

# EU-LUPA

## European Land Use Patterns

Applied Research 2013/1/8

### Executive Summary

Final Report

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

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## 1 EU-LUPA project in brief

Land use in Europe has changed drastically during the last fifty years, primarily in relation to the betterment of human well-being and economic development, while unfortunately causing serious environmental problems. Policy change plays a role in the performance of territories. Understanding the impacts of these land use changes on sustainability is currently a major challenge for the policy and scientific community.

The following paper documents the results of a three-year-long applied research project entitled European Land Use Patterns, (EU-LUPA), which was carried out under the auspices of the European Observation Network for Territorial

The EU-LUPA Project had a number of overarching goals. The first of these was the creation of a cohesive methodology for the analysis of land use in different regions of the European Union, based on data from a variety of sources and utilizing a variety of spatial scales. The second was the production of knowledge and valuable information integrating the physical dimension with the socio-economic well as with environmental protection – knowledge that would allow us to comprehend changing modern-day trends in land use, their dynamics and underlying conditions. The third goal was to identify the main problems and challenges in terms of land use in different territories and regions as well as to identify remediating steps and offer recommendations that would help us resolve these problems.

The EU-LUPA Project constitutes a first attempt within the ESPON framework to assess land use changes in Europe at a regional level.

It is important to highlight that the analysis done in EU-LUPA project is for the period 1990-2006, and therefore just before the economic and financial crisis which hit Europe in the year 2008. However, the outcomes of such analysis provide powerful information about the situation in which the regions entered the crisis; and this is considered very useful since it offers lessons learned that should help policy makers at the regional level to identify their context and chances to exit the crisis.

## 2 EU-LUPA policy framework

Although European policy does not have a specific spatial planning responsibility or competence for planning *per se*, it sets the framing conditions of planning through different strategies and instruments.

Land use implications on the compliance of the key EU policy objectives and targets are crucial due to its cross-cutting nature touching upon many different territorial challenges. Not least, to urbanization and rural-urban relationships, climate change mitigation and adaptation, natural resource management, energy, transport, regional competitiveness and cohesion.

Within the EU policy framework we could find many specific responses to land use and land take. For instance there are specific references in the following documents: 'Sustainable Europe for a Better World: A European Union Strategy for Sustainable Development' (COM(2001)264); the Commission Communication 'Towards a Thematic Strategy on the Urban Environment' (COM(2004)60); as well as the 'European Social Fund and the Cohesion Fund Council Regulation' (EC) (No 1083/2006). It is also acknowledged within the concept of territorial cohesion in the 'Territorial Agenda 2020', where it is noted that changes in land use (urbanisation, mass tourism, etc.) threaten landscapes and lead to fragmentation of natural habitats and ecological corridors. Likewise, the 'Territorial Agenda Action Plan' – notes specific actions relevant in the field of 'Land', in particular are action 2.1d: 'Urban sprawl' and action 2.2 'Territorial impact of EU policies'. Cohesion Policy (2014-2020) – includes the thematic objective: environmental protection and resource efficiency. Funds

flow to infrastructure developments (e.g. in the 2000-2006 period 5100 km of road were built and 8400 km of rail was constructed). Additional references are made in: 'Cohesion Policy and cities: the urban contribution to growth and jobs in the regions' (COM(2006)385), the 'Europe 2020 Strategy' (COM(2010)2020); and the general provisions on the European Regional Development Fund; the 'Rural Development Policy' (towards 2020) - where priorities include restoring, preserving, and enhancing ecosystems (e.g. N2000, landscapes, soil management, etc.); and the 'Common Transport Policy' – where development of transport services must take account of their possible effects on the environment'. Even further still, the White Paper on transport, the energy efficiency plan and the communication of the Commission 'A Roadmap for moving to a competitive low carbon economy by 2050' constitutes the key deliverables under the Resource Efficiency flagship. (COM (2011)112 final), while 'The European Landscape Convention' (Council of Europe, 2000) deals with the protection, management and planning of all landscapes in Europe.

But perhaps most notably, the 'Roadmap on Resource Efficient Europe' includes the bold milestone of no net land-take by 2050. Yet EU-LUPA perceives that implementing this mandate would most likely work against the goals of a number of regions; particularly those seeking to ascend the socio-economic ranks toward the most established European nations.

The EU-LUPA project has a pan-European approach to land use. Land use changes and dynamics in Europe are addressed as policy driven processes in the context of European Spatial Development, although the evaluation of policy impacts is definitely out of its scope.

### 3 Methodology

EU-LUPA uses a multi-sector perspective based on a stepwise process. This builds on the following main components:

**Land use characterization.** Based on data provided by CORINE Land Cover 1990, 2000 and 2006, regional typologies are defined as the classification of European NUTS2/3 regions into types based on shared or common characteristics. The role of the typologies has been to serve as an analytical tool to support the development of land use policy recommendations for the ESPON territory. In looking to develop typologies based on the available data of land cover status and changes, the answers to three central questions are sought:

- a) What are the stable elements of land cover in Europe?
- b) What characterizes the observed land changes? Where do the most intense changes occur?
- c) To what extent do land use changes connect to the socio-economic development? Are the trends sustainable?

In order to address these questions the EU-LUPA provides an optimal characterization of land cover status and changes that can be analysed vis-à-vis socio-economic dimensions. This in turn reveals additional insight into the nature of land use patterns and their relationships with socio-economic development:

- **Prevailing characteristics of land use:** based on the distribution to CLC data 1990-2000-2006 this typology answers the question, what characterizes the land use in Europe?
- **Amount of land use change:** as a percentage of the total area of NUTS2/3 regions. To simple answer the question, how much land is changing, and where?
- **Intensity of land use change:** in NUTS2/3 regions, to answer the question, what is the degree of human intervention on the land in order to meet the needs of our socio-economic activities? In relation to the intensity of land use change it is understood as the degree of human intervention on the land caused by socio-economic activities by

means of the consideration of GDP and population density. It is included in the analysis based on an inferred intensity hierarchy that is inherent in the CLC classification.

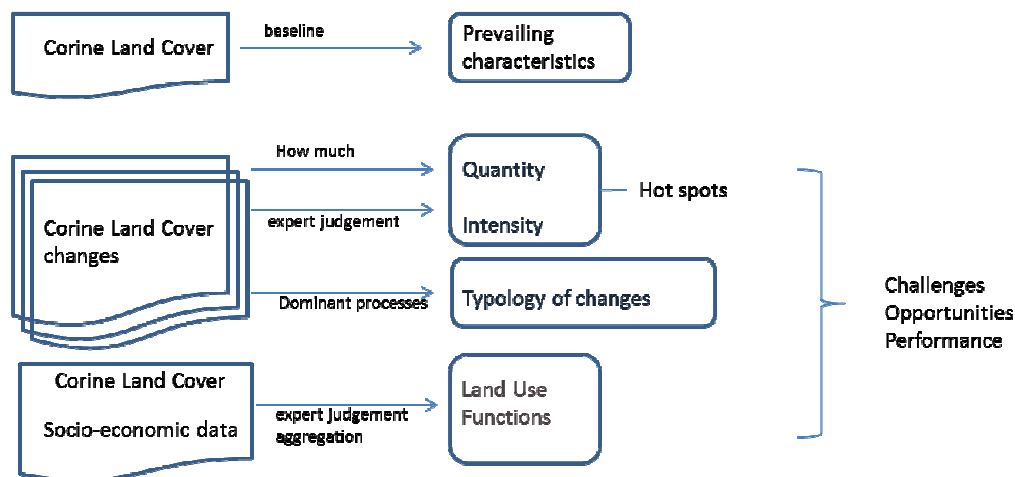
- **Hotspots of land use change:** In relation to the two previous outputs, a basic typology showing Hotspots of land use change. It generalizes regions based on a matrix of absolute change (by area) and intensity of change. This provides a generalized picture of which regions stick out in terms of high levels of physical land change, in terms of the degree of human intervention on the land, or both.
- **Land use change typology:** this is the cornerstone of the EU-LUPA land use characterization and it answers the question, what characterizes land use changes for NUTS2/3 regions in Europe? In relation to land use change, this is the cornerstone of the EU-LUPA land use characterization and it answers the question, what characterizes land use changes in Europe, based on the regional clustering of all CORINE Land Cover Flows and changes in land use intensity. The results are typologies of Land Use Change provided at a regionalized NUTS2/3 level.

**Land Use Functions approach.** How and to what extent are changes in land use patterns interacting with socio-economic developments? To answer this question a Land Use Functions approach was used. Land Use Functions express the goods and services that the use of the land provides to human society. It is used to assess how changes in land use (partly driven by policies) impact on the multiple functions attached to land use, which in turn affects sustainability and stock and quality of natural resources.

Are the trends sustainable, and to what extent will on-going changes compromise future developments? This is answered through the assessment of Land Use Performance and Efficiency, which includes analysis on the extent that certain “patterns of Land Use” have been effective in achieving policy goals, and the amount of land taken to do so.

**Case studies** are used to better understand hidden land use processes not captured through analysis at the European scale, and to validate and better understand the main project outcomes. Four areas in EU have been selected: Öresund – a cross-border region with highly differentiated and multifunctional land use structure (from urban core, semi-urban to arable); Eurocity Basque Bayonne- San Sebastián - a cross-border region, with high share of urban areas in a multifunctional rural setting which is still dominated by agricultural activities; Chelmsko-Zamojski, which is located on periphery (EU border) and characterized as a monofunctional agricultural region; and Jeleniogórski – located on the Poland-Germany-Czech Republic borderland with multifunctional land uses reflecting the economic transition taking place there.

**Policy recommendations.** Based on scientific evidences and key findings, EU-LUPA outlines some general responses and key messages for policy development towards more sustainable land use management, and hence a more resource efficient territorial development. This is in line with the EU development principles and objectives mainly under the EU Cohesion Policy, EU2020 Strategy and the Territorial Agenda.



**Figure 1. Overview of the methodological approach to the land use patterns taken by EU-LUPA. The first pillar on the left represents the needed data as inputs. The second pillar can be analysed from the top to the bottom, starting with a simple characterisation of the baseline, then identification of hot spots and typologies of changes, and finally the characterisation of land use functions. All these elements together assist in the identification of challenges, opportunities and performance.**

#### 4 Which are the prevailing characteristics of land use in Europe?

What does current European land use look like, what are the current land use patterns on the European territory, where are certain patterns dominant and in what particular types of regions or countries are they evident?

The assessment of land use in Europe based on the distribution to CLC data provided at both a 1km<sup>2</sup> grid and a regionalized NUTS2/3 levels reveals that there are certain dominant patterns or prevailing characteristics of land use that could be summarized, as follows:

- European territory is dominated by rural landscape strongly linked to agricultural activity.
- Prevalent urban areas are only found in the high density area of Belgium, The Netherlands, in some regions of Germany and in Paris and London. It means that in other areas in which a high degree of urbanisation (e.g. coast) would be expected, the regional context still has a strong rural component.
- There is a north-south gradient noticeable: not only a clear north-south gradient in climate showing a clear gradient in vegetation patterns and the fact that specific land cover classes such as sclerophyllous vegetation, vineyards, rice fields, and olive groves, are mainly occurring in southern Europe, but there is also a clear gradient in land use intensity, which is the highest in North-West Europe. In Scandinavia, land use intensities are again much lower, reflecting the high percentage in cover of forest, water and other semi-natural areas.



## 5 Where are the most intensive changes?

There is a clear east-west dimension. Large volumes of land use extensification are almost exclusively found in Eastern European member states; particularly in Poland, The Czech Republic and Hungary. This pattern is very dominant in the 1990-2000 period but continues in 2000-2006 as well.

High volumes of land use intensification are especially notable in countries such as The Netherlands, Brussels, Spain, Portugal and Croatia. In Spain, this is especially evident for regions along the south and east coast as well as the island regions. On regional/territorial level it is evident that intensification is associated with the growth (sprawl) of urban areas and their associated artificial surfaces. But furthermore – and in a very high degree in, for instance in Portugal, Spain and other Mediterranean areas, the issue of ownership reforms and characteristics of land tenure are a driver of intensification. This issue is discussed in more detail in relation to the identification of land change hotspots. Intensification also appears to take place in a greater degree for coastal regions (Spain, France and Croatia). It is likely that this pattern is related to the growth of the coastal tourism in these regions, but additional validation is necessary.

In the Czech situation it is interesting to point out the seemingly high degree of rural extensification being countered by urban-related intensification in the capital region of Prague. Further, when comparing the 1990-2000 and the 2000-2006 results (Map 8 and Map 9 of Scientific Report Volume I), even while taking into account the much larger time span in the former time period) it appears that extensification processes have slowed for the country as a whole. EEA country analyses show that the main driver of extensification has been the conversion of different crop areas into land for pasture. This is a process which has been driven by national policy that uses subsidies to encourage the grassing of arable and extensive grassland management.

The shift from 1990-2000 to 2000-2006 also relates to changes in mobility, where halted subsidies for dwellings and an increase of suburbanization have been influential on the slowing down and decline in extensification (Vobecká 2010), an issue which is dealt with further in connection with the Land Change Hotspots. In the 2000-2006 times' series (Map 9 of Scientific Report Volume I) very significant intensification is notable in particular regions of Norway. These are regions that we know have undergone relatively little amounts of land change (by area) based on Maps 1-3 of Scientific Report Volume I); however the changes that have taken place were very intensive. This is due to the development on intensive mining, hydrocarbon extraction and other heavy industrial activities in rural and remote locations. Interestingly, these intensifications are not taking place in parallel with extensification of other land covers in these areas, which indicate that these are “new” economic activities that are taking place on previously unused land.

Quite high rates intensification are notable for many regions in Spain in all three time series. The highest levels of intensification have taken place for coastal regions along the Mediterranean and for the island regions. This is clearly related to the growth of artificial surfaces in urban areas. CLC flow data and EEA land cover analysis (EEA, 2011) indicates that much of this intensification is due to the sprawl of economic sites and infrastructures (which both construction areas and transport infrastructure are grouped).

For agricultural withdrawal, abandonment processes have been most pronounced in the central-south and north-east regions of Hungary (between 2000 and 2006), on the Italian island of Sardinia (between 1990 and 2000), and in Ireland and southern Portugal to differing degrees throughout the 1990-2006 period.

## 6 Where are the hotspots of land use change?

Hotspots enable us to identify places in Europe where marked changes have been taking place during the last 16 years, where are the main changes in typical land use patterns? And therefore, what could the main driving forces behind these land use and land use pattern changes be? See Map 1.

It is important to understand the overall change accumulated over a period of 16 years, showing that:

- Change is not necessarily negative, but there is a need to understand why and the quality
- Change is related to certain dynamics in the region, and strongly related to type of change
- In contrast to the clear north-south divide in terms of prevailing characteristics of land use, there is a clear east-west divide in terms of the intensification of land use. Regions with high intensification and a relatively high amount of change are identified mainly in some regions of the Mediterranean coast, Belgium, The Netherlands, Spain, Portugal and Ireland but particularities in each country.

All regions in Portugal are identified as hotspots – albeit to differing degrees – in all of the time series'. This is mainly due to the fact that all regions show very high levels of overall change due to the high levels of on-going changes related to forest management. Conversely, in terms of intensity show more stable patterns with the exception of two regions: Lisbon and Alentejo. In the former, intensification is predominantly related to residential sprawl between 1990 and 2000; a process that has slowed considerably since then (EEA, 2011). In Alentejo, relatively high land change is characterized as an extensification process. This is due to the fact that land abandonment due to the withdrawal of farming activities (EEA, 2011).

The immediate effects of the inclusion of East-Central European countries - previously part of the "East Block" mostly characterized by state and cooperative ownerships - are immediately reflected through a drastic decline in intensity over substantial areas in the period from 1990 to 2000. The reforms in ownership from the former state and cooperative ownerships forms has had some immediate consequences in relation to intensity due to that the new private farms did not have the necessary means to ensure a high intensity in land use. The situation in Poland being different in this respect because of a dominance of private land use activities, and as a consequence effects as described above only relating to the relatively smaller areas owned by cooperatives and a few state holdings as well.

The situation in Poland was also affected through the lack of funding for investments in many of the small farms functioning more as subsistence bases for a still older population, and several of the regions where this has been the dominating characteristic have continued being regions of decreasing intensity through the 2000-2006 period as well. One important element in this connection has been the small size of a substantial part of the already private farms. The advantage in other parts of East-central Europe has been that in the aftermath of the first round of extensification the new private farms were able to establish themselves not as subsistence activities but as professional and capital intensive farms on previous state or cooperative owned large scale farms. And similar situations have appeared in relation to other types of land use.

Ireland being a "hotspot" for IT development during the 1990's had some spin-off in relation to increased intensification of activities related to land use. Partly because the attraction of

labour force away from direct land use to industrial activities required adjustment in land related activities requiring technology to replace the missing workforce. With a partly collapse of the IT-adventure after 2000 the process described above came to a halt, and the shift is apparent when comparing the 1990-2000 and the 2000-2006 situations.

While missing data for Sweden, Finland and Norway for the period 1990-2000 does not allow a comparison between the two periods, an important issue of the effects of increasing activities related to resource extraction, especially in relation to oil and gas development, is very apparent for the 2000-2006 period shown for Norway. While fisheries used to be a mainstay for coastal communities in Norway the picture today is a high degree of dependency on the sea, but to a high degree in relation to energy resource extraction, in the South related to the oil related industries which took off several decades ago, while NW Norway is highly influenced by expansions in both oil and gas development during the last decade. This leads to the inclusion of large areas for on-shore production facilities, but requires at the same time related economic activities – processing, investigation, planning, education etc., which shows through inclusion of still larger areas for housing.

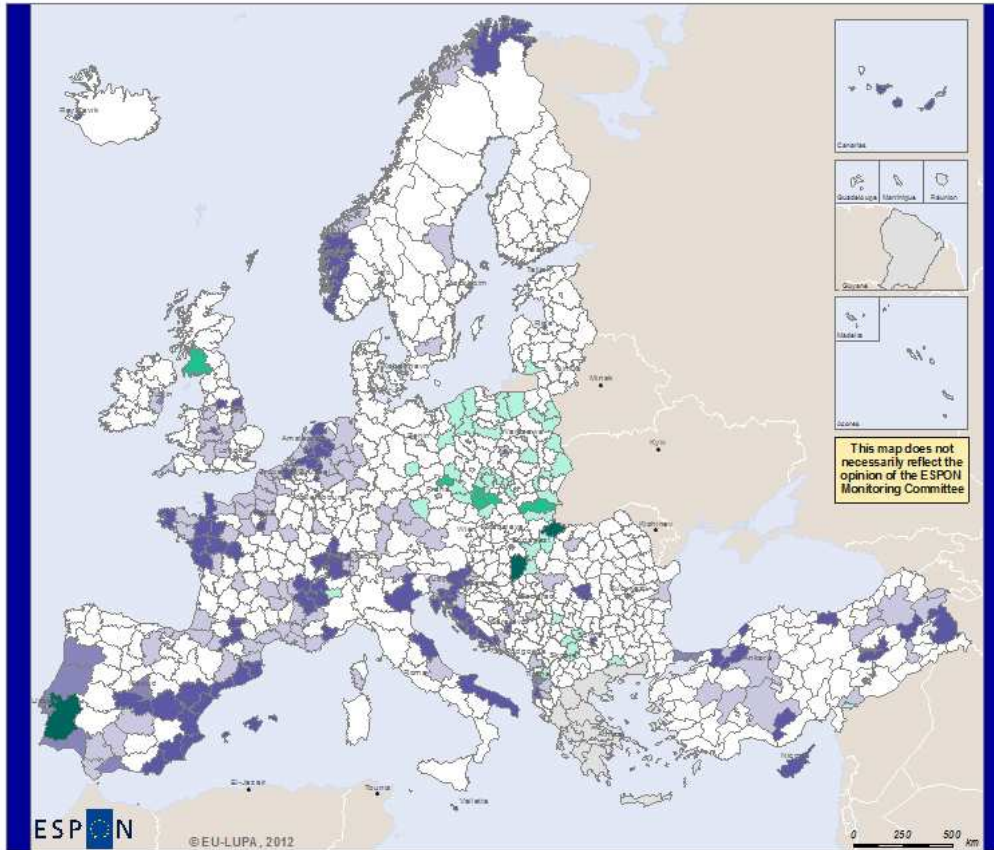
While many border regions used to be characterised by differences in land use due to the influence of differences in national land use policies, Common Agricultural Policy (CAP) has reduced these differences. Now differences tend to reflect combinations of natural potentials, settlement patterns and infrastructural characteristics, are much less dependent on national policies. As a small scale example, one could mention the border between Denmark and Germany, which was previously marked with very different land uses according to CORINE 1990 data. However, with the incentive of EU membership for Denmark, a marked intensification in cattle and milk production in the border region of Southern Jutland developed, while the land use south of the border continued to be characterized by extensive land use. As a result, the differences in land use characteristics have been considerably reduced. As a large scale example, the above mentioned East-West divide in land use characteristics due to previous differences in economic systems could be emphasized. A general characteristic in this connection is the process of de-population and retracting/ensification of agricultural activities from mountainous and sparsely populated areas, and replacing it with tourism – often in combination with agriculture and other traditional land uses.

European tourism is an activity requiring still larger areas, and the development of the Spanish coastline illustrates that it is not only a question of short term changes, but seems to have been a consistent development process throughout the whole period from 1990 to 2006.

## 7 Resulting land use change typologies in Europe

While the hotspots enable us to identify places in Europe where marked changes have been taking place during the last 16 years, the Land use change typology provides a connection between types and processes of change. See map 2.

# 2000 - 2006 Land Change Hotspots





 EUROPEAN UNION  
 Contributing to a Europe of Regional Development (4th Pillar)  
 INVESTING IN YOUR FUTURE

Regional level NUTS 2012  
 Source: Nordregio, 2012  
 Origin of data: EEA, 2011  
 © EuroGeographics Association for administrative boundaries

## Matrix of land change hotspots

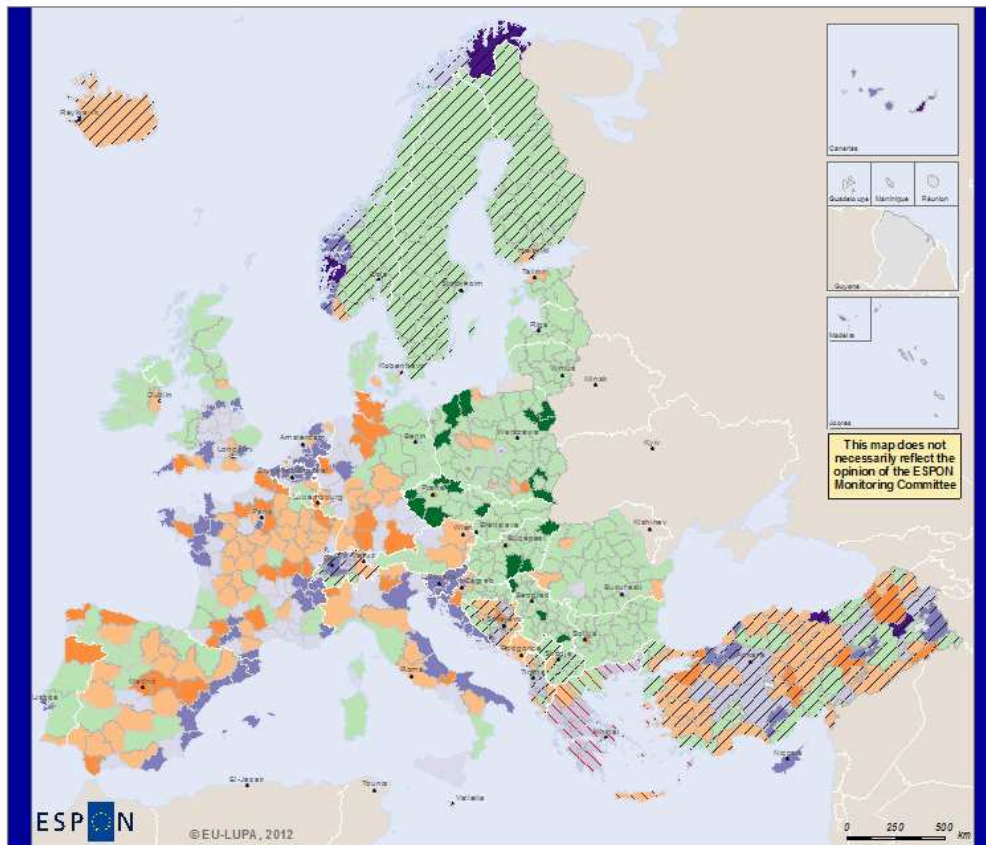
The x-axis shows the amount of land that has undergone change between the given years (in, percent) while the y-axis indicates the change in intensity as a result of those changes. Therefore, regions in white represent regions with relatively stable land cover characteristics while increasingly darker shades of green or purple identify "hotspots" of change where high intensifications or extensifications are coupled with increasing levels of overall land change.

Intensity of change	Above 1.50					
	1.00 to 1.49					
	0.50 to 0.99					
	0 to 0.49					
	Below 0					
		Below 2.5%	2.5-5%	5-10%	10-20%	Above 20%
		Amount of change				

 No Data

Map 1 Hotspots of land change – 2000-2006

# Land Use Change Typology 1990 - 2006



EUROPEAN UNION  
 Policy Instruments for Growth, Regional Development & Employment  
 (2007-2013)

Regional level: NUTS 2/3/4  
 Source: Nordregio, 2012  
 Origin of data: EEA, 2011  
 © EuroGeographics Association for administrative boundaries

## No. Land Use Change Types

- 1 Very high intensification - land take, often from natural areas
- 2 High intensification - continued urban land take from rural land
- 3 Moderate/high intensification - urbanizing areas while maintaining rural functions
- 4 Moderate intensification - rural conversions combined with notable land take
- 5 Moderate/low intensification - mainly rural conversions with low levels of land take
- 6 Low intensification - rural conversions with negligible land take. Some agricultural withdrawal
- 7 Extensification - rural conversions with significant levels of farm withdrawal

- Only 1990-2000 data
- Only 2000-2006 data
- No Data

Map 2 Land Use Change Typology – 1990-2006

The intention of the “land use change typology” was to trade-out the measure of amount of land change in the hotspots map and replace it with a characterization of changing land uses. Regionalized land use change intensity is therefore combined with the distribution of the most telling groups of land cover changes in a cluster analysis, and then grouping the results into descriptive land use change types.

By comparing Map 1 Hotspots of land change – 1990-2006 - and Map 2 Land Use Change Typology – 1990-2006 – it is straightforward to see that many of the regions noted as a hotspot of land change are reflected as regions in shades of purple or bright orange – as being regions of at least moderate intensification. In this connection, the main benefit of the Land use change typology is that it enables to reflect a limited number of dominant characteristics of land use changes; especially, urbanization from natural areas, intensive urbanization, maintenance of rural functions, agricultural withdrawal, etc. In terms of urbanization for instance, it adds another dimension where population or employment data is often used to reflect the urban development of regions. Complementing this, we can now see a regional dimension to these processes as they take place, literally, on the ground. In this connection, a direction of further work could be to make a closer comparison to land changes resulting in new or maintained urban areas, and to compare this data with regional – or even municipal – population data. This could give an interesting insight into places that are either maintaining or growing their population (labour force) and what the implications are in terms of land take and urbanization.

While the descriptions of the “land use change typologies” highlighted a number of very interesting trends – trends which were largely validated in the case studies - the reality is that they represent a further generalization of land change processes. And while it was shown to be beneficial to generalize land change trends it is also potentially misleading; not least due to the fact that any changes deviating from the “average changes” or dominant changes are not well reflected. Most notably, this relates to the “scale effect” where, as mentioned, rural land changes that are more extensive in area than concentrated urban changes are dominant in terms of average regional change. Consequently, the results of the Land use change types can have a tendency to over generalize land changes - and the processes behind those changes – for some region, especially relatively large ones.

Two examples of this were mentioned; in the Skåne region of Southern Sweden (where urban sprawl resulting from the construction of the Oresund Bridge was reflected in the typology because of the dominant agricultural and forest conversions) and to a lesser extent in region containing Madrid. Thus, the Land use change typology’s asset of providing a general picture of the characteristics of land changes is also its weakness. It shows that generalizing can be a risky objective; especially in terms of regional patterns of land use where a variety of interacting and independent changes reflect a very complex set of regional processes.

## 8 Land use functionality assessment

Based on the need to approach the multiple perspectives of land use, the EU-LUPA project has introduced the notion of Land Use Functions (LUFs) and has completed a comprehensive analysis of changing performance in relation to six individual land use functions:

LUF1: Provision of work; LUF2: Provision of leisure and recreation; LUF3: Provision of primary products; LUF4: Provision of housing and infrastructure; LUF5: Provision of abiotic resources; LUF6: Provision of biotic resources.

Synthesis of these functions also allows for the summaries of land use functions relating to the provision of economic, environmental and social functions.

LUFs express the goods and services that the use of the land provides to human society, which are of economical, ecological and socio-cultural value and are likely to be affected by policy changes. Key findings of the analysis include the following:

- Extreme changes do not occur and the overall pattern shows stability in the six years studied (2000-2006). Overall Scandinavia shows the highest stability, being central and southern Europe more unstable with mixed patterns.
- The two mainly economic LUFs (LUF1 Provision of work and LUF2 Leisure and recreation) show a high stable performance in the *Blue Banana*<sup>1</sup> corridor, as it could be expected, although some negative changes in LUF 1 are observed in the fringes, e.g. in the Netherlands and East Germany, Eastern France and Barcelona. Positive changes are scattered except in Scandinavia and the Baltic countries. Other countries showing positive development are eastern Turkey, western Spain and central Europe.
- LUF2 Leisure and recreation shows a more general trend to increase the performance than to decrease. In general, coastal areas and the Canarias islands improve. Romania and Bulgaria increase from low to medium, showing developments in the tourist sector in the years previous to their entrance in the EU (2007).
- In contrast with the economic LUFs, LUF3 Provision of food, timber and biofuels shows negative developments in several regions, especially in the Mediterranean countries, which could be associated to land abandonment and decrease in area harvested (mainly conversion of rural areas into urban). In contrast, there are positive changes in Scotland and central Europe. It is interesting to see the different geographical patterns in Sweden, with a high and stable performance in the North (associated to forestry), and a negative performance in the south (linked to agricultural production).
- LUF4 Housing and infrastructure shows a high stable performance in the Blue Banana, similarly to the economic LUFs, indicating significant urban and infrastructure developments in the European Megalopolis. Coastal areas in the Mediterranean show as well a high stable performance and even an increase in some regions. Increases are also observed in southern Spain, southern Italy and eastern Germany, as well in main cities in central Europe (Budapest, Bratislava and surroundings). Decrease is found in few rural areas of Romania, Poland, South Sweden and Lleida (Spain).
- LUF5 abiotic resources shows scattered changes as it describes broad environmental issues linked to air, water and soil quality. Therefore variations are difficult to explain without assessing the changes in the indicators affecting the LUF.
- LUF6 biotic resources show significant improvement in central Spain and north-western France. There are more negative developments than in the other environmental LUF. For example, in some regions of the Dutch 'randstad' (industrial and metropolitan conurbation occupying west-central Netherlands) where significant infrastructure and urban development has taken place. This trend appears as well in Southern Alps including the densely populated Po valley (Italy).
- More intensive changes tend to occur in shorter lapse of time, while reversing their potential negative impact would take much more time -if not irreversible. This is well exemplified on the LUF ecological functions that needs longer period of time (> 6 years in our project) to see changes (changes at general ecosystem level, not single factors). On the other side economic components are much more flexible and change over very short period of time. The risk is when rapid changes in socioeconomic components are based on intensive use of large areas. In those cases an exhaustive analysis would be required to avoid a serious compromise for the future.

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<sup>1</sup> Discontinuous corridor of urbanisation in Western Europe. It stretches approximately from North West England in the north to Milan in the south.

## 9 What do the case studies reveal?

Spatial planning traditions, systems, policies and strategies and the differences between regions and countries are very important when analysing the results. The completion of four case studies revealed the following general conclusions for the EU-LUPA project as a whole.

The investigations contained in this study have allowed us to establish, check and verify our own typology of the land owner and develop the conceptualization and methodology of Land Use Functions. One important object of focus and analysis in fieldwork were the four types of Land Cover Flow (urban residential sprawl, sprawl of economic sites and infrastructures, internal agricultural transformations, and forest creation and management), which were identified on the land use maps of the regions in question. Care was taken in the course of field work to identify these areas correctly. We also described the detailed characteristics of the previously identified types, placing special emphasis on the contemporary changes in land use and its dynamics.

Urban residential sprawl represents the intensification of multi-level land utilization and of the average dynamics of land use changes (conversion of agricultural and into built-up areas in most cases). The main factors of those changes are: location close to road or railway infrastructure, good connection to core towns, access to social infrastructure. All of the in-depth investigations pertained to areas represented under cluster 6 (Dynamic rural and peri-urban changes). In accordance with the definition of Cluster 6, in these regions the development of non-land-based economic activities occurs. The highest pressure on peri-urban areas is observed around big cities, which will certainly become a challenge for regional green structure plans like the Finger plan in Denmark or sectorial planning in the Basque Country. Highly dynamic expansion of individual housing is clustered along the major roads, which causes problems with accessibility. Urban sprawl is less chaotic in countries with standardized spatial planning, and therefore the land use follows a mosaic-like pattern (there are a lot of single houses scattered over a large territory, between the forest and agricultural areas). In the Polish cases there are also difficulties with lack of development in technical and social infrastructure in the suburban area.

Sprawl of economic sites and infrastructures characterizes the intensification of land use. Dynamics and directions of land use as well as the changes in land cover are high or very high and are connected with the location and the pressure exerted by new investors. All analyzed areas represented cluster 6 (Dynamic rural and peri-urban changes). There are some spatial conflicts in this area. For instance, in Lomma (Sweden) the nature reserve is located on one side of the road and new services are situated on the other. There was significant pressure on this nature reserve, which resulted in the construction of a protective fence. In the Øresund Region, mostly on the coast, conflicts between the construction of second houses, areas of leisure activity and wind power plants are appearing. Also in the Polish cases, the highest level of development of infrastructure is to be seen in the most attractive places (e.g. development of tourism infrastructure in mountainous areas). One very common type of infrastructure is the leisure-designated areas, such as golf courses and horseback riding paths, especially in the vicinity of cities, but in an attractive landscape.

Agriculture-internal conversions characterize the extensification or stabilization and differentiated dynamics of land use changes (from high to low), depending on the region. Some of the territories represent high natural environment values and, consequently, are protected by law. The investigated areas represent a wide range of clusters (cluster 3 – extensification of rural activities, cluster 8 – high extensification in rural and sparsely populated regions and cluster 9 – stable rural and peri-urban activities), which is confirmed by relatively diverse directions and dynamics of land use changes. Agricultural areas were gradually transformed into more peripheral ones, where the building pressure and land



prices were lower (e.g. in Denmark, farmers moved to Jutland and the new EU member states). The internal conversions are mostly observable in the neighborhood of big cities: there are more ecological farms, which produce healthy food and sell it to a local market. One of the most considerable changes in land use is related to the migration from peripheral areas to the coast and the city. People living in rural areas give up cultivation of land, move to towns and effectuate a change towards more environment-friendly means of production. In the Basque

Country rural tourism is more popular (to foreign visitors) in comparison to the most typical coastal tourism. Internal conversions in the Chełmsko-Zamojski region derive from the economic transformation. Changes in the structure of land use are related to the profitability of production: high extensification of a region's agriculture results in an increase in cereal cultivation and the abandoning of sugar beetroot, tobacco, flax, and hemp and potato cultivation.

Forest creation and management represents stabilization and low dynamics of the land use changes. The major reason for this stabilization is the poor quality of the land in relation to other economic activities and land protection. The investigated areas represent cluster 3 (extensification of rural activities) and cluster 9 (stable rural and peri-urban activities).

The Basque case elucidates the shifting function of the forest. There are a lot of areas classified as forests that in reality turn out to be tree plantations. There are no visible changes in CLC data, but they do influence environmental issues. In the Chełmsko-Zamojski case, over the last decades, the encroachment of the forest on meadows and pastures has been observed and results in the reduction of their respective areas. This process of renaturalization is strongly linked with the concentration and intensification of cattle breeding within the region, and the concurrent abandoning of meadows and pastures as sources of fodder. Small farms do not uphold livestock production due to macroeconomic changes in agriculture and their meadows and pastures are often undergoing a process of renaturalisation. The processes taking place in forest areas (extensification and stability) have no major impact on land use change, such as intensification. The changes often appear as a point, invisible to the Corine Land Cover, but exerting a very strong influence on the functional and economic structures.

Fieldwork also involved conducting a series of interviews with representatives of the local authorities who are directly engaged in local land use issues, as well as with scientist from the academic institutions of the region. Participants of the project also took part in a series of workshops that also involved included local representatives.

## 10 Lessons learnt for policy development

Policy makers should rely on research evidences in order to define the most appropriate measures and policies responses in line with the EU development principles and objectives (mainly under the EU Cohesion Policy, EU2020 Strategy and the Territorial Agenda)

- to support **responsible land management**, monitoring land use intensity,
- to resolve **conflicting land use demands** affecting the economic, social and environmental performance of a region,
- and to **identify the potentials for improving regional competitiveness and territorial cohesion towards sustainability**.

The land use characterization in the European territory undertaken in the project (See Volumes I and II) offers very valuable information with regard to the potentials and challenges of the regions, and it allowed us to identify the key policy areas to focus on when

elaborating the policy recommendations. The key policy messages provided by EU-LUPA are far from being *ad hoc* regional policy recommendations. They are **general messages for awareness rising regarding land use changes in EU** (See Volume XIII of the Scientific Report).

- **In the need for strengthen territorial cohesion particular emphasis should be placed on the role of cities, local development and the macro-regional strategies.** Generally speaking the local municipalities have a strong weight regarding land use decision-making, although the balance between the power of local and supra-local levels might differ among countries.
- **The enlargement of the EU to 27 Member States presents an unprecedented challenge for the competitiveness and internal cohesion of the Union.** The assessment of the intensity of Land Use Change (see Volume I chapter 3.2) revealed that there is a clear east-west dimension that could be partly explained due to the enlargement of the European Union in the nineties. A couple of examples are provided which illustrate such phenomena. Large volumes of land use extensification are almost exclusively found in Eastern European member states, particularly in Poland, The Czech Republic and Hungary. This pattern is very dominant in the period 1990-2000 but continues in 2000-2006 as well. The land ownership reforms in Eastern Central Europe during the 1990s resulted in marked changes, a process which was further fuelled by the expectations regarding future membership of EU in the period up to and after the membership in 2004.

Besides, it also revealed that some of the most significant changes between 1990 and 2000 took place on the Iberian Peninsula. Considering that the agrarian reforms in such regions began during the 1970's and ended in the late 1980's, the changes could be partly explained likely due to the ascension of Spain and Portugal to the EU in 1986.

These are important observations because they highlight the types of changes that can be expected by current or future candidate countries.

- **The integration of the EU in global economic competition is accelerating, offering regions and larger territories more options to decide their development path, as development is no longer a zero sum game for Europe. Interaction is growing within the EU territory and between the surrounding neighbor countries and other parts of the world.** The social performance is high in the Blue Banana corridor. Interestingly, the regions where changes in economic performance are found do not coincide with those regions showing changes in environmental or social performance. This indicates that the three dimensions are not following the same development patterns. The economic aspects show a decrease in performance in Southern Finland, Northern Denmark, North France, Cataluña (North-eastern Spain) and central Italy, and increases in southern Norway and Levante (eastern Spain).

In the analysis of Land Use Functions, the two mainly economic LUFs (LUF1 Provision of work, and LUF2 Leisure) show a high and stable performance in the Blue Banana corridor, as it could be expected, although some negative changes in LUF1 are observed in the fringes, e.g. in the Netherlands and East Germany, Eastern France and Barcelona. Positive changes are scattered except in Scandinavia and the Baltic countries. Other countries showing positive development are eastern Turkey, western Spain and central Europe.

LUF2 Leisure shows a more general trend to increase the performance than to decrease. In general, coastal areas and the Canarias islands improve. Romania and Bulgaria increase from low to medium, showing developments in the tourist sector in the previous years to their entrance in the EU (2007).

- **Interactive mega-drivers at pan-European scale provoke territorial processes at regional and local scales.** Changes in land use and land cover date to prehistory and are the direct and indirect consequence of human actions to secure essential resources. This may first have occurred with the burning of areas to enhance the availability of wild game and accelerated dramatically with the birth of agriculture, resulting in the extensive clearing (deforestation) and management of Earth's terrestrial surface that continues today. More recently, industrialization has encouraged the concentration of human populations within urban areas (urbanization) and the depopulation of rural areas, accompanied by the intensification of agriculture in the most productive lands and the abandonment of marginal lands. All of these causes and their consequences are observable simultaneously around the world today.
- **Processes such as urbanization, agricultural intensification, a-forestation, rural abandonment, land use specialization are land use processes resulting from interacting driving forces.** The assessment of the prevailing characteristics of land use in Europe at grid level highlights that with an average coverage of 32.4% of Europe, "Rural forest" is the most extensive land type, follow by "Arable land in predominantly rural areas" accounting for an average of 22.36% and "Pastures, agricultural mosaics and mixed forest" in predominantly rural areas covering an average of 21.61% of Europe.

The production cycle of many decades or even centuries related to forestry is responsible for a substantial part of the major changes registered in for instance Sweden and Finland, but also in Latvia, Estonia, Portugal, Spain and southwest France. It is also very interesting to see the different stages of the felling-afforestation-re-felling transformation cycle the four regions appear to be situated. While a relative dominance of afforestation appears to be taking place on the Iberian Peninsula and in southern Finland, recent felling appears as dominant in southern Sweden and especially in Latvia. It is clear that situations with continued felling without a balance of afforestation are an unsustainable land cover trend.

For agricultural withdrawal, abandonment processes have been most pronounced in the central-south and north-east regions of Hungary (between 2000 and 2006), on the Italian island of Sardinia (between 1990 and 2000), and in Ireland southern Portugal to differing degrees throughout the 1990-2006 period.

LUF3 Provision of food, timber and biofuels shows negative developments in several regions, especially in the Mediterranean countries, which could be associated to land abandonment and decrease in area harvested (mainly due to conversion of rural areas into urban). In contrast, there are positive changes in Scotland and central Europe. It is interesting to see the different geographical patterns in Sweden, with a high and stable performance in the North (associated to forestry production), and a negative performance in the south (linked to agricultural production).

- **The ongoing mega trends are to some extent linked to the implementation of certain policies.** Certain EU policies are affecting land use changes and will do so in the future in different ways: some of them tend to homogenize the European territory and others, as the Common Agricultural Policy, provoke regional inequities as is the case of eastern Poland in the Ukraine frontier or border Germany-Denmark reflecting different approaches to such policy, as derived for the assessment of the project case studies

- **There is a need for a more integrated policy approach towards sustainable land use.** Past and current policy decisions can influence the rate at which land use and land cover change. Our hypothesis is that different planning systems may affect land use and land cover changes in different ways: Centralized vs decentralized planning systems alongside spatial planning traditions: regional economic planning approach (France, Portugal and Germany); comprehensive integrated approach (Nordic Countries and Austria); Land use management (UK, Ireland, Belgium); urbanism tradition (Mediterranean countries) (EC The EU compendium of spatial planning systems).

- Due to the cross-cutting nature of land use, integrated programmes are needed to guarantee the EU objective for territorial cohesion.
- Policy responses are needed to help resolve conflicting land use demands and to guide land use intensity to support sustainable land management
- Coordination of different sector policies and various policy levels is therefore crucial: good governance.
- Land-use planning and management are powerful and essential to better reconcile land use with environmental concerns and resolve potential conflicts between sectoral interests and potential uses.

- **There is still a double-sided relationship between land and growth in most of the regions in the European territory.**

We need land to grow, but our growth puts pressure on the social, economic and environmental services we can obtain from it. It also shows that the drivers, the enablers and the ingredients of what we require for development are the very things pressuring the over-consumption of land. This pressure cannot continue to escalate as we continue to develop and it means that a growth model that is blind to the host of thresholds related to land and its resources cannot continue sustainably.

European economies depend on natural resources, including raw materials and space. Land is a limited resource. Different sector interests are often competing for the same territorial resource.

Europe's Resource Efficient Strategy sets the goal of no additional land consumption after 2020, yet this mandate will mostly likely work against the goals of a number of regions; particularly those seeking to ascend the socio-economic ranks toward the most established European nations. The fact that the magnitude of land change has been more or less maintained throughout the period from 1990 to 2006, and prospective new members of EU appear ready to make use of land change as a vehicle for economic progress, it seems that measures of compensating any limitations in this respect would be needed. Therefore, it is both an unlikely and unrealistic goal for a number of European regions.

- **Monitoring and mediating the negative environmental consequences of land use while sustaining the production of essential resources should be a major priority of policy-makers, because**

- the way land is used has impacts on biodiversity and ecosystem services, on land degradation, and pollution on water, soil and air;
- the occurrence of hazards due to climate change is increasing and different parts of Europe experience different types of hazards;
- there are development opportunities for the production of renewable energy sources.

- **Growth is possible without major new land in take**, especially in western European regions where the connection between socioeconomic development and urbanization (i.e. toward a global, knowledge intensive and service based urban economies) has already taken place. This is possible by reusing/optimising existing urbanised land. The high-level conference on 'Soil remediation and soil sealing' (DG ENV, Brussels 10-11 May 2012) highlighted the crosscutting component of this intensive use of the land. This cannot be tackled by a single policy but needs better integration across policies.

The correlation between population growth rates and land take (2000-2006) shows that in most regions the pattern has been that the increase in the average population growth has gone together with an increase in the average annual growth rate of land take. Land take is growing faster than population. However in certain regions mainly of Spain, The Netherlands and Ireland, the urban development has been a fast phenomenon particularly during the analysed period with irrelevant population growth. At the European level, housing, services and recreation made up a third of the overall increase in urban and other artificial area between 2000 and 2006. (EEA, Land Take GDI 5 March 2012)

Western European countries but in particular Spain, Ireland, Portugal suffered an unsustainable rise in the price of real state from the 1990s to 2008, commonly known as property bubble. House ownership in Spain is above 80%. The desire to own one's own home was encouraged by governments in the 60s and 70s, and has thus become part of the Spanish psyche. In addition, tax regulation encourages ownership: 15% of mortgage payments are deductible from personal income taxes. Certain parallelisms between increase in employment rates and land artificialization could be seen in several Spanish, Irish and Portuguese regions. Again this could be explained due to those countries dependency on construction/building sector.

- **Land use characteristics are becoming increasingly multi-functional, crossing not only sectors but also administrative borders.**

The expression “multi-functional landscapes” refers to areas serving different functions and combining a variety of qualities, i.e. that different material, mental, and social processes in nature and society take place simultaneously in any given landscape and interact accordingly. Multi-functionality in landscape, therefore, means the co-existence of ecological, economic, cultural, historical, and aesthetic functions. Thus, landscape multi-functionality is not necessarily synonymous with multiple land uses.

Different land uses can be a criterion for multi-functionality in landscapes, but even a single land use can involve numerous functions. Different land uses can result in different functions, but not all functions can be expressed as land uses. The problem in this connection, however, is that the concept “land use” often – as emphasized in the report - is only related to the physical characteristics of the land cover identified through for instance the Corine land cover characteristics and the economic activities related to its use.

Different land uses can be a criterion for multi-functionality in landscapes, but even a single land use can involve numerous functions. Paracchini et al. (2011)<sup>2</sup> therefore emphasizes that the concept of multifunctional land use provides a favourable approach based on the recognition of that in order to maximize the benefits obtained

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<sup>2</sup> Paracchini, M.L., Pacini, C., Laurence, M., Jones, M., Pérez-Soba, M. (2011): An aggregation framework to link indicators associated with multifunctional land use to the stakeholder evaluation of policy options. *Ecological Indicators*. Vol. 11, Issue 1, January 2011. P 71-80. Elsevier

from a given parcel of land, a more equitable balance of the competing economic, environmental and social demands on land is more sustainable in the long-term than an unbalanced system based on individual sector based rationale. In such a context there is, however, also a need for evaluation tools which allow a more sensible approach to the assessment of whether competing demands in a multifunctional land use system are sustainable or not. In particular, there is a need to integrate information and data from a wide variety of sources into a single evaluation framework, recognizing that different land uses can result in different functions, but not all functions can be expressed as land uses.

The approach to “land use” should therefore not only be seen from the land cover perspective but also from the perspective of “functionality”, which provides linkage with other transversal issues. “Functionality” could be a motivating approach in the integration of land cover, land use management, socio-economics, transportation, energy conservation, water management and climate change. While the concept of “land use” traditionally has been considered (to some extent) to be binary, i.e. one land use activity would exclude other activities, the situation in Europe is that the functionality of land areas has been increasingly diversified: on one hand towards exclusiveness with mono-functional large scale production, and on the other hand towards inclusiveness, which stresses the fact that different activities co-exists.

- **It is necessary to consider the governance structures and planning systems in place in each territorial reality in order to define the most appropriate level of implementation of policy messages and recommendations.** The question is: Is there any relationship between the regional land use performance and different planning systems/traditions in Europe? This is a conceptual challenge still unresolved within the EU-LUPA project.

- **Tailored measures and policy instruments for specific locations or land-use types are needed.** Our key recommendation is that each region should undertake a regional assessment following the strategy defined for the assessment of the case studies which would allow a proper contextualization of the land use patterns and dynamics and support the identification of the policy options that better respond to the challenges and opportunities in each territorial reality.

Volume XIII of the Scientific Report addressed the above mentioned general messages for awareness rising extensively. EU-LUPA provides a battery of policy messages developed at case study level in Volumes VI to IX of the Scientific Report that should be considered for future policy development.

## 11 Further steps

EU-LUPA project was a highly complex and extensive project which has generally made a big step towards a better understanding of land use performance and land use changes in the European space. At the same time it provides a good basis for further research on the investigated topic.

Having said that it is also evident that some issues have been encountered during the project development which caused difficulties and, if solved, could lead to improved results.

### Data requirements

There is a need for more frequent data updates and better resolution and further improvement of the data coverage at regional scale.

The use of CORINE Land Cover 2010 and updated socioeconomic data at NUT3 level would allow the identification of what has happened during the economic crisis. Besides, the spatial coverage in EU-LUPA is not entirely consistent for each time series in CORINE Land Cover. This prevents full European coverage of the typologies for the entire 1990-2006 time series.

The methods developed by EU-LUPA are flexible enough to accept more detailed data whenever available.

### Analytical tools

Indicators developed and/or used at EU level, should be adjusted for a more precise analysis and understanding of land use dynamics at case study level. Different regions have developed different data sets depending on their own geographical characteristics. Northern regions might require the analysis of some data that could not make sense for the Mediterranean countries. This is particularly evident for example when addressing climate change issues.

Due to the on-going changes in land use characteristics in Europe, difficulties in accurate identification of mono versus multi functionalities are apparent. Considerations on criteria for such identification have become key questions in, for instance, the current discussions on the future CAP structure.

The development of quantitative and qualitative tools is needed in order to better analyse the sustainability of diverse land uses in the European context. The development of a system of indicators monitoring prevailing characteristics of land use and land use changes in relation to socio-economic trends is suggested here. Further analytical work in that direction would enable the response to remaining unresolved questions on how to balance landscape protection and social welfare in the context of regional development. This has been already partly covered in the on-going ESPON Priority 2 Project: Liveland.

To date, several analyses have been undertaken in EU-LUPA to assess Land Use Performance (LU Performance) and Land Use Efficiency (LU Efficiency) at regional level in Europe. However, from the results achieved so far it has been very difficult to extract any clear conclusions due to several constraints and conceptual limitations, which are the following:

- The question has been approached by **analysing performance and efficiency**. Land Use Performance was defined within EU-LUPA as the degree in which the land is used to comply with a specific policy target. Efficiency has a wide variation in meaning for different disciplines. In general terms, efficiency describes the extent to which time or effort is well used for the intended task or purpose. In the case of land use science, this definition could be translated as the extent to which land is well used for the intended

function considered. Efficiency can be understood as the amount of resources needed to obtain certain output (benefit). In the case of EU-LUPA the resource is the land and it involves an understanding of both the quantity and quality.

- How to measure if on-going trends of land use change in the European regions are **sustainable**, or whether they are compromising future development has been one of the key challenges of the EU-LUPA project research, but there are several challenges and questions that remain unresolved or in need for further explanation and rationalization. Data availability at NUTS3 in order to evaluate the potential correlation between land use dynamics observed in the Land Cover Characterization and typologies and the distance to the headline policy targets.
- **Most policy targets are territorially blind:** One of the difficulties to understand the performance of European territories in relation to land use is that most of the policy targets do not have a direct translation on land use.
- **Narrow time-frame:** The consideration of only 6 years to measure land, environmental, social and economic changes is not enough timeframe to extract conclusions on performance and efficiency.
- The Land Use Functions approach to assess land use efficiency is in principle quite coarse due to the degree of aggregation of the socioeconomic data - one related to the administrative unit at which the data is provided; the other to the typology of the data itself.

### **Regional complementary potentials**

Detecting territories with complementary potentials which can join forces and explore their comparative advantages together has been identified as a key issue for future analytical research. Defining synergic development potential is seen crucial for regional cooperation and cohesion. From the reading of the EU-LUPA maps there are very clear disparities and also complementary potentials between neighboring countries, but also between many neighboring regions. ESPON project ULYSSESS has done a significant step in that respect.

### **Policy development and implementation**

Further research is required for the elaboration of a set criteria for the selection of policy interventions and criteria for the implementation with regard to sustainable, responsible, efficient land use and land use management. This could be materialized in a targeted analysis, under priority 2 in the next ESPON programme.

### **Deeper analysis of urban phenomena**

A closer comparison to land changes resulting in new or maintained urban areas could be undertaken and to compare this data with regional – or even municipal – population data. This could give an interesting insight into places that are either maintaining or growing their population (labour force) and what the implications are in terms of land take and urbanization.

The future efforts, therefore, should be targeted further in the harmonisation of indicators and data sets among the EU member states, which would enable the research into the European space and its structures at lower levels also. Particularly, the initiatives of National Contact Points (Capitalisation of ESPON results) should be further encouraged.



[www.espon.eu](http://www.espon.eu)

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