

# EU-LUPA

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#### Case studies Land Cover Changes

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# 1. Introduction

The present report is presenting results of the analysis of land cover changes with regard to the project case studies.

It starts with identification with the key factors and drivers of land use change in the selected case study areas.

It continues with the identification of land use change challenges in the assessed areas and proposed recommendations to cope with the challenges and strengthen the potentials

A verification of Land Cover Flows characterization in the case studies is then shown.

Final chapter is devoted to the conclusions in the analysis of the case studies in the context of the Land Cover Change types used in the project.

## 2. Identification of the factors and drivers of land use change in case studies areas (macro scale)

Table 1 Analysis of land use changes in the case study region according to Land Cover Types

Case study area	Land cover types	Change <i>E- ekstensification; S – stabilization; I - intensification</i>	Dynamics <i>+++ - high ++ - medium + - small</i>	Factors <i>++ - most important; + - less important</i>	Identified processes
Oresund	Arable land	E	++	+ From 1972 – zoning system in Denmark (agriculture, leisure, urban) protected agriculture area (one compromise: communication network) + EU support big farms	Moving animals' farms to less develop countries. Transform agriculture to ecological, organic. On Danish side arable land decreases, in Sweden side it's stable because Skane is the only agricultural region in whole country.
	Pastures with annual/permanent crops	E	+	+ trend to transform land from agriculture to sport and recreation functions	Decrease area in Capital Region of Denmark and Skane, but increase in other part of Zealand
	Forests	S	+	+ forest is more and more popular for recreation services	Internal changes
	Natural Grassland				
	Transitional woodland – shrub areas				
	Sparsely vegetated areas				
	Marshes, coastal areas and inland waters	S	+	++ in the case of coastal areas strongly developed residential function in the past, now protection of access to coast for recreational purposes	Strongly developed zone of summer houses along sea coast during many decades. Now landscape conflict with needs of wind power plant on the sea and spatial conflict about needs of access to sea coast and recreation, which is a barrier for further residential zone enlarging and intensifying.
		E	+	+ in the case of inland waters environmental protection	Environmental protection of water reservoirs and their surroundings and recreational purposes are the often reasons of economic activities abandon. Now function of environmental protection and recreation dominates in these cases.
Core urban areas	S	+	+ migration of young people into city centers and older (with families) to suburbs	Internal changes	

	Urban areas in transition	I	++	++ suburbanization, improving quality of life, ++ transformation of regional economy appearing as dispersion of industry, warehouses and research activities	Urban sprawl according spatial plans (controlled by law). Transformation of regional industry and economy appearing in deconcentration of high-tech economy and R&D sector activities connected with demanding of clean environment, improving conditions of work and spatial accessibility, lowering costs and decreasing role of agglomeration profits.
	Urban areas in intensive transition				
	Urban areas in arable land	I	+	++ suburbanization, improving quality of life	Urban sprawl according spatial plans (controlled by law)
	Urban areas in pastures with annual and permanent crops	I	++	+ investment in sport and recreation areas	Investment in golf clubs, leisure areas, horseback riding paths, etc,
	Urban areas in forested areas	I	+	+ investment in recreation areas, horse path,	Investment in leisure areas, horseback riding paths, etc,
	Urban areas in transitional woodland areas				
	Urban in marshes, coastal areas and inland waters	I	++	++ nice landscape, high land value	Business centers, wind power plant
<b>Basque Eurocity</b>	Arable land	E	++	+ urbanization process, ageing of population, style of life	Urbanization, withdrawal of farming, transformation of agriculture to more ecological
	Pastures with annual/permanent crops	S	+	++ terrain (hills and mountain areas)	Stable area of pastures, but just in mountain region
	Forests	E	++	+ forest are mostly private areas	A lot of plantations of trees, which can be cut down in every moment – destroy of environment (soil, water, landscape).
	Natural Grassland				
	Transitional woodland – shrub areas				
	Sparsely vegetated areas				
	Marshes, coastal areas and inland waters				
	Core urban areas	I	+	+ Depopulation, style of life + transition from heavy industry to high-tech	old industrial buildings, the port disappeared – there appeared high-tech companies
Urban areas in transition	I	++	++Suburbanization, improving quality of life	Urban sprawl controlled by spatial plans.	

				+Style of life +Research and business activities	
	Urban areas in intensive transition				
	Urban areas in arable land	I	++	+ Improve quality of life, ++Good localization, near cities and transport corridors, + Specific day schedule of Spanish people (They have a long lunch break in the middle of the day, so they want to live near their work)	Urban sprawl, transport corridors, rural tourism
	Urban areas in pastures with annual and permanent crops				
	Urban areas in forested areas				
	Urban areas in transitional woodland areas				
	Urban in marshes, coastal areas and inland waters	I	++	++ Natural process of suburbanization +Nice landscape, good infrastructure	New investments: second houses, urban sprawl,
<b>Chełmsko-zamojski</b>	Arable land	E	++	++ Collapsing of food processing industry + Macroeconomic circumstances for agriculture + Needs of energy production	Shifting of cultivation area structure from industrial plants, like sugar beetroots, potatoes, flax or tobacco, to cereals and some energy willow on weaker soils. Forestation of steep slopes and plots with weaker soils.
	Pastures with annual/permanent crops	E	+	++ Cattle breeding concentration and intensification + Drainage systems in river valleys abandon	Forestation of wetlands and wildlife growth. Pastures not fully utilized due to cattle breeding concentration.
	Forests	S	+	+ Market circumstances of wood supply for building and furniture production + Environmental protection	Maintaining activity of sawmills and small furniture factories. Environmental protection in some areas. Gradual enlarging of forest areas on worse conditioning agricultural land. Gradual leisure function growth in forests and in their neighborhood in some areas, especially in Roztocze Hills.
	Natural Grassland	S	+	+ Environmental protection	Wildlife growth, forest succession and drainage systems abandon in some areas.
	Transitional woodland – shrub areas	S	+	+ Environmental protection	Wildlife growth.
	Sparsely vegetated areas				
	Marshes, coastal areas and	I	+	+ Flood protection	Some new artificial water reservoirs



	inland waters			+ Leisure function role growth	appearing. Predominance of their recreational function with second houses zone appearing in neighborhood. Some small ponds for recreational fishing appeared as well.
	Core urban areas	E	++	++ Emigration of young people to bigger educational centers and bigger labor markets ++ Collapsing of industry in the region + Decreasing of administrative role of Chełm and Zamość + Revitalization of Zamość oldtown	Stagnation of towns development. Ageing of population due to emigration of young people due to educational and labor market purposes and suburbanization. Shifting of their functions from administrative-industrial to trade-educational. Strong increase of relatively big moles winning competition with small enterprises in the town center. Revitalization of historical Zamość old town is going to strengthen tourist and cultural function in it.
	Urban areas in transition	I	+	++ Suburbanization with predominance of housing and services functions, improving quality of live	New housing areas along main roads from Chełm and Zamość with small entrepreneurship. Lack of spatial planning in suburbs in some cases, especially further from main roads, causing spatial conflicts regarding housing areas and infrastructure networks development.
	Urban areas in intensive transition				
	Urban areas in arable land	I	+	+ Local fresh food market	Some cases of vegetable production and greenhouses investments for local market.
	Urban areas in pastures with annual and permanent crops	E	+	+ Macroeconomic circumstances of agriculture + Local fresh food market	Abandon of cattle breeding in suburbs. Some orchards supplying local market with fruits.
	Urban areas in forested areas				
	Urban areas in transitional woodland areas				
	Urban in marshes, coastal areas and inland waters				
<b>Jeleniogórski</b>	Arable land	S	+	++ lack of other opportunities, European Union payments, good environmental conditions	Consolidation of land in big agricultural enterprises, agricultural production in the areas with the best environmental conditions, stimulation of agricultural production due to European Union

					payments
Pastures with annual/permanent crops	S	+	+ European Union payments		Most of the grasslands are not fully utilized – small amount of cattle and sheep breeding, some utilization is apparent and done due to European payments
Forests	I	++	++ renewal of destroyed environment		Big effort to renewal of destroyed forests after the ecological catastrophe
Natural Grassland					
Transitional woodland – shrub areas	I	++	+ activities of construction, industry, army		Forests and woodland are under the transformation processes due to construction of some infrastructure, industry plants, army activities or other human activities.
Sparsely vegetated areas					
Marshes, coastal areas and inland waters					
Core urban areas	S	+	+ depopulating processes, collapse of industry		Small revitalization processes.
Urban areas in transition	S	+	+ depopulating processes, development of some new entrepreneurships		Development of new industrial activities, construction plants not in the center part of towns (on ex-industrial zones) but outside of the centers or even outside of the town
Urban areas in intensive transition					
Urban areas in arable land	I	++	++ natural process of suburbanization – better quality of life		Development of individual housing, close to the city but in the open, rural space with high landscape values
Urban areas in pastures with annual and permanent crops					
Urban areas in forested areas					
Urban areas in transitional woodland areas					
Urban in marshes, coastal areas and inland waters					

**Table 2 Analysis of land use changes in the case study regions/areas according to Land Cover Typology**

Case study area	Name of investigated area	Type of land according to Land Cover Typology	Change <i>E- ekstensification; S – stabilization; I - intensification</i>	Dynamics +++ - high ++ - medium + - small	Land Cover Flows	Factors ++ - most important; + - less important	Remarks
<b>Oresund</b>	1. Hedeland - Sprawl of economic sites and infrastructures	Urban areas in intensive transition	I	+++	Sprawl of economic sites and infrastructures	++ very good localization close to the city with specified spatial plan	Old grave and clay mine, which was transformed into big very diverse recreation zone
	2. Lomma – Natural Grassland	Natural Grassland	E	+++	Agricultural Internal Conversions	+ high value of nature + protection because of threat from motorway and new investment	Nature reserve protecting wildlife of small pond. A couple of new economic investments in the surrounding.
	3. Forest near Svedala	Forest	S	+	Forest creation and management	+ cut down because of trees disease	Horseback riding paths and old golf club in the area. Transformation of forest slightly east from indicated point.
<b>Basque Eurocity</b>	1. Lanbarren Industrial Zone	Urban areas in arable land	I	+++	Sprawl of economic sites and infrastructures	++ very good location – near the motorway and harbour, increase of international exchange	Very good location of that new logistic park.
	2. Urban sprawl In Kalitxo	Urban areas in arable land	I	++	Urban residential sprawl	++ location in a very favourable place – close to the city and the ocean. + development of the accompanying infrastructure (eg. shops).	Complex development of the new settlement – there was one investor.
	3. Derio – technological park	Urban areas in arable land	I	++	Sprawl of economic sites and infrastructures	++ close location to Bilbao city, + nice location in terms of landscape and close to the airport	Complex development of new research and technological park – totally new investment outside of the city

	4. Geldo – forest changes	Forests	S	+	Forest creation and management	+ poor quality of land for other activities, extensive land use, plantations cultivated in terms of economic profits	No visible Corine changes – due to a fact, that there is big rotation in the coverage of the woodlands
	5. Bidart – sprawl of economic sites and infrastructure	Urban areas in arable land	I (in LCT - E)	++	Sprawl of economic sites and infrastructures	+ good localization – close to the city and motorway	Urban residential sprawl
	6. Mutriku – old city	Urban areas in transition	S	+	No changes ?	+ city located in valley- there are not more land for urbanization – just on the slopes	No visible Corine changes
	7. Getaria - port city and agricultural land	Arable land	S	+	Agricultural Internal Conversions	+ region located on the coast, without good connection to big cities	Internal changes in town and agriculture
	8. Legutio – Urban residential sprawl	Urban areas in arable land	I	++	Urban residential sprawl	++ access to social infrastructure: schools, health care, kindergarten, shops. ++ good localization: close to big city, in nice landscape, near good road	New investment based on old part of town with services.
<b>Chelmsko-zamojski</b>	1. Huczwa river near Malice village – Agriculture internal conversions	Pastures with annual/permanent crops	E	++	Agricultural internal conversions	++ macroeconomic circumstances for agriculture + non maintaining drainage system	Conversion arable land with cereals and maize cultivation to pastures for cattle breeding during 1990s'. Wildlife growth.
	2. Werbkowice – Urban residential sprawl	Urban areas in transition	I	++	Urban residential sprawl	++ life quality improvement + potential accessibility + macroeconomic circumstances of agriculture	Majority of houses is from 2000s', arable land with very good quality of soils were transformed into housing area on outskirts of little town. Neighborhood of main road, but underdeveloped

							local road infrastructure.
	3. Polanówka – Forest creation and management	Forests	S	+	Forest creation and management	++ macroeconomic circumstances of agriculture + macroeconomic circumstances of wood production + ownership of forest	Natural succession of forest on fallow private agricultural lands on slopes. Wood production inside state forest area.
<b>Jeleniogórski</b>	1. Jeżów Sudecki – suburban zone of Jelenia Góra	Urban areas in arable land	I	++	Urban residential sprawl	++ natural process of suburbanization – better quality of life	Undergrowth of social and technical infrastructure
	2. Hotel building in Karpacz	Urban areas in transition	I	+++	Sprawl of economic sites and infrastructures	++ big increase of popularity of skiing in Poland, lack of luxury hotels in that subregion	Big controversy according the spatial planning, according the typology there are not intensive changes – the building start after 2006.
	3. Forest changes – Izerskie Mountains	Forests	S	+	Forest creation and management	++ reconstruction of forest after the ecological catastrophe in the 1980.	State Forest, Ecologist and National Park Policy
	4. Sosnówka Lake	Inland waters	I	+++	Water bodies creation	++ Anti-flood protection ++ Reservoir of drinking water	Creation of the lake on previously wetlands

**Table 3 Identification of the factors and processes in case study regions according to Land Cover Change Typology**

Land Cover Change Typology	Case study region and Name of investigated area	Identified processes	Factors ++ - most important; + - less important	Remarks
Urban land management				
Urban residential sprawl	<ol style="list-style-type: none"> <li>1. Jeleniogórski / Jeżów Sudecki</li> <li>2. Basque Eurocity / Urban sprawl In Kalitxo</li> <li>3. Legutio – Urban residential sprawl</li> <li>4. Chelmsko-zamojski / Werbkowice</li> </ol>	Changes of agricultural land into the build-up areas. New houses are surrounded by the agricultural land – big mixture of land use. When the investors are private people - lack of development of technical and social infrastructure (eg. roads). When there is one investor - complex development of the new settlement.	<p>++ natural process of suburbanization – better quality of life</p> <p>++ location in a very favorable place</p> <p>++ access to social infrastructure: schools, health care, kindergarten, shops.</p>	
Sprawl of economic sites and infrastructures	<ol style="list-style-type: none"> <li>1. Jeleniogórski / Hotel building in Karpacz</li> <li>2. Basque Eurocity / Lanbarren Industrial Zone</li> <li>3. Basque Eurocity / Derio – technological park</li> <li>4. Basque Eurocity / Bidart – sprawl of economic sites and infrastructure</li> <li>5. Oresund / Hedeland</li> </ol>	<p>Intensive development of tourism infrastructure in the most attractive places.</p> <p>Very good location of new investments – close to the main transport corridors and close to the main cities.</p> <p>Transformation of industrial sites in direction of leisure activities functions development.</p>	<p>++ big increase of popularity of skiing in Poland, lack of luxury hotels in that subregion</p> <p>++ very good location – near the motorway and harbor, increase of international exchange</p> <p>++ increasing demand of leisure activities sites surrounding agglomeration</p> <p>+ transformation of industry in developed countries</p>	Some of the changes are not recognized by Corine typology
Agriculture internal conversions	<ol style="list-style-type: none"> <li>1. Basque Eurocity / Getaria - port city and agricultural land</li> <li>2. Chelmsko-zamojski / Huczwa river near Malice village</li> <li>3. Oresund / Lomma</li> </ol>	<p>Internal changes in town and agriculture.</p> <p>Conversion of wet arable land into meadows and pastures due to worse natural conditions for plant cultivation and collapsing of food processing industry.</p> <p>Environmental protection on small valuable areas in neighborhood of attractive investment areas</p>	<p>+ region located on the coast, without good connection to big cities</p> <p>+ worse environmental conditions for plant cultivation</p> <p>+ collapsing of food processing industry in the region</p> <p>+ pressure of investments and entrepreneurship in attractive localizations</p>	

Conversion from forested & natural land to agriculture				
Withdrawal of farming				
Forests creation and management	<ol style="list-style-type: none"> <li>1. Basque Country / Geldo – forest changes</li> <li>2. Chełmsko-zamojski / Polanówka</li> <li>3. Oresund / Forest near Svedala</li> <li>4. Jelenioński / Izerskie Mountain</li> </ol>	Forests are characterize by the very extensive land use. Some of the forests are under of economic cultivations – they are plantations. Due to economic circumstances, the tree in forests are cut or not. In some places the forest is recultivated due to ecological reasons	<p>+ poor quality of land for other activities, extensive land use, plantations cultivated in terms of economic profits</p> <p>+ enlarging demand for services connected to leisure activities</p> <p>++ reconstruction of forest after the ecological catastrophe</p>	No visible Corine changes – due to a fact, that there is big rotation in the coverage of the woodlands
Water bodies creation and management	<ol style="list-style-type: none"> <li>1. Jeleniogórski / Sosnowka Lake</li> </ol>	The artificial lake was created at the beginning of XXI century. It is very intensive change of land use – the wetland were transformed into the anti-flood and reservoir of the drinking water for Jelenia Góra citizens.	<p>++ Anti-flood protection</p> <p>++ Reservoir of drinking water</p>	
Changes of Land Cover due to natural and multiple causes				

### 3. Identification of the challenges of land use change in case studies areas and proposed recommendations

Table 4 Challenges and recommendations concern land use changes from interviews

Case study region	Challenges	Recommendations
<b>Oresund</b>	<ul style="list-style-type: none"> <li>green energy production, from wind power plants for bio-fuel cultivation. It is necessary challenge due to predicted future energy prices rising.</li> </ul>	<ul style="list-style-type: none"> <li>concentration of urban sprawl in isochrones from railway stations. It helps to develop more effective railway transport and modal shifting among daily commuting people.</li> <li>Converting rural areas should be conducted dual. In the first direction relatively good connected with agglomeration parts of the region should be transformed into leisure activities for citizens or summer houses areas. In the case of rest of such areas should be introduced function of green energy production, from wind power plants or plant for bio-fuel cultivation.</li> </ul>
<b>Basque Eurocity</b>	<ul style="list-style-type: none"> <li>the challenges for the region is division of Basque Country into three provinces and the level of responsibilities that each of them have</li> <li>connection and cooperation between the three main cities is important – thanks to such situation there can be stronger functional specialization of each of the city and cooperation between them. Thanks to that level of development of each of the functions can be much higher and much more competitive on national and EU level</li> <li>the development of the Basque Country should be based on criteria of interconnection (spatial and sectoral) and fulfil the main objectives as: reinforce and rebalance urban system, improve urban areas and stimulate creation of medium cities network</li> </ul>	<ul style="list-style-type: none"> <li>holistic development of the region needs a very good planning system which will be complex on the horizontal and vertical level – these means that sectoral plans should be created in cooperation with territorial ones (cohesion in spatial planning);</li> <li>very detailed planning on the municipality level – thanks to that there will not be many conflicts of functions;</li> <li>cooperation between different parts of the regions and division of functions within the territory – development of stronger functions of some particular towns has an important influence on the whole region. There should be regional competitiveness and not competitiveness within region.</li> </ul>
<b>Chelmsko-zamojski</b>	<ul style="list-style-type: none"> <li>co-existing agricultural activity and environmental and landscape values protection</li> <li>introducing of services sector on rural areas, which will help to limit young people outflow</li> <li>exploitation of the energy sources with co-existing regional unique character</li> </ul>	<ul style="list-style-type: none"> <li>key of financial support for farmers should stronger motivate to conducting really traditional agricultural activity, which could substitute potential profits from crops in intensive farming. Support for traditional farms for diversified forms of co-existing agricultural activities and services for agrotourism and leisure activities based on regional heritage.</li> <li>different forms of support for selfemployment in rural areas in</li> </ul>



		<p>third sector. Dispersing of offices and regional institutions from the biggest towns to smaller ones and to rural areas. Special funds deducted from wind power plants owners dedicated for really local societies. Rules for investors exploiting slate gas resources regarding minimal share of employment in non-specialized professions among local societies.</p> <ul style="list-style-type: none"> <li>• On regional level strictly planned zones of the highest landscape values, which are excluded from energy production function, but especially supported in conducting of traditional agriculture and developing services connected to leisure activities and agrotourism.</li> </ul>
<p><b>Jeleniogórski</b></p>	<ul style="list-style-type: none"> <li>• complex and holistic planning – connection of sectoral planning (socio-economic) with territorial one</li> <li>• conducted the permanent, annual monitoring of spatial organization in such spheres as: environment protection, industry investments, housing, cultural landscape and infrastructure</li> <li>• there should be obligatory in establish the local plans of spatial organization for each settlement</li> <li>• higher activity of local institutions – local self-government has to have the initiative.</li> </ul>	<ul style="list-style-type: none"> <li>• holistic development of the region needs a very good planning system which will be complex on the horizontal and vertical level – these means that sectoral plans should be created in cooperation with territorial ones (cohesion in spatial planning);</li> <li>• equal importance of sectoral and territorial planning;</li> <li>• very detailed planning on the municipality level – thanks to that there will not be many conflicts of functions;</li> <li>• cooperation between different parts of the regions and division of functions within the territory – development of stronger functions of some particular towns has an important influence on the whole region. There should be regional competitiveness and not competitiveness within region;</li> <li>• permanent monitoring of socio-economic and spatial changes in the region and its communes;</li> <li>• coherent visions of development of communes, counties and region – there should be some hierarchical way of planning of strategies of development, because thanks to that will be “added value” of bigger scale of development;</li> <li>• engaging many institutions, local actors, representatives of main institutions important for spatial planning and creation of socio-economic development – thanks to that social consultancy the whole process of planning will be more coherent, transparent and complex;</li> <li>• good management – giving priority to public needs and public goods over the private benefit.</li> </ul>

#### 4. Verification of Land Cover Flows Characteristics in selected regions

Case study region	Land Cover Flow Cluster	Characteristic of the cluster according the typology	Remarks
<b>Oresund</b>	Cluster 2, 4 and 6 – Intensive change in urban areas, urban and economic sprawl and dynamic rural and peri-urban changes	Changes in urban core and urban and economic sprawl are strictly connected to the economy transformation from traditional spatially concentrated urban activities to more dispersed activities of high-tech and R&D sectors. Urban and economic sprawl is quite controlled according to “finger plan”, which indicates major development axis of “Hovestad” along sea coast and main routes. A parallel processes occurred on Swedish side, which accelerated after constructing Oresund Bridge. On peri-urban and rural areas increase of different forms of leisure activities function instead of intensive agriculture is significant. Intensive agriculture is gradually shifted to Jutland Peninsula and, finally, to new member states. However this process is much elder than since beginning of 1990s’.	Spatial pattern of land cover and land cover flow in Oresund Region is quite clear. There is urban core in Copenhagen and Malmo, urban sprawl areas along planned “fingers”, created for decades summer houses area along sea coast and zone of transforming functions of rural areas in the Zealand and Skane interior. So according to divide of the region consisted from 3 NUTS3 units, Greater Copenhagen, Zealand and Skane, clusters are diversified and attributed properly. Although there is worth to say, that high diversification inside these three units exists as well.
<b>Basque Eurocity</b>	Clusters 6 and 9 – Dynamic and stable rural and peri-urban activities	Levels of forest creation and management are relatively high, leading to the indication that these are largely rural regions. Some dynamic situations are happening between the development of non-land based economic activities (economic sites and infrastructures) and withdraw of farming. Continuation of primarily farming activities with rural services and related activities. Relatively low overall change is taking place in these regions and the intensity of the changes that are taking place is stable.	The level of changes in Basque Country, and especially in the Eurocity are more intensive, that it was indicated by the typology. From the coverage point of view, for sure forest and agriculture seems to be the most important, but from the economic point of view not. There are intensive changes in terms of new infrastructure, new build-up areas, development of industrial and logistic activities. The changes in Basque Country are on the higher level of intensity than the description of clusters said.
<b>Chełmsko-zamojski</b>	Cluster 8 – High extensification in rural and sparsely populated	In the framework of land cover flow “extensification” category corresponds to	In broader sense, changes of land cover in the region, which seems to be extensification, can mean

	regions	<p>character of changes in the region very well. Agricultural internal conversion in the arable land rely on shifting of crop structure from traditional industrial plants to more extensive cereals and rapeseed production and some innovative cultivation, like energetic willow. There is also some changes between meadows and pastures and arable land. During 1990s' change of macroeconomic circumstances for agriculture caused converting some wet unfavourable arable land into more extensive meadows. In 2000s' in spite of EU payments some unfavourable arable lands became fallow land, and after that, due to forest succession, were converted into forests.</p>	<p>intensification of agriculture. There is such situation with concentration of cattle breeding, which caused appearing more and more untilled meadows with growth of wildlife. Also is worth to mention that although urban residential sprawl take place in very small area along main roads and is related almost only to Chełm and Zamość, but this process is accelerating since 1990. and due to some lacks in spatial planning is causing the most of spatial conflicts in the region. This process seems to be the most rapid in land use changes last years. In aerial sense, due to monofunctional character of the region, changes in agricultural land are the most significant. However the most dynamic and the most influential for the regional multifunctionality and economic development seems to be urban sprawl connected to the entrepreneurship in market-oriented services dispersion on rural areas.</p>
<b>Jeleniogórski</b>	Cluster 3 – Extensification of rural activities	<p>Relatively high levels of forest creation and withdrawal of agriculture characterize these regions but these activities are not being replaced by urban expansion. This indicates regions that are likely losing population to urban centres in other regions. It is likely that marginal agricultural conditions are leading to a lack of land-based job opportunities in these regions.</p>	<p>Generally Jeleniogórski subregion was correctly classified to that cluster. There is some internal diversity within that subregion (in some part there is intensive development of suburban areas, touristic infrastructure, industrial zones), but the general trend and situation is correlated with that description. Forest creation is connected not with extensification, but with renewal of destroyed forests after the ecological catastrophe in the 1980s.</p>

## 5. Results of the case studies in the context of Land Cover Change Types

The case studies (regions: Øresund, Basque Eurocity, Chełmsko-Zamojski, Jeleniogórski) identified four types of the Land Cover Flow Typology: urban residential sprawl, sprawl of economic sites and infrastructures, agriculture internal conversions and forests creation and management. All analysed regions are strongly diverse in the land use structure and land use changes respectively. According to ten distinguished clusters, within the examined regions it is possible to separate some specific territories representing different clusters. Finally, the case studies investigated four of them: cluster 3 (Extensification of rural activities), cluster 6 (Dynamic rural and peri-urban changes), cluster 8 (High extensification in rural and sparsely populated regions) and cluster 9 (Stable rural and peri-urban activities).

**Table 5 Investigated types and clusters**

Land Cover Flow Types/Clusters	Cluster 1	Cluster 2	Cluster 3	Cluster 4	Cluster 5	Cluster 6	Cluster 7	Cluster 8	Cluster 9	Cluster 10
Urban land management										
Urban residential sprawl						B,C,J			B	
Sprawl of economic sites and infrastructures						B,O,J				
Agriculture internal conversions			O					C	B	
Conversion from forested & natural land to agriculture										
Withdrawal of farming										
Forests creation and management			J,C						B,O	

B – Basque Eurocity, O – Øresund, J – Jeleniogórski, C – Chełmsko-Zamojski

**Urban residential sprawl** represents intensification of multiple land utilisation and average dynamics of land use changes (conversion of agricultural land into built-up areas in most cases). The main factors of those changes are: localisation close to road or railway infrastructure, good connection to core towns, access to social infrastructure. All deeply investigated areas represented cluster 6 (Dynamic rural and peri-urban changes). In accordance to 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 Fingerplan in Denmark or sectorial planning in Basque Country. Very dynamic individual housing concentrates along the major roads, which causes problems with accessibility. Urban sprawl is less chaotic in countries with standardised spatial planning, and therefore the land use is very mosaic (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** characterises the intensification of land use. Dynamics and directions of land use as well as the land cover changes are high or very high and are connected with the localisation and pressure derived from the new investors. All analysed 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 a significant pressure on this nature reserve which resulted in building a protection fence. In Øresund Region, mostly on the coast, conflicts between building of second houses, leisure activities area and wind power plants are appearing. Also in 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 mountain areas). Very common type of infrastructure are the leisure-designated areas, such as golf clubs and horseback riding paths, especially in the vicinity of cities, but in an attractive landscape.

**Agriculture internal conversions** characterise extensification or stabilisation 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 they are protected by law. The investigated areas represent 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), what is confirmed by relatively diverse directions and dynamics of land use changes. Agriculture areas were gradually transformed into more peripheral ones, where the building pressure and land price are lower (e.g. in Denmark, farmers moved to Jutland and the new EU member-states). The internal conversions are mostly observable in the neighbourhood of big cities: there are more ecological farms, which produce healthy food and sell it on a local market. One of the most considerable changes in land use is related to the migration from peripheral areas to the coastal and urban ones. People living in rural areas resign from cultivation of land, moving to towns and changing the way of production to a more environment-friendly. In the Basque Country rural tourism is more popular (to foreign visitors) in comparison to the most typical coastal tourism. Internal conversions in 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 region's agriculture results in the increase of cereals cultivation and the abandoning of sugar beetroots, tobacco, flax, hemp and potatoes cultivation.

**Forests creation and management** represents stabilisation and low dynamics of the land use changes. The major reason for the stabilisation is poor quality of 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). On the example of Basque Country the shifting function of forest is observable. There are a lot of areas, classified as forests, which in reality turn out to be tree plantations. There are no visible change in the landscape or in CLC data, but only as the environmental issue. In Chełmsko-Zamojski case in the last decades forest invasion on meadows and pastures is observed and therefore resulting in the reduction of their areas. This process of renaturalisation is strongly linked with concentration and intensification of cattle breeding within the region, abandoning meadows and pastures as a fodder source. Small farms do not uphold animal production due to macroeconomic changes in agriculture and their meadows and pastures areas are often under 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 having a very strong influence on the functional and economic structures.

**Table 6 Identification of the factors and processes in the case study regions according to Land Cover Flows characteristics**

Land Cover Flows Typology	Case study region and Name of investigated area	Identified processes	Factors ++ - most important; + - less important
Urban land management			
Urban residential sprawl	<ol style="list-style-type: none"> <li>1. Jeleniogórski / Jeżów Sudecki</li> <li>2. Basque Eurocity / Urban sprawl In Kalitxo</li> <li>3. Legutio – Urban residential sprawl</li> <li>4. Chełmsko-Zamojski / Werbkowice</li> </ol>	Changes of agricultural land into the build-up areas. New houses are surrounded by the agricultural land – big mixture of land use. When the investors are private people - lack of development of technical and social infrastructure (eg. roads). When there is one investor - complex development of the new settlement.	<p>++ natural process of suburbanization – better quality of life</p> <p>++ location in a very favorable place</p> <p>++ access to social infrastructure: schools, health care, kindergarten, shops.</p>
Sprawl of economic sites and infrastructures	<ol style="list-style-type: none"> <li>1. Jeleniogórski / Hotel building in Karpacz</li> <li>2. Basque Eurocity / Lanbarren Industrial Zone</li> <li>3. Basque Eurocity / Derio – technological park</li> <li>4. Basque Eurocity / Bidart – sprawl of economic sites and infrastructure</li> <li>5. Øresund / Hedeland</li> </ol>	<p>Intensive development of tourism infrastructure in the most attractive places.</p> <p>Very good location of new investments – close to the main transport corridors and close to the main cities.</p> <p>Transformation of industrial sites in direction of leisure activities functions development.</p>	<p>++ big increase of popularity of skiing in Poland, lack of luxury hotels in that subregion</p> <p>++ very good location – near the motorway and harbor, increase of international exchange</p> <p>++ increasing demand of leisure activities sites surrounding agglomeration</p> <p>+ transformation of industry in developed countries</p>
Agriculture internal conversions	<ol style="list-style-type: none"> <li>1. Basque Eurocity / Getaria - port city and agricultural land</li> <li>2. Chełmsko-Zamojski / Huczwa river near Malice village</li> <li>3. Øresund / Lomma</li> </ol>	<p>Internal changes in town and agriculture.</p> <p>Conversion of wet arable land into meadows and pastures due to worse natural conditions for plant cultivation and collapsing of food processing industry.</p> <p>Environmental protection on small valuable areas in neighborhood of attractive investment areas</p>	<p>+ region located on the coast, without good connection to big cities</p> <p>+ worse environmental conditions for plant cultivation</p> <p>+ collapsing of food processing industry in the region</p> <p>+ pressure of investments and entrepreneurship in attractive localizations</p>
Conversion from forested & natural land to agriculture			
Withdrawal of farming			
Forests creation and management	<ol style="list-style-type: none"> <li>1. Basque Country / Geldo – forest changes</li> <li>2. Chełmsko-Zamojski / Polanówka</li> <li>3. Øresund / Forest near Svedala</li> <li>4. Jeleniogórski / Izerskie Mountain</li> </ol>	Forests are characterize by the very extensive land use. Some of the forests are under of economic cultivations – they are plantations. Due to economic circumstances, trees in forests are cut or not. In some places the forest is recultivated due to ecological reasons	<p>+ poor quality of land for other activities, extensive land use, plantations cultivated in terms of economic profits</p> <p>+ enlarging demand for services connected to leisure activities</p> <p>++ reconstruction of forest after the ecological catastrophe</p>
Water bodies creation and management	<ol style="list-style-type: none"> <li>1. Jeleniogórski / Sosnówka Lake</li> </ol>	The artificial lake was created at the beginning of XXI century. It is very intensive change of land use – the wetland were transformed into the anti-flood and reservoir of the drinking water for Jelenia Góra citizens.	<p>++ Anti-flood protection</p> <p>++ Reservoir of drinking water</p>
Changes of Land Cover due to natural and multiple causes			

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