Included as services	8	32	60
Percentage of Added Value Pyrénées-Atlantiques (2005)	2,8		Included as services	6,9	15,9	74,4
Other qualitative description of region	The Basque Bayonne-San Sebastián Eurocity extends from Bayonne to San Sebastián along 50 km of the Atlantic front of the Pyrenees, on both banks of the River Bidassoa, the mouth of which marks the border between France and Spain. The main towns in this coastal cross-border conurbation of 600,000 inhabitants are those of the Bayonne-Anglet-Biarritz Conurbation community on the French side and San Sebastián on the Spanish side. It is the natural access route between the Iberian Penninsula and Western					

	and Central Europe..." - At the heart of the Atlantic Arc between Bilbao and Bordeaux. - At the western end of the French- Spanish border. - On the Atlantic façade of the Pyrenees. Both territories share a common Basque cultural heritage and throughout history have lived together through periods governed by mutual goodwill and the desire to promote reciprocal needs and interests, and, as has occurred in other border areas, also through periods of confrontation and estrangement. In effect, the special circumstances of the twentieth century made the Franco-Spanish border very strong. This cross-border conurbation forms a true urban corridor and is located on one of the main road axes existing between the Iberian Peninsula and the rest of Europe. This situation as an obligatory point of passage for road traffic naturally results in a high flow of traffic at different levels (local as well as trans-European) and of different natures: people (cross-border workers, tourists, patients, students, etc.) vehicles (24,000/day).
Major local and regional plan documents	In the Basque Country: Partial Territorial Plan of the Functional Area Donostia-San Sebastian PTS de Ordenación de los Márgenes de Ríos y Arroyos Plan de Energía Eólica PTS de Red Ferroviaria en la CAPV PTS de Creación Pública de Suelo para Actividades Económicas y Equipamientos Comerciales PTS de Zonas Húmedas PTS de Protección y Ordenación del Litoral PTS de Infraestructuras de Residuos Urbanos de Gipuzkoa Master plans at local level Eurocity Donosti-Bayonne Prospective document (White Paper in 2000) Cross-border convention on waste treatment Consorcio Bidassoa-Txingudi (legal structure including Hendaye, Irun and Fontarabie) Atlantic-Pyrenees Euro-Institute.

* Spanish side: 0,06 (1991-2007); French side: 0,14 (1990-2007)

Localization on the map


0
0,1
grados
Boucau
Anglet
Bayonne
Biarritz
Saint-Pierre-d'Irube
Lahonce
Bassussarry
Arcangues
Villefranque
Bidart
Guéthary
Ahetze
Ustaritz
Jatxou
Halsou
Larressore
Saint-Jean-de-Luz
Ciboure
Urrugne
Saint-Pée-sur-Nivelle
Ascain
Souraide
Hondarribia
Irun
Biriatou
Pasaia
Donostia-San Sebastián
Errenteria
Oiartzun
Sare
Zarautz
Orio
Usurbil
Lasarte-Oria
Astigarraga
Hernani
Urnieta
Aia
Andoain
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Field study – interview (draft version of questions)

I. Socio-economic factors of land use change

1. Could you describe the main demographic processes in the region: migrations, birth rate etc.? What is their impact on land use?
2. What are the main processes and trends of settlement? What is the impact of new settlements on land use and spatial organization? Is there a lot of new built-up areas? What are the forms: contiguous development, linear patterns, scattered development?
3. What are the main processes, directions of changes in the field of agriculture (extensification or intensification, changes of fields spatial structure and crops structure)?
4. Are there such processes like: changing agricultural function of areas into other functions? Building-up areas of fertile soils? Increasing/decreasing the share of untilled land? Please describe briefly the processes concerning changes of agricultural land use.
5. What are the main processes in the field of industry and technical infrastructure (new plants, industry centers, roads, railways etc.)? How would you assess its influence on land use?
6. What are the main processes in the field of tourism and services? Is there any development of tourism infrastructure (new hotels, holiday centers, swimming pools, tourist roads)? How intensive is the development in the spatial context (spatial extent of new areas used for tourism purposes etc.)?
7. How would you describe and summarize the general conditions of economy in your region and its impact on land use? Please refer also to employment issues.

II. Environmental issues

1. Could you describe the main changes of natural areas in the last five decades (changes of forested areas, biodiversity, water conditions)? Has the spatial extent and condition of areas of high nature value changed for the last five decades?
2. Please assess the main contemporary and future threats for natural areas (especially protected areas) in the region. How are they related to land use changes?
3. Were there any natural disasters in the region in the last two decades which influenced the land use and land cover (floods, fires)?

III. Multi-functionality

1. Please name socio-economic and environmental functions of land use in the region.
2. Multifunctional land use - which of the functions in your region co-exist?
3. Which of the functions are the most important in the context of land use?
4. Is the number of functions of land use increasing or decreasing?

5. To which extent is the land in your region used in multifunctional way?
6. What kind of functions co-existence is:

   a) the most effective?

   b) the most desirable?

   c) the most common?

   d) the most difficult?

7. Which of the functions of land use are the most important for the future regional development?

IV. Spatial conflicts

1. Are there any conflicts related to land use? (As space is limited different actors compete to obtain the possibly largest area or their needs. For example: inhabitants strive to build houses, a businessman wants to put a plant or warehouse, there is a need to build somewhere sewage plant, administration of protected area tries to enlarge the area and so on).
2. What are the “competing” actors and functions (environmental, agricultural, industrial, settlement etc.)?
3. Which of the actors are the most dynamic and successful in obtaining new land?
4. What are the most likely conflicts related to land use in future and what could be its impact on land use?

V. Government and policy

1. Please assess the state and regional law concerning spatial management and planning in your region. Are legal rules effective in sustainable and rational management of land?
2. Is the local and regional administration effective in land management and in preventing and solving conflicts related to land use? (Please describe and assess the issue and give some examples. Summarize the role of local and regional administration in management of land use).
3. Is there any monitoring of land cover changes in the region? (Please describe briefly).

VI. Localization (depending on the region)

1. How land use changes are resulting from vicinity of state border (how the state border influence land use in your region)?
2. How land use changes are resulting from vicinity of sea coast (how the coastal location influence land use in your region)?

VII. Land use in general

1. Please describe and summarize the major processes and trends of land use changes in the region over a last 50 years.
2. In a typology elaborated on the basis of statistic data, your region represent the type X, characterized by..... Is it a proper type for your region? Please explain.

EU-LUPA
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.....

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CONTENTS

The location of the region in economic space is very often a key factor of land use processes. The location in European and national scale will be described, as well as the internal spatial differentiation of the region in terms of accessibility, core-periphery relations.

3.5. Conclusions in the context of land use

The above mentioned issues and processes related to localization, demography, economy, environment, administration and governance will be summarized and assessed from the point of view of land use, its contemporary and future changes.

4. ANALYSIS OF LAND USE CHANGES

4.1. Dynamics and directions of land use and land cover changes

Dynamics of land use and land cover will be presented graphically (charts, maps) on the basis of regional databases. The period of analysis will depend on availability of data. Interview results will provide detailed information for description, understanding and explanation of the dynamics and directions of land use.

4.2. Trends, actors and drivers of the changes (micro and macro scale)

On the basis of interviews results, regional, local documents and literature main drivers of land use change will be identified and described on the local/regional scale. Drivers can be related to demographic processes, economy, employment, agriculture, environment, governance, transport. The major actors (for example: entrepreneurs, new inhabitants, farmers, tourists) who determine land use changes will be identified. An important point will be also a holistic analysis of drivers and actors who create a complex and interrelated system.

4.3. Contemporary and potential conflicts

As space is limited different actors compete to obtain the possibly largest area or their needs. Spatial conflicts reflect how strong is the competition for land and who are the most important actors, what are the main drivers. Interviews with local experts will provide information on contemporary and potential future spatial conflicts.

4.4. Scenarios

The possible scenarios of future land use and land cover changes will be presented on the basis of statistical data and the other information collected during the study. The scenarios will reflect low, moderate and fast economic development.

5. MULTI-FUNCTIONALITY OF LAND USE

5.1. Functional differentiations

Functional profile of the chosen region will be presented and analysis of the local differentiations of economic functions.

5.2. Current multiple uses of land

Identification of co-exists functions of the land use in the region. Inter-actions between the multiple uses of land and their temporal and spatial changes. Evaluation of the most effective, desirable, common and difficult functions in the context of land use multi-functionality.

5.3. Potentiality of multiple uses of land

Identification of the potential other land activities. Possible conflicts between functions.

6. POLICY CONTEXT OF LAND MANAGEMANT

6.1. Land use in the regional/local documents

Local and regional strategies, plans and programs related to land use, spatial planning and management, socio-economic development and environment will be reviewed and assessed.

6.2. Influences of regional/local planning

Programs and plans of spatial development contain the future directions of land use, which are planned and expected by local/regional authorities. The review of regional and local plans and programs will help with foreseeing future land use changes.

7. CHALLENGES AND POLICY RECOMMENDATIONS (2020 perspective)

8. CONCLUSION

Drivers and dynamics of land use will be summarized and assessed. An important part of conclusions will be identification of major effects of land use changes.

LITERATURE

APPENDIXES

Annex V Bibliography

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The ESPON 2013 Programme is part-financed by the European Regional Development Fund, the EU Member States and the Partner States Iceland, Liechtenstein, Norway and Switzerland. It shall support policy development in relation to the aim of territorial cohesion and a harmonious development of the European territory.

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