PLUREL

Land use relationships in rural-urban regions

Module No. 1

December 2008

PERI-URBAN LAND USE RELATIONSHIPS – STRATEGIES AND SUSTAINABILITY ASSESSMENT TOOLS FOR URBAN-RURAL LINKAGES, INTEGRATED PROJECT, CONTRACT NO. 036921

D1.4.1

Downscaling Approach for Scenario-Driven Modelling Outputs from European to Regional Scale

Typology of regional and local driving forces acting on the generic urban region types.

Ingo Zasada*, Annette Piorr, Regine Berges, Felix Müller, Carolin Kahlisch,Verena Toussaint (ZALF)

*Responsible partner and corresponding author
Tel: +49 3343282152; Email: Ingo.Zasada@zalf.de

Document status:

Draft:	v. no.3
Submitted for internal review:	23.10.2009
Revised based on comments given by internal reviewers:	-
Final, submitted to EC:	16.09.2010

SIXTH FRAMEWORK PROGRAMME

Contents

1 Abstract

This report aims at delivering a concept of regional adaptation of scenario storylines and modelling data derived from scenario modelling at national scale to a higher disaggregated scale. This approach has been developed as an integrative element for the scenario-modelling cascade of the PLUREL project. The research task dealt with in this report provides an interface between Module 1 and Module 2.

Starting point for the establishment of the algorithm is the scenario-output modelling at national level, predicting urban land-use change as a result of a changing demographic and economic framework on NUTS 0 level. A procedure for the further disaggregating to regional level (NUTS 2) based on storylines (M1, see Carter, 2007) and parameterized projections (IIASA, NEMESIS models) of future European development scenarios has been developed.

The method includes expert estimations on the influence of six different regional characteristics (accessibility, innovation, environmental quality, natural and technological hazard, and the regulatory regime) on urban land use change in the four PLUREL scenarios. The results are aggregated to an index providing a value for each NUTS2 region. Hence the framework delivers a generic approach for downscaling scenario specific outputs to NUTS 2-level.

The report describes the generic downscaling approach and its outcomes in the following elements:

- the varying influence of regional determinants on urbanisation process
- the scenario-related differences of those determinants.

The results show that the six determinants, according to literature, act either as incentives or as constraints to urban growth. Moreover their aggregated influence differs between the four scenarios. Thus different index values for the strength of urban growth or shrinkage could be allocated to the NUTS2 regions in Europe.

Popular science description

Apart from the normally used factors (drivers) of urbanisation for future regional projections – namely Population and GDP, the focus of the alternative approach presented here is on more general, static characteristics of regions which influence urbanisation. They can be divided into incentives and constraints to urban growth. On the one hand there are the accessibility of regions, their innovation capacity and the quality of the environment. These three act as promoters of urban growth, as they raise the attractiveness of regions for people. On the other hand the thread of natural or technological hazards, such as land slides or plane crashes, as well as the strength of the regulatory regime curbs urban growth. Building houses in these regions is more risky or even forbidden and therefore constrained.

But how strong is their influence in the four different PLUREL scenarios? For example in the Water World scenario, where natural disasters are supposed to increase, the natural hazard potential will probably have a stronger impact on urban growth. Therefore experts were asked to weigh the determinants for each scenario according to their influence. The, to an index aggregated, results show a divers picture for the NUTS2 regions in Europe. They show increased urban growth for all scenarios except from the Water World scenario. Here the constraints to urban growth have a stronger influence than the incentives.

PLUREL

Classification of results/outputs:

Spatial scale for results: Regional, national, European	NUTS 2
DPSIR framework: Driver, Pressure, State, Impact, Response	Driver -Pressure - State
Land use issues covered: Housing, Traffic, Agriculture, Natural area, Water, Tourism/recreation	Urban land use
Scenario sensitivity: Are the products/outputs sensitive to Module 1 scenarios?	Yes (the regionalisation index)
Output indicators: Socio-economic & environmental external constraints; Land Use structure; RUR Metabolism; ECO-system integrity; Ecosystem Services; Socio-economic assessment Criteria; Decisions	Regionalisation Index
Knowledge type: Narrative storylines; Response functions; GIS-based maps; Tables or charts; Handbooks	Tables, Spidergrams, Maps

How many fact sheets will be derived from this deliverable:	**none**

2 Introduction

In the framework of impact assessment and political decision-making support, scenarios represent tools to develop assumptions on future sets of conditions including society, economy, technology or climate. Rather than forecasting future developments, recent European-wide scenario development processes, such as IPCC Special Report on Emission Scenarios, PRELUDE or PLUREL (EEA 2007; Nakicenovic et al. 2000; Ravetz 2008; Reginster and Rounsevell 2006) refer to possible futures, which explore certain development trajectories. Those scenario approaches make use of narrative storylines and qualitative descriptions of socio-economic, technologic and climatic driving forces under the particular regard of urbanisation processes. Qualitative storylines allow a heuristic approach with uncertainties, providing scenario requirements, such as plausibility and consistency as well as a high degree of understanding by experts and policymakers (EEA 2007). Piorr (2008) assessed both drivers and scenarios in the context of land use change. She outlined the main factors leading to land use changes, and changes in ecosystem services and functions and highlighted the need to develop downscaling procedures for scenarios in order for them to be applied at different scales.

In the case of the scenario development of PLUREL, four future scenarios along the two dimensions environmental-economical and regional-global orientation are distinguished (Ravetz 2008). Qualitative assumptions on the socio-economic and technological development as well as to the degree of Land Use Change (LUC), energy use and urbanisation are outlined within the scenario storylines (Ravetz 2008).

Land-use development, especially in the context of urbanisation is first of all related to socio-economic drivers. But nevertheless the European Environmental Agency concluded that these are interacting with localised environmental and spatial constraints. Among regional socio-economic aspects the authors emphasise the importance of transportation and land use planning (EEA 2006). Additionally factors, such as innovation, environmental quality as well as natural and technological vulnerability are of importance to regional occurrence of land use change.

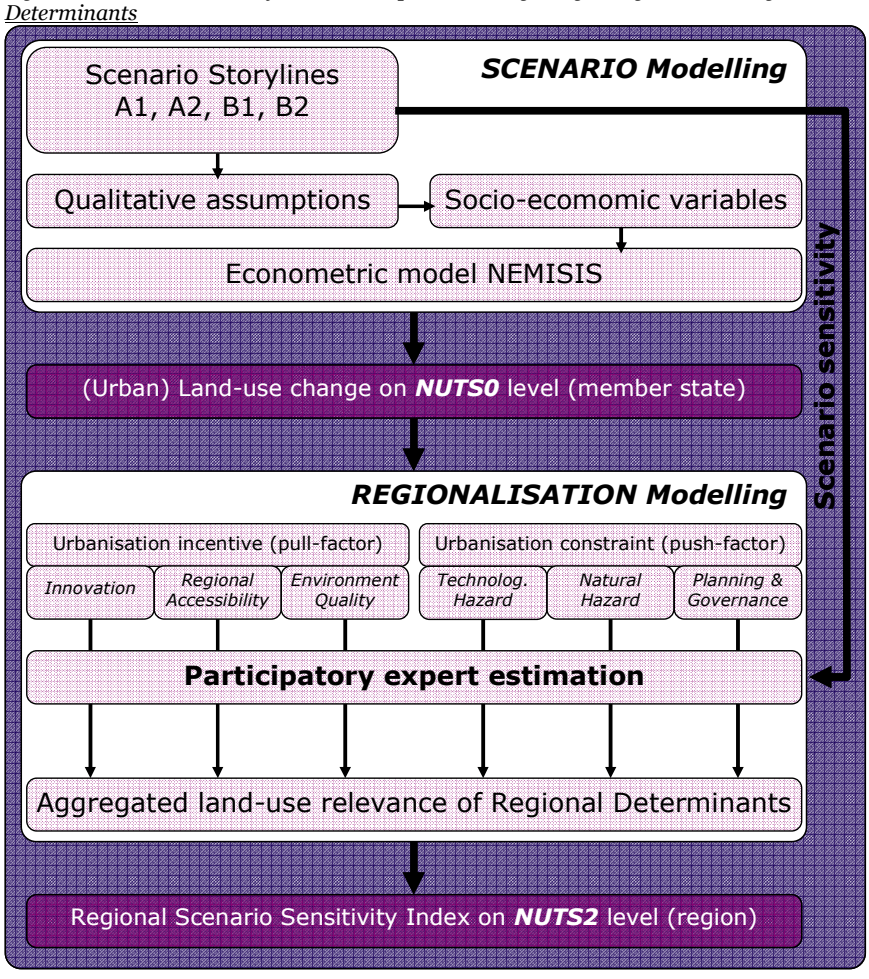
This report outlines a conceptual understanding of how both components of regional specification are integrated into the scenario-modelling cascade of the PLUREL project. Starting point for the establishment of the algorithm is the scenario-output modelling at national level, predicting regional urban land-use change as a result of a changing demographic and economic framework on NUTS 0 level. A procedure for the further disaggregation to regional level (NUTS 2) based on storylines (M1, see Carter, 2007) and parameterized projections (IIASA, NEMESIS) of future European development scenarios has been developed. Hence the framework delivers a generic approach for downscaling scenario specific outputs to NUTS 2-level.

In general two different approaches are followed:
- the general (varying) influence of regional determinants on urbanisation process
- the scenario-related differences of those determinants.

For the demographic and economic drivers modelling results were delivered at NUTS 0-level, simulated in the NEMISES model. Land use changes are transferred into the spatially explicit RUG land use model, through a Cellular-Automata-Model driven by spatial allocation rules for small-scale land-use distribution. The whole modelling cascade is outlined in Figure 3.

For the regional determinants, related to planning and governance regimes, innovation and accessibility, hazard potential and environmental quality, the downscaling takes places via Regional Clustering as regionalisation step. Doing so, the modelling of a regionally comprehensive European scenario framework includes creating a multitude of regionally specific scenarios. Instead by compiling of regional impact clusters it is focused on regionally relevant aspects of future scenarios.

Figure 3: Cascade scheme of scenario output modelling integrating Downscaling Model based on Regional Determinants



2.1 Objectives of WP1.4

WP1.4 aims at downscaling the impacts of the driving-force scenarios from the EU to the regional or even case study level. This is accomplished by the RUG model, which makes use of GDP, Population values and Land use outputs from NEMESIS. Moreover an alternative approach is developed; relying on different typologies apart from the NEMESIS outputs (DOW 2009). This approach is the topic of the report at hand.

Integration within the PLUREL work flow

The two above named elements of this report can be applied separately or together in order to specify response functions, developed in WP2.3 in a regional context and related to the scenarios of M1. In this sense, D1.4.1 delivers a part of the tool-box for downscaling. The RUG model (D1.4.2) is an additional part of this toolbox. Vice versa, deliverable D2.3.1 (preliminary version= Milestone report M2.3.6) takes up this interface between M1 and M2 from the Module 2 point of view.

By implementing a participatory approach, integrating different kinds and levels of knowledge and experience (based on literature, experts, stakeholders and practitioners), the added value for the research is gained. The knowledge base has been broadened and as well the approach as the weighting procedures and results have undergone a valuation procedure.

Integration within the PLUREL products

Product chains
This deliverable is related to one product chain. Product chains have been defined in order to structure physical project outputs towards the final user interface of PLUREL, the former SIAT-RUR – now iIAT. They specify what kind of output is expected to be delivered. Deliverable D1.4.1 presents the textual description related to the two products listed in table 1.

Table 1: D1.4.1 within the PLUREL product chain III

Chain no.	Product	Sub products	Kind	sensitive to M1 Scenarios	Modules	Main partners
III	Thematic clusters in Europe	Thematic clusters (NUTSX), based on: Innovation trends; Accessibility; Hazard risks; Planning and Regulatory regime	maps, graphs	yes	WP 1.4, WP2.2, WP2.3	ZALF, SYKE

Knowledge chains
This deliverable has a highly integrative position within the PLUREL project, as it contributes **to two knowledge chains. The scenario chain 1 brings the global scenarios into a regional storyline context. The downscaling of data chain presents the operational procedure of bringing the modelling outputs from M1 from the national scale to a regional scale, taking into account regional differentiation factors and transferring them into a spatially explicit context.**

Figure 1 shows the position of D1.4.1 in the scenario chain 1, and Figure 2 respectively for the downscaling of data chain.

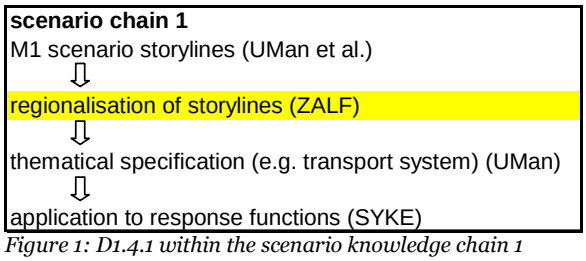


Figure 1: D1.4.1 within the scenario knowledge chain 1

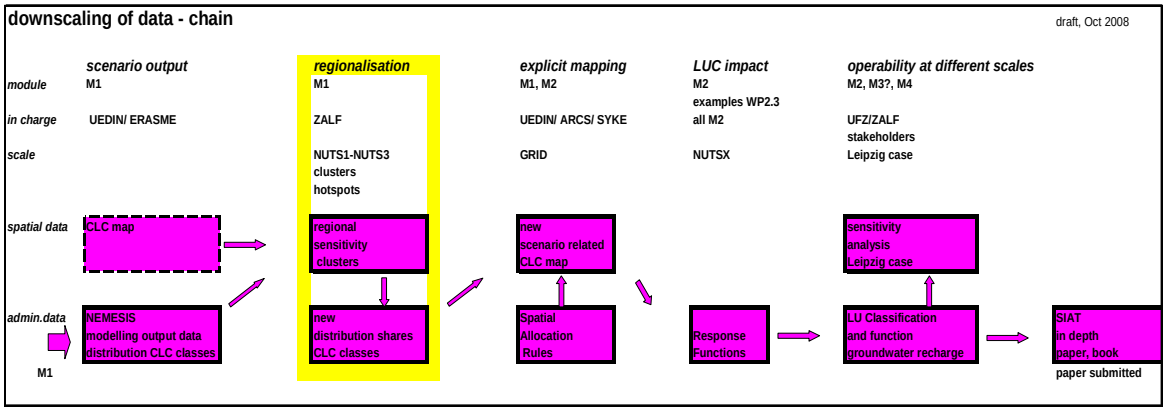


Figure 2: D1.4.1 within the knowledge chain "downscaling of data"

Dissemination activities

The results of this research have been disseminated as follows

Piorr, A. 2008. Changes in urban and peri-urban land use: approaches and problems of assessing drivers and scenarios. In: Ecosystem Services and Drivers of Biodiversity Change. Report of the RUBICODE electronic conference, April 2008, 47-48.
http://forums.ceh.ac.uk:8080/~rubicode/upload/Rubicode_report.pdf

Berges, R, Zasada, I, Piorr, A., 2009. Regionalization of land use change scenarios based on expert knowledge. Ecology and Society. Submitted in January 2009

Ingo Zasada, I, Berges, R, Piorr, A, 2009. A Generic Downscaling Approach for Scenario Driven Modelling Outputs from European to Regional Scale. Integrated Assessment of agriculture and Sustainable Development, AgSAP Conference 2009, Netherlands. Poster accepted

2.2 Objectives of the deliverable

The objectives of the deliverable are, as stated in the DOWs description of WP 1.4, to show an alternative concept for the regionalisation of the scenarios and land use models. It is one tool in the downscaling toolbox created by WP 1.4 and can be applied separately or in combination with the RUG model. Products of D 1.4.1

are tables for the six different regional determinants and the indices created with the help of expert estimations on the scenarios. The weighing factors can be visualised in spidergrams. Based on the index values pan-European maps are created.

2.3 Structure of the deliverable

The report is structured according to the two elements of the described downscaling approach. Chapter 3 describes the six different regional determinants and their behaviour as incentives or constraints to urban growth. Chapter 4 shows the expert evaluation method of the determinants in the four PLUREL scenarios and its results.

3 Impacts of Regional Determinant Framework on Urbanisation

The economic and demographic driven scenario modelling in Module 1 generates land-use changes at NUTS0. Except socio-economic key factors the entire European Union is more or less regarded as a uniform entity. According to the work plan and the models capabilities, regional spatial and structural differences are not taken into account.

In Module 2, responses for different land-use functions at NUTSX level (scale between NUTS2 and NUTS3) are expected to be calculated for the different scenarios. In order to achieve a regional differentiation, a generic approach has been applied. Based on a literature survey, beyond demography and economic development, the most important determinants for land use changes resulting from urbanisation processes have been identified: planning and governance, innovation and transportation, hazard potential and environmental quality. As important regionalising determinants they are used to define spatially explicit Regional Clusters. These can be either continuous macro-regions (e.g. Alpine region, Eastern Europe) or hot-spot-regions occasionally quite small-scale structured (e.g. capital or island regions). These characteristics can enhance or restrict the extent of land-use change. In the following the six determinants and their impact on land-use change are briefly presented.

3.1 Planning and Governance

The European Union is characterised by varying, historically developed governing and planning systems. They represent an aspect, which macro-regionally shapes European-wide outputs of development scenarios.

Government and planning structures in Europe can be distinguished regarding sizes of administrative entities, competencies of horizontal administrations (municipalities, counties, regions, and national states), general extent of governing intervention of formal and semi-formal structures (governance).

Regarding the planning regimes cornerstones of the classification are the vertical governing approach (bottom-up vs. top-down), the extent of state intervention (restrictive vs. 'laissez fair') as well as the degree of communication and co-operation in planning (Lalenis and Tosics 2008; Dasí 2006). The planning and policy framework determines the urban development pattern. Although hardly quantified in extent of impact on land-use change the role of planning and governance is non-negligible, due to different pattern of legal, constitutional and administrative framework planning and governance systems have an impact on Land Use Change itself. Weak planning facilitates unwanted growth of low-density urban sprawl (EEA 2006), whereas restrictive approaches are much more capable to manage growth or encourage less land consuming dense urban development.

Lalenis and Tosics (2008) provide a typology for the regulatory framework pattern throughout Europe combining the spatial planning style with the level of state intervention (Cf. Figure 4). In general the traditional five planning system

types British, Napoleonic, Germanic, Scandinavian as well as East European can be distinguished. Within national states the system is more or less homogenous. Differences occur only in countries with autonomous and federal regions structure like the UK and Germany. Dealing with future scenarios it needs to be kept in mind that through the European harmonisation process and the general increase of competencies of the supra-national body of the EU will lead also to a harmonisation of national governing and planning regime. Differences between the types are increasingly blurred.

3.2 Regional hazard potential and vulnerability

Cities and regions are exposed to natural and technological hazards corresponding to their geographical and topographical location, either on daily basis or as single disasters (Pelling 2003). They emerge either as direct impacts, like mainly human casualties, and the destruction of physical structures of settlement and infrastructure or as systemic impacts on economic and income losses (Pelling 2003). The Inter-Agency Secretariat of the International Strategy for Disaster Reduction - UN/ISDR (2004) distinguishes natural hydro-meteorological and geological hazards from technological hazards as result of major accidents associated with industrialization and technological innovation. Natural hazards, like floods, droughts, wildlife fires, volcanic or biological hazards result in the region's bio-physical framework, like in coastal and riverine, mountainous or low-precipitation regions. Technological hazards, such as plane crashes, chemical leakages or even nuclear meltdowns are related to the adjacency to urban agglomerations.

Both kinds of hazards are interrelated with urbanisation resulting in a vicious circle as stated by Pelling (2003). On the one hand urban areas are in many cases located within natural hazard zones and prospectively impacts of climate change will in particular affect those hotspot areas (IPCC 2000). On the other hand the further urbanisation process featured by a concentration of people and assets increases the regional vulnerability to disasters (Quarantelli 2003). Anthropogenic alterations and LUCs exacerbate the impacts of natural disasters (Abramovitz 2001).

Vulnerability represents the exposure and inability to respond to hazards. In urban areas vulnerability is defined as physical and social vulnerability, focusing on the built structures and on society and economy. In contrast, the capability to respond to hazards defines the degree of resilience (Pelling 2003). The ESPON project 1.3.1 (Schmidt-Thomé 2006) analysed the European pattern of natural and technological hazard potential (Cf. Figures 5 and 6).

3.3 Innovative capacity

Urban development is strongly depended on regional economic performance as a measure of competitiveness, comparative advantage and the degree of regional specialisation. Within a knowledge-based society regional competitiveness is among others based on innovative capacity (Acs 2002), or in other terms the innovation system (Cooke 2001). Regions differ both in performance as contributor as well as in their behaviour as applier of innovation. The European Innovation Scoreboard summarizes five indicators of innovation dimensions to an aggregated index of regional innovation performance, which assesses 203

European regions in a range between 0,90 and 0,01 (MERIT and JRC 2006). Regions can be classified into different groups using hierarchical clustering. Significant national and regional differences can be observed (Cf. Figure 7).

3.4 Accessibility

The role of accessibility, transportations costs and land use is already described by classical models of Von Thünen (1826) or Alonso (1964). The New Economic Geography (Krugman 1991) reinforces the importance of the region and centrality by emphasising the importance of agglomeration effects, the concentration of economic activity in certain central regions. Centrality is defined by the integration of a region into the European and global transportation network, consisting of air connection, motorway and rail network and harbour nodes, resulting in hierarchically differentiated space. European regions, which are well connected by transportation infrastructure, possess those gateway functions (Anderson and Anderson 2000) as basis of economic performance and contributing to urban growth, such as the regions of the Blue Banana or European capital regions. The ESPON project 1.2.1 (Mathis et al. 2004) assessed the European transportation network and evaluated the regional accessibility (Cf. Figure 8).

On the regional level transportation has effects on certain region types according to characteristics of modes of transportation. The role of the use of the car is manifold studied (Newman and Kenworthy 1989). High car ownership, weak regional public transportation system, modal split with dominance of individual traffic are considered as main drivers of urban development beyond the former urban boundaries and a low-density, dispersed urban fabric.

3.5 Environmental Quality

Urban areas as location for housing, working, leisure and tourism are increasingly depended on the quality of the living environment. Environmentally healthy and attractive regions are increasingly subject to immigration. Environmental quality on regional scale is defined by bio-physical conditions, such as the proximity to natural amenities, like mountains and water (Marcouiller et al. 2002; Wu 2002), but also by the degree of anthropogenic influence on the region. Soil, water, air and biodiversity are key issues of environmental quality which are affected, in most cases, in a negative way. Whereas topographic features are measured and indexed, the anthropogenic impact is substitutionally represented by the degree of naturalness, measured by ESPON (2006), taking into account share of natural and artificial surface as well as the intensity of agricultural land use (Cf. Figure 9).

Land use changes due to urbanisation processes are often connected to environmental impacts related to changed intensities in the use by agriculture, tourism, transport, and energy. Soil, water, air and biodiversity are the key issues of environmental quality which are affected, in most cases in a negative way. Depending on the intensity of changes, but also on land use tradition, or characteristics in certain areas (e.g. mining) European regions can be classified according to the status of the environmental quality.

Furthermore “hotspots” can be identified in regions with specific environmental problems that characteristically develop due to locational source related

emissions (e.g. air pollution). Areas with a high density of industries and transportation networks certainly belong to this hotspot regions. On the other hand also regions with specific desired environmental potentials (e.g. Natura 2000 areas) are to be designated in regional clusters.

3.6 Summary

The translation of future scenarios into regional land use results on NUTS 2 level relies upon a systematic assessment and categorisation of regional specificities: Regions characterised by specific determinants differ regarding their "sensitivity" towards European economic and demographic change regarding their land use development. In DPSIR terms: Their driver-pressure relations show a high degree of variety to the effect of regional push and pull factors:

- Regions in countries with a highly restrictive planning system will display less sprawl intensities as a consequence of growth (or other kinds of socio-economic change like shrinking of household sizes) than regions with a laissez faire planning regime. Both formal (government) and informal (governance) aspects play into this relationship.
- Bio-physical conditions determine the environmental quality (slopes, mountains, water area, natural area) inhibit settlement growth. These conditions can change over time due to climate change.
- Vulnerability to natural and technological hazards such as flooding landslide risk, water shortages as well as human caused accidents represent an other pull factor, decreasing regional probability for urban development.
- The availability of certain technologies like transport technology affects the patterns and intensity of urban sprawl/growth, for example by expanding commuting areas.

In the M1 modelling procedure, narrative storylines form the starting point for scenario development. Demographic and economic indicators are calculated according to the scenario storylines and fed into the NEMESIS land use change model, which projects the relative change of urbanised area for each NUTS 2 region. The result however, does not take into account the heterogeneous structures of the European territory. In order to qualify and specify the results, but also to lay the basis for following steps of disaggregation, a rule set is needed.

CONSTRAINTS

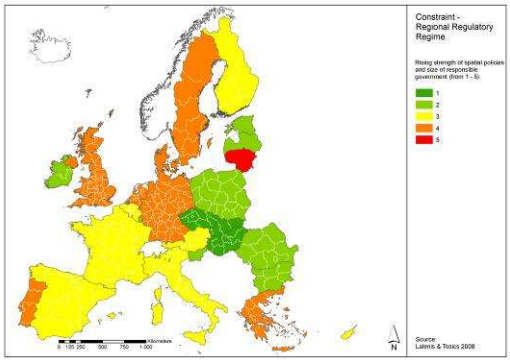


Figure 4: Regulatory Regime at NUTS2

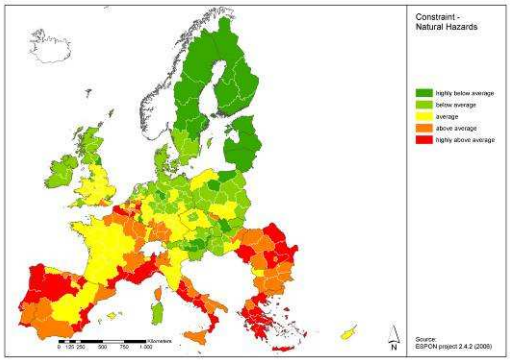


Figure 5: Natural Hazard Potential at NUTS2

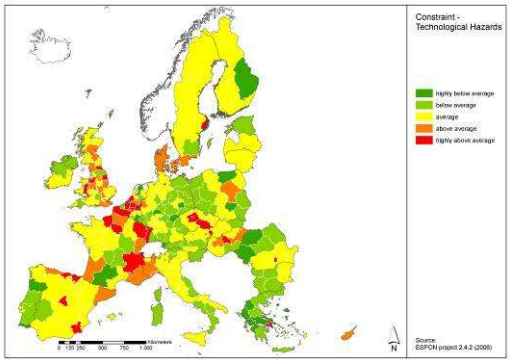


Figure 6: Technolog. Hazard Potential at NUTS2

INCENTIVES

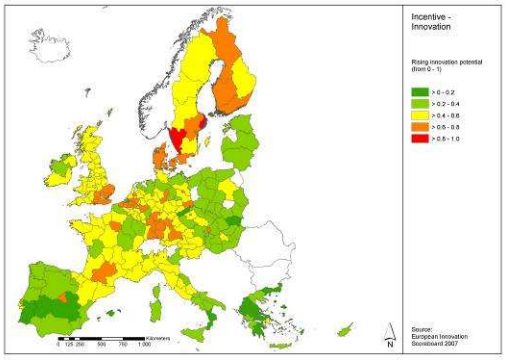


Figure 7: Innovation Capacity at NUTS2

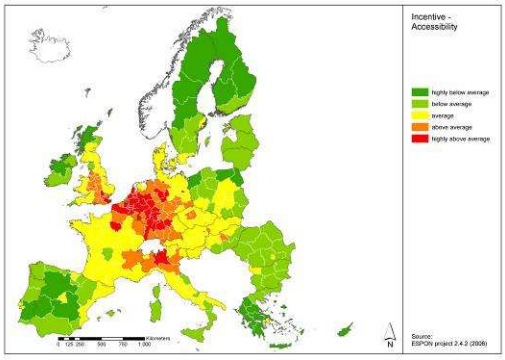


Figure 8: Accessibility at NUTS2

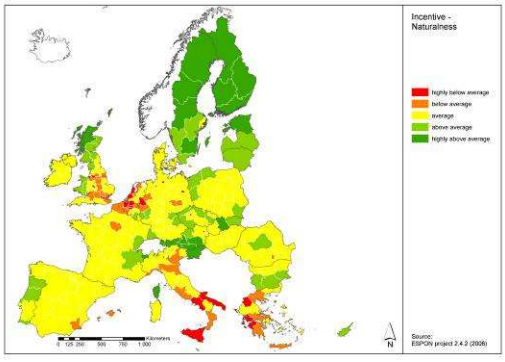


Figure 9: Environmental Quality at NUTS2

4 Scenario-related Determinant-weighting

4.1 Principle

It is intended to regionalise the scenarios by integrating further qualitative factors including their scenario sensitivity based on expert knowledge. Thereby specification of the scenarios at hand takes place, leading to changed model results as we state that the regional framework, not yet represented by the model, influences the amount of urban growth or shrinkage – not only its location.

4.2 Procedure

Commonly there exists a huge variety of methods to get information from experts in empirical social research. For modelling future situations methods as written expert survey, interview or discussions are combined in special methods, the Delphi method, future workshops or scenario technique are corresponding examples.

By conducting a literature review on influencing factors on urban LUC, we decided upon important regional determinants and designed the downscaling process. To get first estimations on the determinants scenario-dependent influence, a questionnaire was conducted and sent to eight experts via email several weeks in advance to the workshop, giving enough time to take a stand on the objective. The questionnaire consisted of a table where the experts could evaluate the determinants importance in every scenario in three steps, low – medium – high. Additionally a description of the task, a visualisation of exemplary results and summaries of scenario storylines were added, enabling simple judgement of respondents (Harvey 2001).

During the feedback round the general approach and details about the determinants are presented. For transparency and comparability reasons the average weights from the questionnaires for the determinants in the scenarios as well as one randomly chosen questionnaire example were shown. The round is open to clarify further questions.

The discussion of the results and the re-estimation take place in a separate workshop. Led by professional facilitators, debating ambiguities, each determinant is looked at in the four scenarios and its weight is determined in consensus oriented discussion. Finally the satisfaction of the experts with the results and the procedure is demanded. When all experts feel comfortable with the results, the workshop is terminated.

4.3 Results

During the workshop, major changes were conducted (cf. Tab.2). Especially strong are the changes in scenario B1, where often a complete shift from relatively high values in the questionnaire (Quest.) to zero in the workshop (WS) and the other way around can be observed. Likewise noticeable is that the main

modifications happened to the determinant "Environmental Quality" throughout all scenarios.

Table 2: Scenario-specific weights of determinant impacts

	A1		A2		B1		B2	
	Quest.	WS	Quest.	WS	Quest.	WS	Quest.	WS
Accessibility	2	**2**	0,5	**0,5**	1,2	**0**	0,2	**0,5**
Innovation	2	**2**	1	**1**	1,5	**2**	1	**0**
Environmental Quality	0,3	**1**	1	**0**	1,2	**2**	1,7	**2**
Technological Hazards	1,8	**2**	1,2	**1**	0,8	**0**	1,2	**1**
Natural Hazards	0,8	**1**	2	**2**	1	**0**	1,3	**1**
Regulatory Regime	0,6	**0**	0,7	**1**	1,2	**2**	1,2	**0**

Resulting index values for NUTS3 regions are shown in Figures 10 -13. In the scenarios A1, B1 and B2 urban growth is expected to increase in the majority of the regions (Cf. Figures 10, 12, 13). The A2 scenario shows the opposite development.

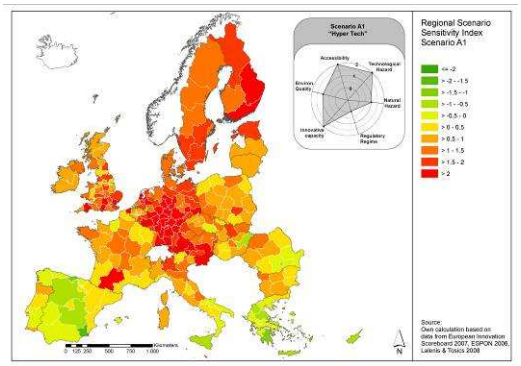


Figure 10: Regionalisation Index Scenario A1

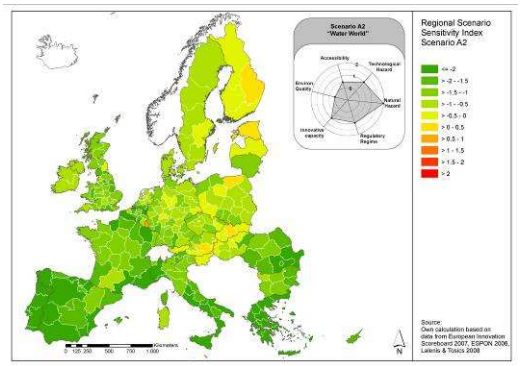


Figure 11: Regionalisation Index Scenario A2

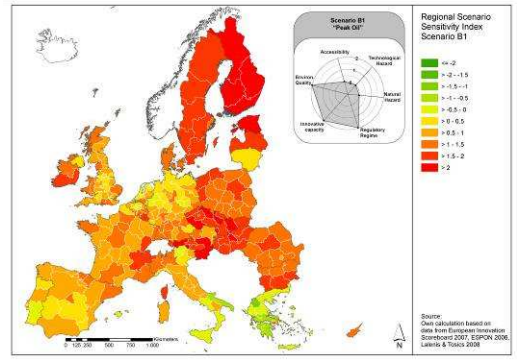


Figure 12: Regionalisation Index Scenario B1

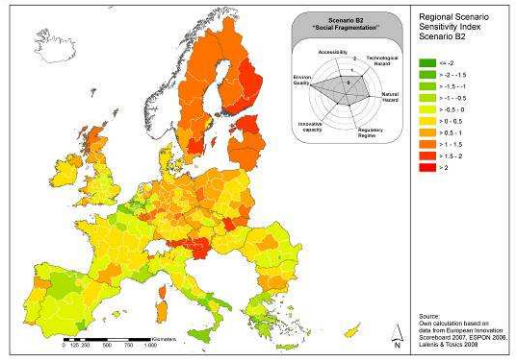


Figure 13: Regionalisation Index Scenario B2

References

Abramovitz, J. 2001. Unnatural Disasters. Starke, L. 158. Washington, D.C., Worldwatch Institute. Worldwatch Papers.

Acs, Z. J. 2002. Innovation And The Growth Of Cities. Edward Elgar Publishing, North-ampton.

Alonso, W. 1964. Location and Land use. Havard University Press, Cambridge.

Anderson A. A. & Anderson D. 2000. Gateways to the Global Economy. Edward Elgar, Cheltenham.

Cooke, P. 2001. Regional innovation systems, clusters, and the knowledge economy. Industrial and Corporate Change 10[4], 945-974.

Dasí, J. F. 2006. Governance of Territorial and Urban Policies from EU to Local Level - ESPON project 2.3.2. 2006. Luxemburg, ESPON.

EEA. 2006. Urban Sprawl in Europe - The ignored challenge. 10/2006. Copenhagen, European Environmental Agency.

EEA. 2007. Land-use scenarios for Europe: qualitative and quantitative analysis on a European scale. 9/2007. Copenhagen, European Environmental Agency.

ESPON. 2006. Territorial trends of the management of the natural heritage - ESPON 1.3.2. 2006. Luxemburg, ESPON. Project Reports.

Harvey, N. 2001. Improving Judgement in Forecasting. Pages 59-80 in J. S. Armstrong, ed. Principles of Forecasting: A Handbook for Researchers and Practitioners. Kluwer Academic Publishers, Norwell.

IPCC. 2000a. Special Report on Emission Scenarios.

IPCC. 2000b. Special Report on The Regional Impacts of Climate Change - An Assessment of Vulnerability.

Krugman, P. R. 1991. Increasing returns and economic geography. Journal of Political Economy 99, 483-499.

Lalenis, K. and I. Tosics. 2008. Typology of government relations and general national spatial planning concepts - PLUREL Milestone Report 2.2.3. PLUREL Milestone Reports.

Marcouiller, D. W., J. G. Clendenning, and R. Kedzior. 2002. Natural Amenity-Led De-velopment and Rural Planning. Journal of Planning Literature 16:515-542.

Mathis, P., E. Bock, J. Coquio, and L. Guimas. 2004. Transport services and networks: territo-rial trends and basic supply of infrastructure for territorial cohesion - ESPON 1.2.1. Luxemburg, ESPON. Project Reports.

MERIT and JRC. 2006. European Innovation Scoreboard 2006 - Comparative Analysis of Innovation Performance.

Nakicenovic, N., J. Alcamo, G. Davis, B. de Vries, J. Fenhann, S. Gaffin, K. Gregory, A. Gräbler, T. Yong Jung, T. Kram, E. L. La Rovere, L. Michaelis, S. Mori, T. Morita, W. Pepper, H. Pitcher, L. Price, K. Riahi, A. Roehrl, H.-H. Rogner, A. Sankovski, M. Schlesinger, P. Shukla, S. Smith, R. Swart, S. van Rooijen, N. Victor, and Z. Dadi. 2000. Special Report on Emissions Scenarios: A Special Report of Working Group III of the Intergovernmental Panel on Climate Change. Cambridge, Cambridge University Press.

Newman P. & Kenworthy J. R. 1989. Cities and automobile dependence. An international sourcebook. Aldershot.

Pelling, M. 2003. The Vulnerability of Cities: Natural Disaster and Social Resilience. Earthscan Publications Ltd..

Piorr, A. 2008. Changes in urban and peri-urban land use: approaches and problems of assessing drivers and scenarios. In: Ecosystem Services and Drivers of Biodiversity Change. Report of the RUBICODE electronic conference, April 2008, 47-48.

Quarantelli, E. L. 2003. Programs and Policies That Ought To Be Implemented For Coping With Future Disasters. 332. Disaster Research Center.

Ravetz, J. 2008. Scenario Framework. D 1.3.2. PLUREL Milestone Report.

Reginster, I. and M. D. A. Rounsevell. 2006. Future scenarios of urban land use in Europe. Environment and Planning B: Planning and Design 33[4], 619-636.

Schmidt-Thomé, P. 2006. The Spatial Effects and Management of Natural and Technological Hazards in Europe - ESPON 1.3.1. 1.3.1. Luxemburg, ESPON. Project Reports.

UN/ISDR. 2004. Living with Risk.

Von Thünen, J. H. 1826. Der isolierte Staat in Beziehung auf Nationalökonomie und Landwirtschaft. Hamburg.

Wu, J. 2002. Environmental Amenities, Urban Sprawl, and the Economic Landscape. 1-41. Lincoln Institute.

Annex

Policy Briefing

Published in "Ecosystem Services and Drivers of Biodiversity Change". Report of the RUBICODE electronic conference, April 2008, 47-48.
http://forums.ceh.ac.uk:8080/~rubicode/upload/Rubicode_report.pdf

Changes in urban and peri-urban land use: approaches and problems of assessing drivers and scenarios

Dr. Annette Piorr,
Leibniz-Centre for Agricultural Landscape Research (ZALF),
Institute of Land Use Systems
apiorr@zalf.de

Changes in land use generally cause changes in ecosystem services and functions (Costanza et al. 1997 Lambin/ Geist 2006.). Recently research has increasingly attended to land use changes between urban and rural regions. An urban-rural region is a system of functions, resulting in patterns of activities causing certain land uses as response to these activities. The balance between open space and urbanisation, effects interlinking agro-ecosystems and urban land uses is increasingly discussed in terms of the provision of ecosystem services (Loibl/ Köster 2008). One reason why land use change in urban rural regions often proves distinct and highly dynamic, is the plurality of land uses along urban fringes. It is connected with a plurality of mutual demands and supplies, services and functions, and hence points at sensitivity from a high number of driver-pressure relationships.

Demography and global economic trends are seen as most relevant drivers of land use change, and specifically affect urbanisation and counter-urbanisation. They are a result of activities related to space consumption: production/work, transport/commuting, housing, water and food supply, lifestyle, recreation. Beyond regional characteristics, land use change is driven by planning policies and governance, environmental quality, climate change, social issues as migration, technology and accessibility. Those regional characteristics and different types of urban-rural patterns provide different spaces of choice for land use changes and accordingly show different driver-impact relationships. This simple insight has challenging implications for research on land use change impact assessment.

Information on future trends and impacts or changed driver constellations is usually derived by implementing scenario settings to economic, bio-economic, environmental, demographic etc. modelling procedures. Demography and global economic trends are usually modelled by implementing scenario-based assumptions at European or national (NUTS1) level. For other drivers named above, either national or regional characteristics, like geo-morphological and bio-physical site conditions, socio-cultural background, or legal frameworks are crucial factors, that have to be considered at lower spatial levels: national, regional, related to the settlement pattern or the population density. Hence, it is essential to develop downscaling procedures for scenarios.

The clustering of regions, depending on the degree of sensitivity to certain drivers or scenario storylines was applied in several projects: ESPON 1.3.1 (Schmidt-Thomé 2006),

Scenar 2020 (Nowicki et al. 2007), SENSOR (Stuczynski 2007). Using a rural-urban-region (RUR) typology related to settlement morphology and applied for the EU-27 at NUTSX level (mix between NUTS2 and NUTS3 (Alterra 2005)), Zasada et al. (2008, 2009) deal with two different elements of regionalisation or downscaling for scenario modelling outputs: On the one hand drivers are treated as determinants differentiating a European entity into *Regional Clusters* and hotspots of driving forces, showing either macro-regional clustering effects (e.g. migration movement pattern, pattern of national administrative and planning systems) or hotspots with structural impacts (from climate, technology), depending on scenario settings. On the other hand six *Rural-Urban-Region (RUR)* types (Very large monocentric (1.0), Large monocentric (1.1), Medium monocentric (1.2), Urban polycentric (2), Dispersed polycentric (3) and Rural (4) (Loibl et al. 2007)) show distinctive elasticities to these different driving forces (determinants) regarding land use change. When referring to dynamics of change, often a central component of scenario analyses, a third element has to be taken into consideration: the *spatially explicit allocation* of different land uses. Usually a framework of rules acting via restrictions (e.g. legal) and ethnic behaviours (e.g. migration) leads to growth/decline patterns displaying increased fragmentation or centralisation. Translation of high-scale modelling outputs on changed spatial demands on different land uses to small-scale land use distribution in urban, peri-urban and rural regions, requires the definition of spatial allocation procedures/rules based on expert knowledge.

Coming back to the question of ecosystem services or functions, it is obvious, that beyond the pure information of change of space claimed for certain land uses (industry, services, housing, agriculture) also the allocation (limited by spatial conditions and connectivity) of such trends and related impacts on land use functions determines whether a the system is receptive towards changing trends of different drivers. Identifying not only trends, but also the land use related impacts supplied or demanded by societal or institutional groups, and any regulatory framework performance towards better targeting, research can support policy makers directing the competition on the resource land in a sustainable way.

Alterra 2005: Sensor´s NUTSX region map. http://www.zalf.de/home_ip-sensor/products/SENSORNUTSmap.ppt

Costanza, R. et al. 1997: the value of the world´s ecosystem services and natural capital. Nature, 387, 253-260.

Lambin, E.F. and Geist, H. (eds) 2006 Land use and land-cover change: local processes and global impacts. Springer: Berlin, Heidelberg, GE, 204 pp

Loibl, W., Köster, M. , Steinnocher, K. (2007): Quantitative classification of the major European rural-urban regions. PLUREL report D2.1.3, publication to come at http://www.plurel.net/Products-54.aspx

Loibl, W., Köster, M. (2008): Report on methodology to delineate RUR sub-regions. PLUREL report D2.1.4, publication to come at http://www.plurel.net/Products-54.aspx

Nowicki et al. 2007: Scenar 2020 – Scenario study on agriculture and the rural world. http://ec.europa.eu/agriculture/agrista/2006/scenar2020/final_report/scenar_ch02.pdf

Schmidt-Thomé, P. 2006: The spatial effects and management of natural and technological hazards in Europe - ESPON 1.3.1. http://www.gsf.fi/projects/espon/Finalreport.pdf

Stuczynski, T. 2007: Assessment and modelling of land use change in Europe in the context of soil protection. Monografie I Rozprawy Naukowe, Pulawy, 19. ISBN 978-83-89576-19-8.

Zasada I., Piorr, A., Berges, R. Müller, F., Toussaint, V., (2008): Downscaling approach for scenario-driven modelling outputs from European to regional scale. PLUREL report D1.4.1, publication to come at http://www.plurel.net/Products-54.aspx