

# PLUREL



Instruments and tools

Module 5

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**PERI-URBAN LAND USE RELATIONSHIPS –  
STRATEGIES AND SUSTAINABILITY ASSESSMENT  
TOOLS FOR URBAN-RURAL LINKAGES,  
INTEGRATED PROJECT,  
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## Updated concept for PLUREL Xplorer

**Katharina Fricke\*, Katharina Helming (ZALF)**

\*Responsible partner and corresponding author  
Tel: +49 3343282426; Email: [katharina.fricke@zalf.de](mailto:katharina.fricke@zalf.de)

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# Abstract

## Objectives/aims

The PLUREL's result exploration tool PLUREL XPLOERER [pronunciation: ik-'splör-ər] aims at supporting planning and policy discussions on rural-urban land use interactions at European and at regional level. The PLUREL XPLOERER (1) anticipates the consequences of selected global driving forces and European policies on rural-urban land use types; and (2) analyses how they affect social, economic and environmental goods, services and functionalities of the rural-urban regions. It will contain an impact analysis application component and integrates the different PLUREL products on their relevant spatial scales into an online available platform.

## Methodology

The PLUREL XPLOERER integrates and links the various sub-products of the PLUREL project by revealing causal chain relationships of rural-urban interlinkages. By revealing the interlinkages of PLUREL results by linking the major product results with the underlying data management system and GEO portal, it illustrates the logical chains of PLUREL analytics. The PLUREL XPLOERER covers European, regional and partly local (city region) scales, while land use change is seen as the main pressure in its analytical string. The applied DPSIR concept is particularly useful when scientific process knowledge has to be translated into knowledge for policy support because its specific strength lies in its adaptability to many different objectives and scales of analysis. Thus all PLUREL products will be arranged in order of the DPSIR causal chain relationship of land use changes. PLUREL results/products will be accompanied by structured fact sheets containing e.g. maps, graphs, tables, and reports.

The development of the tool in terms of user interface, content and functionality is conducted iteratively to take up user requirements and reflections on consecutive prototypes. The cubic shape of the explorer illustrates the multiple entry points into the analyses provided by PLUREL. The user can choose from which perspective or dimension he or she would like to start his or her journey through PLUREL's results.

## Results / findings / conclusion

The *Concept for the PLUREL XPLOERER* at hand explains how the single products of PLUREL are integrated into the project's analytical thread of rural-urban interactions. WP5.3 assists all PLUREL partners in correctly compiling all meta-information and dimensions for all results in terms of this concept. Nevertheless partners have to contribute targeted towards the PLUREL XPLOERER.

Based on this concept and a careful analysis of the expected outcomes of other modules activities, the design features, operational elements and the resultant structure of the PLUREL XPLOERER will be further specified in the following months during the phase of technical implementation and knowledge integration. Iterative adaptations of this concept are consequently foreseen.

## The context - prerequisites for the PLUREL XPLORES concept

As defined in the New Implementation Plan (NIP) of 2009, the main task of Module 5 is to synthesise results from all PLUREL modules into products that are of use for specific user groups inside and outside the scientific community.

### *Purpose of the exploration tool*

In this context the role of WP5.3 is to construct an overarching tool for interactive exploration and examination of PLUREL results in a way that it exemplifies and illustrates sustainability issues related to peri-urban land use, its driver-pressure relationships, its political, socio-economic and physical framework conditions, its possible impacts in the sustainable development context, and its relation to governance processes. This way it shall support the discussion process about sustainable RUR development strategies at different levels of governance and for a variety of interest groups.

To illustrate causal chain relationships of RUR processes as examined in PLUREL, the PLUREL XPLORES will link major project results with the underlying data management system.

In general, Module 5 provides the data warehouse infrastructure for data exchange of GEO-compatible databases and the map portal to explore the data spatially. PLUREL XPLORES serves as a graphical user interface for displaying the results at European and case study scale for all 3 sustainability dimensions. It will comprise other PLUREL products such as the IAT application and the scenario maps and will provide linkages to the handbook for good practice and planning guidance.

### *End user identification*

While the general purpose of the PLUREL XPLOER was already part of the PLUREL concept, its specific features, functionalities and interface properties had to be identified through end user consultations.

Throughout various discussions in working groups within the project (PLUREL stakeholders), with Commission Services (in end user meetings in Brussels) and through existing network contacts for PLUREL partners (e.g. CURE, PURPLE; see below) and other sources of information (e.g. meetings, conferences, internet), the following end user groups have been identified:

Table 1: End Users and the purposes of the PLUREL XPLOER

<b>Spatial scale</b>	<b>Identified users</b>	<b>Interest in the PLUREL Xplorer tool</b>
European	<ul style="list-style-type: none"> <li>• EC</li> <li>• DG Regio</li> <li>• EC DG Environment</li> <li>• EC DG Agri</li> <li>• EEA</li> <li>• ESPON</li> <li>• Committee of the Regions</li> <li>• PURPLE* network</li> <li>• CURE* network</li> </ul>	<ul style="list-style-type: none"> <li>• Discussion support concerning rural-urban interlinkages</li> <li>• Awareness raising</li> <li>• Problem identification</li> <li>• Analysis of causal chain relationships</li> <li>• Identification of relations between European level policies and local/regional RUR land use changes</li> <li>• Knowledge dissemination</li> </ul>
* for further information see chapter below		
National level	<ul style="list-style-type: none"> <li>• Planning Authorities</li> <li>• Universities</li> </ul>	<ul style="list-style-type: none"> <li>• Awareness-raising</li> <li>• Analysis of causal chain relationships</li> <li>• Discussion support</li> <li>• Practice and process examples</li> <li>• Higher education</li> </ul>
Case study level	<ul style="list-style-type: none"> <li>• policy makers</li> <li>• practitioners</li> <li>• planners</li> <li>• PURPLE members</li> <li>• CURE members</li> <li>• Other regional authorities</li> </ul>	<ul style="list-style-type: none"> <li>• Awareness-raising</li> <li>• Comparisons of regions and their reactions on land use change</li> <li>• Analysis of causal chain relationships</li> <li>• Practice and process examples</li> <li>• Identification of development options</li> <li>• Discussion support</li> </ul>

### *End user requirements and resulting prerequisites at European Level*

One of the first steps in the design of the PLUREL XPLOER was to analyse on Commission Level end users requirements for the structure and capabilities of the PLUREL XPLOER. A workshop was organised to identify end users' visions on the tool operation at EC level. The end users on Commission Level were interested in a PLUREL XPLOER even though the European Commission has no direct mandate in land use planning in the urban rural context.

It was therefore suggested that PLUREL XPLOER is not constructed as a dynamic impact assessment tool such as e.g. the SENSOR SIAT for rural land use policies (Helming et al., 2008) but rather as a discussion support system based on results of studies on urban rural interactions at European, regional and local level respectively scale (also compare to Milestone Report M5.3.1). On this basis a first iteration of discussion with PLUREL modules was conducted to identify options for the PLUREL XPLOER

development. It was agreed that PLUREL XPLOERER will take the form of a logically structured graphical user interface (GUI) of PLUREL outcomes. This way it will show the logical thread through PLUREL results on urban rural land use developments and impacts. This in turn may help the users of PLUREL XPLOERER to better understand the causal chain relationships of land use developments in the urban rural context. It might reveal how policy decisions at different government levels can affect these developments irrespective of whether or not they were intended. For example, many instruments of the CAP (e.g. measures of the rural development pillar) do affect rural urban interrelations even though this was not targeted at. The further discussion and resulting development of the PLUREL XPLOERER concept in iterative manner underlines, that this initial idea and chosen path was target-based. Among interested groups acting at European level are the two networks PURPLE and CURE.

PURPLE (*Peri-Urban Regions Platform Europe*) is a network of regions that endeavours sustainable rural and agricultural development in peri-urban regions (<http://www.purple-eu.org/>). One of PURPLE's objectives is to act as a platform for peri-urban regions to share knowledge and good practice, allowing connections and productive cross-fertilisation between existing projects, as well as promoting new trans-European initiatives in the field. A closer linkage between PURPLE and PLUREL can promote both the dissemination of the knowledge on rural-urban interlinkages gained in the project and at the same time support the network's targets. Here, a first exchange at one of the PURPLE's thematic seminars took place on May 19, 2009, and a further discussion is scheduled at the PURPLE conference in Lille in September 2009.

CURE (*Convention for a Sustainable Urban and Rural Europe*) is an initiative commenced by partners representing different sides of the urban or rural issue. CURE partners share the commitment to focus on how cities and rural regions can work together to achieve sustainable future for both sides (<http://www.cureforsustainability.eu/>). The close thematic link to several of PLUREL research themes can profit from a closer interaction of both, the CURE network and the PLUREL project. DG Regio has taken the responsibility for arranging three seminars on urban-rural linkages, based on the CURE initiative. PLUREL partners have taken active part in the two seminars, which have been held so far, and will participate in the third and last one on July 1, 2009. A first discussion at DG Regio took place in April 2009 and subsequent, a workshop on the further cooperation is planned for the second half of 2009 (presumably July 2009).

Further on, a specific report on 'Frequently Asked Questions' (FAQs) on peri-urbanisation in Europe will provide appropriate dissemination material out of the PLUREL outputs. This FAQ report conclusions on the lessons learned from the PLUREL project as to the effect of these policies for sustainable development of land use in peri-urban areas as well as on the implications from the PLUREL project for the formulation of new policies and enhanced information. Hereby it addresses important questions of policy-makers at EU level and/ or at national level related to rural-urban land use relationships.

#### *End user requirements and resulting prerequisites at Regional Level*

The PLUREL end users at case study level are best represented by the stakeholders associated to PLUREL case studies, who are local stakeholders, practitioners, policy makers and planners. They take a very active role in shaping and supporting PLUREL research and serve as multipliers to a wider user group of planners, policy makers and practitioners in other regions across Europe. Many of PLUREL stakeholders are organised in European wide networks such as PURPLE and CURE (e.g. in Leipzig, Warsaw, Haaglanden. For further information on the networks see above). A first, rather abstract concept of the PLUREL XPLOERER was presented and discussed with stakeholders in Koper in September 2007 (Fricke, Helming 2007). It was evident that it was complicated to find a common language and a discussion basis for the design of a PLUREL product without some design example or prototype at hand. Therefore, evolutionary rapid development and operational prototyping (Guida, 1999) was seen as a

helpful concept that allows a more or less direct involvement of stakeholders into the process.

At its meeting in July 2008, the management board decided to have a common dissemination platform constructed instead of a mere Impact Assessment tool as initially foreseen. This dissemination platform for land use changes in rural-urban regions was thought to be an integrative framework for all PLUREL activities and their interrelations. A concept for this new and enhanced scope was developed and presented to the stakeholders at the General Assembly at the PLUREL meeting in The Hague on the 30<sup>th</sup> of October 2008. A further elaborated concept for the PLUREL XPLOER was then presented in Koper in March 2009 and discussed iteratively with the Board of Stakeholders. Here, general demands towards a tool or dissemination platform like online accessibility, maintenance after the project duration, comparability of the results, awareness-raising, flexibility and interactivity were discussed as well as quite specific demands, e.g. the provision of information on the integration of NGOs in regional planning processes in the case studies.

To upkeep this fruitful dialogue during the further elaboration of the PLUREL XPLOER in terms of functionality and design, an online web-forum was installed and linked to the PLUREL website where stakeholders can discuss iteratively with the development team of ZALF and ARCsys.

In a first conclusion, requirements from end users at European and at case study level can be outlined as follows:

- To understand what is happening and why with respect to land use changes in peri-urban regions
- To identify the drivers for land use changes, their dynamics and interrelations
- To understand how governance systems interfere with exogenous driving forces for land use dynamics
- To understand how impacts of land use dynamics can be analysed
- To understand interrelationships between land use dynamics and sustainable development options
- To study how specific themes, such as e.g. climate changes, biodiversity, water quality, migration interrelate with land use dynamics, what are the causal chain relationships
- To provide examples from other regions about problems, strategies and solutions related to land use dynamics

The PLUREL XPLOER concept aims at answering the end users' questions and meeting their requirements by displaying the PLUREL results from different perspectives, revealing causal chain relationships of rural-urban interlinkages.

#### *Existing concepts and tools for land use change assessment*

Targeted policy making requires tools for the *ex-ante* assessment of impacts of policy driven land use changes on sustainable development opportunities in European regions. These tools have to cover all relevant land use sectors and impact issues including their interrelations. They have to be spatially explicit, allow scenario analysis of possible future developments, be based on reproducible analyses, and be transparent and easy to use.

In recent years, modelling and foresight studies of land use change have emerged that consign land use into the logical chain of driving forces and impacts (Veldkamp and Verburg, 2004; Verburg et al., 2006). In particular, the ATEAM project (Advanced Ecosystem Analysis and Modelling) performed scenario based simulations on global climate and land use change impacts on ecosystem vulnerability in Europe (Rounsevell et al., 2006). Building upon this study, the EURURALIS project also addressed a choice of socio-economic impacts associated with land use changes predominantly in the agricultural sector (Klijn et al., 2005). The method allowed the anticipation of possible impacts of economic trend and policy choices on agricultural developments and related sustainability issues. SCENAR2020 was another study that was directly commissioned by the EC to provide support in future policy design through the ex-ante analysis of a suite of



alternative policy directions (Nowicki et al., 2006). Also for the agricultural sector the SEAMLESS project developed an approach for multi-scale modelling to assess sustainability impacts of agricultural policies (van Ittersum et al., 2008). PRELUDE was another study on scenarios for future land use changes in Europe conducted by the European Environmental Agency (Hoogeveen and Ribeiro, 2007). Designed as a facilitation instrument for public debate on landscape visions, various stakeholders elaborated a set of antithetic scenario narratives to envision landscape appearance in 30 years time. Extreme and partly shock based socio-economic developments and land use decisions were important features of these scenarios.

The SENSOR approach queued among the above mentioned studies, while developing *ex-ante* assessment tools for policy support. These fully integrate social, economic and environmental impacts of policy driven land use changes at European scale. To be policy relevant, the approach considered simultaneously the spatially relevant aspects of the economic sectors and activities which are concerned in land use at European level. These included agriculture and forestry as main sectors, transport and energy infrastructure, rural tourism, urbanisation and nature conservation as a 'regulatory activity' occupying land. In analysing driving force and policy scenarios for medium term perspectives (10-20 years), economy driven land use changes between these sectors and activities, their interrelations and their impacts on environmental, social and economic parameters affecting multifunctionality and sustainable development were assessed. The overall objectives of SENSOR were (i) to provide the context of sustainable development, land use multifunctionality and impact assessment, in which the project is placed, and (ii) to weave the logical thread through land use change – sustainability impact relationships (Helming et al., 2008, Diehl et al., 2009).

All the above impact assessment tools have in common that they were referring to concrete European level policy choices. This is not the case in PLUREL. However, the analytical design of driving forces – pressures – impact analysis in those studies proved solid and useful for understanding and assessing land use change dynamics. It was hence adopted in the PLUREL approach.

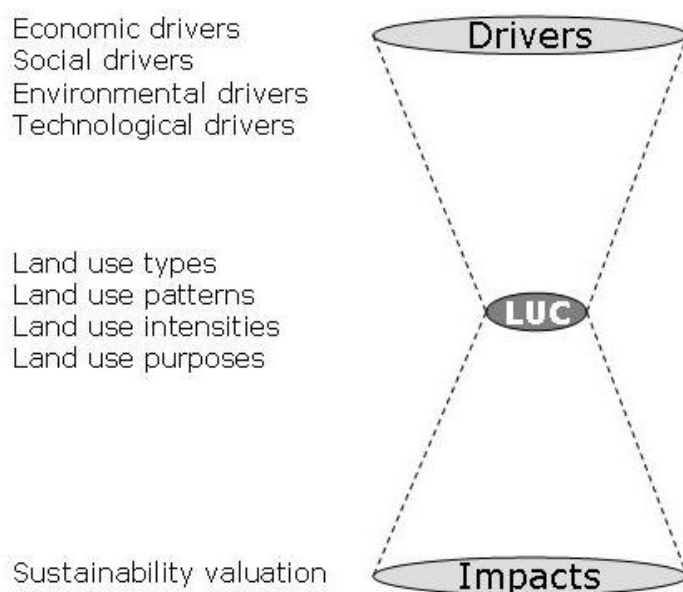
#### *The solution for PLUREL*

PLUREL aims at synthesising a result exploration tool (PLUREL XPLOER) to support planning and policy discussions on rural-urban land use interactions at European and at regional level. It will contain an impact analysis application component and integrates the different PLUREL products on their relevant spatial scales into an online available platform. A concept for the new enhanced scope of the PLUREL XPLOER was developed and presented at the 4<sup>th</sup> PLUREL General Assembly (The Hague, 30<sup>th</sup> October 2008). The elaboration of concept was carried out in cooperation with PLUREL task forces 1 (Product and Knowledge Chains), 2 (Indicator Framework) and 3 (SIAT-RUR). After the 2<sup>nd</sup> Annual Review of PLUREL, the objectives have been refined and specified, particularly in relation to end users requirements. Also the project orientation towards specific final products has been clearer profiled. The strengthened end user orientation is reflected in clearer product orientation of the deliverables. The adaptation and specification of the concept for the PLUREL XPLOER resulted in the deliverable report at hand.

The European Commission does not have a direct mandate for urban development policies. Although rural-urban interlinkages play an important role in the Sustainable Development context, the theme is rather regarded to be of lower policy relevance. Consequently it is purposive to conceptualise the PLUREL XPLOER as a discussion support tool integrating PLUREL activities and their interrelations rather than as a direct policy impact assessment tool. In short, it will serve as a common platform for disseminating PLUREL project results and revealing their interlinkages and causal chain relationships. The PLUREL XPLOER will be designed for external and internal users, such as scientists, decision makers and stakeholders at European and case study level. In order to best integrate PLUREL results into the PLUREL XPLOER, the overall concept is based on the product chains as elaborated in task force 1.



Building upon the analytical design of the SIAT developed in SENSOR (Helming et al., 2008), the PLUREL XPLOERER (1) anticipates the consequences of selected global driving forces and European policies on rural-urban land use types; and (2) analyses how they affect social, economic and environmental goods, services and functionalities of the rural-urban regions. It covers European, regional and partly local (city region) scales. Land use change is seen as the main pressure in the analytical string of PLUREL (Fig. 1).



**Figure 1:** The role of land use changes (LUC) in the analytical string of PLUREL

Regarding the drivers of urban-rural interlinkages, one has to take into account economic, social, environmental and technological drivers. The pressure land use changes may be expressed in terms of land use types (such as housing, transport, urban open, arable, grassland, sealed, etc.), land use patterns (e.g. monocentric, polycentric, etc.), land use intensities (such as high fertiliser input in agriculture, housing density in urban agglomerations etc.) and land use purposes (e.g. pasture that may be used for food production (meat, milk), recreation (horsing etc.), or flood control (retention areas)). One of the following chapters gives a deeper insight of the DPSIR system as applied in PLUREL. It is to note that all PLUREL products will be arranged in order of this DPSIR causal chain relationship of land use changes.

#### *Consequential challenges and constraints*

As the PLUREL XPLOERER covers and synthesizes project results on European, regional and even local scales, it resultantly deals with a variety of governance levels that have to be reflected in the different spatial scales. Further on, heterogeneous decision maker groups on the different governance levels are in the scope with the PLUREL XPLOERER functionality as a dissemination and discussion support tool. Last but not least, different external and internal user groups of the tool need to gain a common understanding about causal relationships in terms of rural-urban interlinkages.

Second order uncertainties in building the concept are also arising from the vagueness and ambiguity in regard to the final products. In general, the final products are the output of an internal and external discussion process during the project duration. Designing the concept of the overall integrating tool in the end becomes more difficult as there is a certain uncertainty about the definitions of results, outcomes and or products. Based on the concept and a careful analysis of the expected outcomes of other modules activities the design features, operational elements and the resultant structure of the PLUREL

XPLORER will be further specified in the following months during the phase of technical implementation and knowledge integration. Iterative adaptations of the concept are therefore foreseen.

# Concept for the PLUREL XPLORES

## *Concept and Approach*

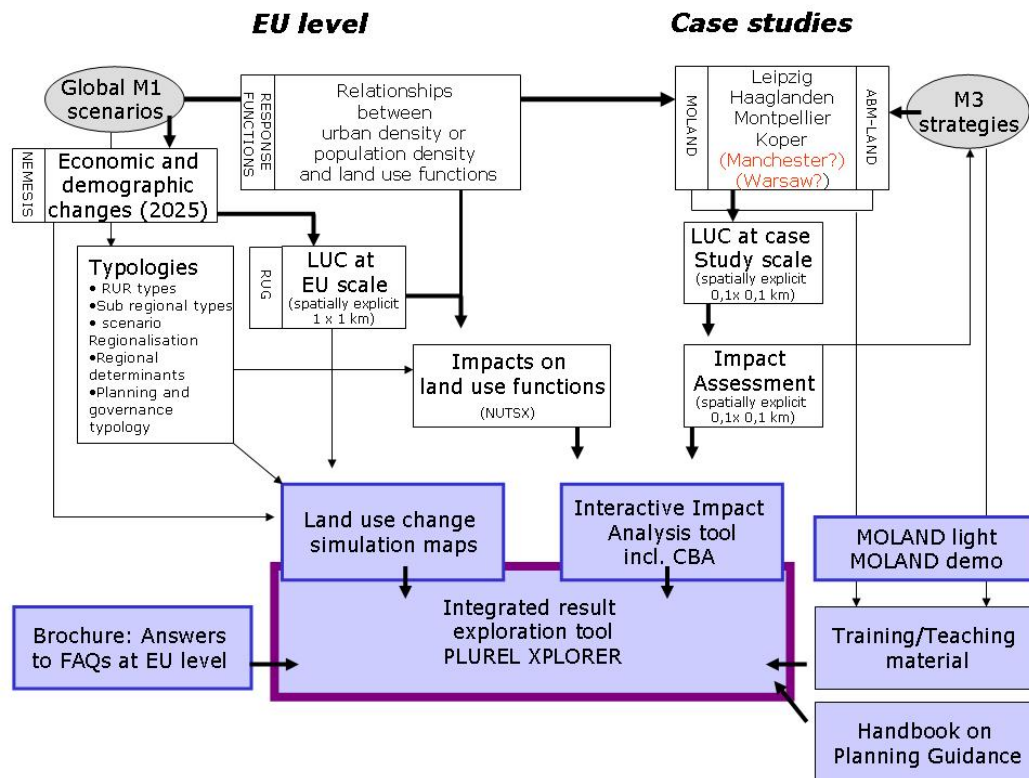
In general, concepts are an abstract idea defined as a "unit of knowledge" built from other units which act as a concept's characteristics. Concepts are vital to the development of scientific knowledge and for structuring the units the concept is built of. In the PLUREL context, the *Concept for the PLUREL XPLORES* explains how the single products of the project are integrated into an analytical thread of RUR interactions. To achieve this integration, a certain abstraction is necessary. It is to be seen as a generalisation to reduce the information content of the concept, typically in order to retain only information which is relevant for a particular purpose. The latter knowledge integration and technical implementation concretises this elaborated concept.

The PLUREL XPLORES's overall aim is to a) disseminate the knowledge on peri-urban relationships gathered within the PLUREL project and b) provide a discussion support system on peri-urban interlinkages for stakeholders at different levels.

The concept for the PLUREL XPLORES is structured along the DPSIR chain and builds upon the PLUREL product chains as specified in task force 1 (Product and Knowledge Chains). A product chain in the PLUREL sense covers a variety of products that belong to a certain thematic area covered within the project. These products take the form of scientific reports and databases as well as input documents for stakeholders and practitioners with a focus on peri-urban land use change and its consequences. PLUREL results/products will be accompanied by structured fact sheets containing e.g. maps, graphs, tables, and reports. The PLUREL XPLORES will feature both, quantitative and qualitative information. Based on this concept and a careful analysis of the expected outcomes of other modules activities the design features, operational elements and resultant structure of PLUREL XPLORES will be iteratively specified in the following months.

## *Content of the PLUREL XPLORES*

The PLUREL XPLORES is an exploration tool for the interactive examination of all PLUREL results. The major PLUREL results included in the PLUREL Explorer can be subdivided into main products (depicted in blue in figure 2) and sub-products (depicted in grey scales in figure 2). The sub-products can be accessed directly via the PLUREL XPLORES interface. They are feeding into the main products, among them the land use change simulation maps and the Interactive Impact Analysis Tool (described in detail in the DoW), which are also accessible via the PLUREL XPLORES.



**Figure 2:** Integration of PLUREL results across modules (according to DoW p.26)

According to the latest version of the DoW, the major PLUREL results included in the PLUREL XPLOER are as follows:

1. description of sustainability issues arising from rural-urban land use interactions – concentrating on pressures in peri-urban areas (sub-product, written report)
2. Driving forces & scenarios: storylines and graphs for land use changes in rural-urban regions. Outputs will be produced at two scales derived from EU land use change (LUC) modelling and from case study land use change modelling. These results present and interpret the modelling of different drivers on urbanisation pressures. (sub-products, included in the iIAT-tool)
3. Land Use Change Simulation Maps and model results: European and regional applications: approach and results. On the one hand these are changes in population density, resulting from demographic changes, on the other hand land use changes resulting from global economic changes. Demographic and spatially explicit land use change maps with EU-27 coverage will be provided for four scenarios oriented on the IPCC SRES scenario storylines (main product, maps).
4. Impacts on the environmental and socio-economic development conditions arising from land use changes in urban, peri-urban and rural sub-regions. Those impacts will be illustrated with indicators and response functions at European level. Impact assessment in M2 and in M4 will be carried out first for single indicators and then be integrated in the spider-diagrams distinguishing environmental, economic and social criteria and/or in groups of specific objective setting (e.g. recreation). (sub-products, included in the iIAT-tool)
5. Case study examples: regional structure (land use, drivers), planning and governance processes, resulting pressures urban-rural dynamics and land uses. (sub-products, included in the iIAT-tool and the MOLAND light and MOLAND demo version, written reports on Joint Analytical Framework of M3)
6. Training and Teaching Material. LUC - policy and impact demonstration tool based on the ABMland applied for one case study example. The “generic version” of ABMland is demonstrated to stakeholders and interested researchers. Examples on how to use the model are given, and ways to change interactions and agents’ decisions

- are shown. A documentation of the model is provided. MOLAND light and MOLAND demo version. (main product, accessible via the PLUREL XPLOER)
7. Interactive Impact Analysis tool including cost-benefit-analysis; multi-criteria analysis (MCA), GUI, spider diagrams. Such diagrams can be displayed at EU-27, national, RUR type, NUTSX region type scale and for the case study regions with more detailed information. The interactive element of the iIAT within the PLUREL XPLOER for the end users will lie in the option to choose or adapt (i) indicators, (ii) their grouping, (iii) the scale, (iv) thresholds or (v) to determine target values for single indicators, on which the system will display the reciprocate effect on the other indicators, as calculated by the MCA (multi criteria analysis). (main product, interactive application)
  8. Cost-impact analysis at European and cost- benefit case study scale for RUR - subregions: results. (sub-product, included in the iIAT-tool).
  9. Planning guidelines overview. The handbook will synthesise the results from across the PLUREL project in a suitable format for practitioners that have an interest in the governance of peri-urban areas. This book will provide an in-depth understanding of the concept of peri-urban areas, what are main issues concerning sustainability of land use systems in peri-urban areas, and what is good practice to address these issues. The main body of the book is based on the results from the case studies. (main product, linkage will be defined during the coming months)

By revealing the interlinkages of PLUREL results by linking the major product results with the underlying data management system and GEO portal, it illustrates the logical chains of PLUREL analytics. The PLUREL XPLOER provides a graphical user interface (GUI) thereby integrating links to a text file repository, where all results provided to the public will be stored as short, easy readable pdf-files, to data via the data warehouse, to maps via the map portal, to the interactive IAT application, to the LUC-model results as well to the land LUC policy and collaboration impact demonstration tool (ABMland). All information can be downloaded as pdf-files.

The tool will include both the PLUREL work at European level and at case study level. The development of the tool in terms of user interface, content and functionality will be conducted iteratively to take up user requirements and reflections on consecutive prototypes. A web-based discussion forum has been set up to discuss the development of the PLUREL XPLOER with the PLUREL stakeholders.

It is to be noted that success of the PLUREL XPLOER is subject to targeted contributions from all PLUREL partners. Since the PLUREL XPLOER is to be linked to the data management system, this activity will be conducted in close interaction with ARCSYS responsible for WP 5.1. Here, ZALF will be responsible for the concept, knowledge processing and implementation, while ARCSYS will be responsible for the software generation and the technical implementation as described in the following chapters. Regarding the interface between the data management system of WP 5.1 and the PLUREL XPLOER (see figure 11), the PLUREL XPLOER is defined as a user interface of the data management system. All data will be stored in the data management system or on the map-server regarding map files from where they will be linked to the PLUREL XPLOER. The basic idea is to guide the end-user of PLUREL XPLOER through the contents, i.e. the PLUREL results, of the data management system in a structured way by using the PLUREL XPLOER interface.

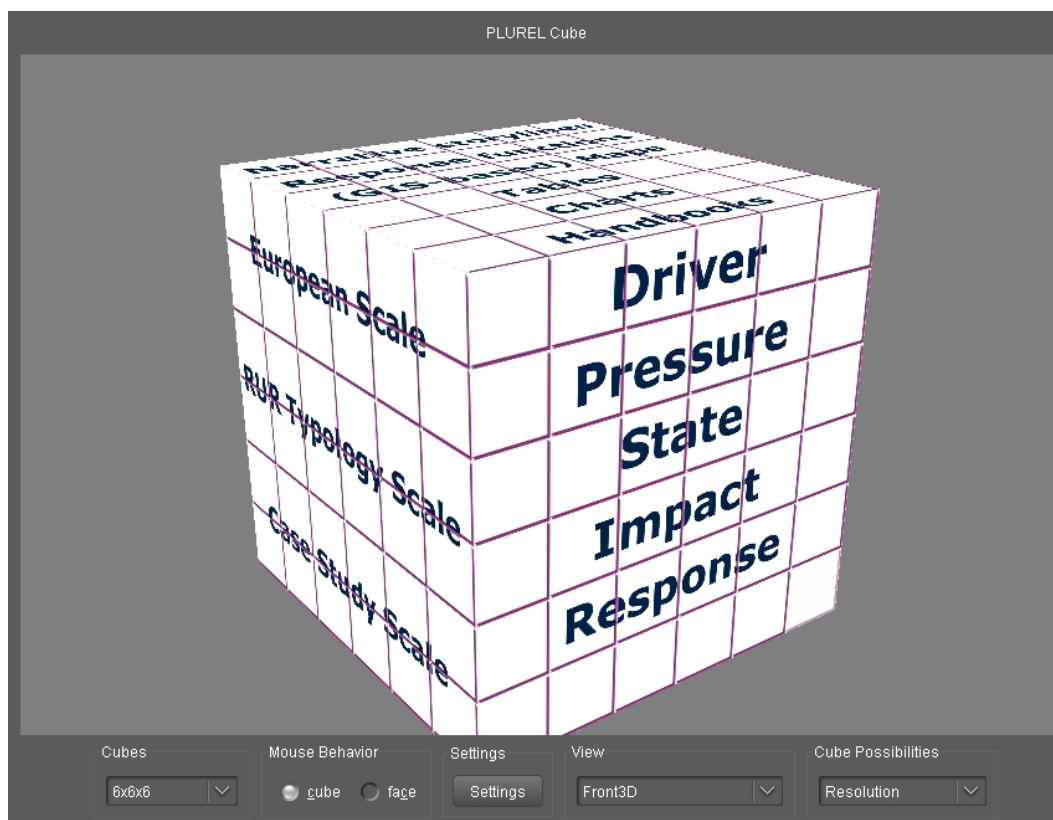
#### *The six dimensions of the PLUREL XPLOER*

The PLUREL XPLOER will present the PLUREL results from all modules in a multidimensional space generated by the elements and processes of human-environment relationships (DPSIR scheme, dimension 1); the spatial scale (Europe, case study level, dimension 2); the main land use types (housing, traffic, agriculture, environment, water, tourism; dimension 3); the indicator types (according to the indicator framework, dimension 4); the scenarios (dimension 5) and the knowledge type (e.g. story, map, graph, equation, dimension 6). All PLUREL results can be characterised by means of these six dimensions, at least by some of them. The cubic shape of the explorer (fig. 3)

illustrates the multiple entry points into the analyses provided by PLUREL. The user can choose from which perspective (dimension) he or she would like to start his or her journey through PLUREL's results, e.g. from the Driver side. If one wants to know something about the drivers of land use change in peri-urban relationships on European scale, a combination of these two topics leads to a fact sheet comprising the required information. Table 2 illustrates possible user questions to the Explorer and respective Explorer dimensions.

Table 2: Questions of end users about purpose and functionality of PLUREL Xplorer, respective specifications and resulting design features

Main Question	Specification (Tick-Boxes)	PLUREL EXPLORER Dimension
What are causal-chain relationships of Land Use Change in peri-urban regions?	Why does land use change? How does land use change? What does the state of the environment look like? What effects does land use change have? How can I react on land use changes?	<b>DPSIR</b>  D P S  I  R
Where do you want to see the results?	In Europe In comparable regions In your or other municipalities	<b>Spatial Scale</b>  Europe RUR-Typology Case study level
In which specific land uses are you interested?	Agriculture, forestry Housing and industry Nature Conservation Water Traffic Tourism and Recreation all	<b>Land Use Types</b>
How can the results be measured?	Single indicators, grouped by  Ecosystem services Quality of Life Cost-Benefit & Cost Effectiveness	<b>Indicators</b>
What might the future look like?	Hyper Tech Water Crisis Peak Oil Fragmentation	<b>Scenarios</b>  A1 A2 B1 B2
How would you like to see the results?	As...  GIS-based maps Graphs Texts Scientific papers (if permitted by IPR) Mathematical equations Handbooks Media clips	<b>Knowledge Type</b>    Narrative storylines  Response functions



**Figure 3:** PLUREL XPLORER as presented in Koper, March 2009.

The following part gives a more detailed overview on the six dimensions PLUREL XPLORER will cover, the end users interest in these dimensions and the content.

*Dimension 1: Position in the DPSIR causal chain relationship of land use changes*

PLUREL end users are interested in the effects of land uses change on peri-urban interlinkages as these land use dynamics may cause serious environmental and specific spatial development problems in the rural-urban areas. Different processes leading to these land use changes and resulting impacts of these land use changes are of a certain interest to the end user. Therefore the cognition and analysis of these processes in the rural-urban relationship are the first possible entry point into the PLUREL results. Recognising the causal chain relationships of land use change, e.g. what drives land use change in the rural-urban context and what are possible impacts of land use changes in relation to sustainable development, supports the user in understanding and steering these processes.

In general, all analyses of the PLUREL XPLORER will be conducted through the lens of land use changes, which is seen as the main pressure in the DPSIR system (compare to Figure 1 above).





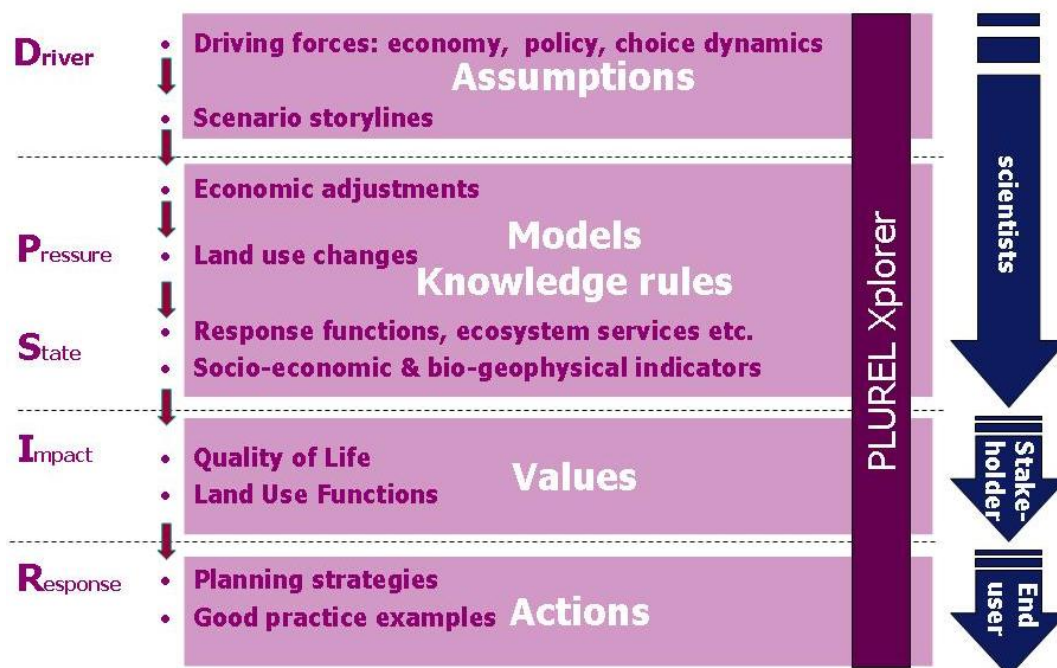
Certain impact issues may describe a state while on the other hand being a driver of land use change in the rural-urban context. So the position of the indicators and related impact issues within the DPSIR framework is variable, while being always related to land use change. Although this variability is taken into account especially in the indicator selection (compare to *Dimension 4: Indicators*), the single products of PLUREL have to be assigned to a rather fixed position in this framework in order to ease the cooperation between the project partners. In the following months, these specifications and assignments have to be developed iteratively

in close cooperation with all project partners.

**Figure 4:** The variability of indicators' positions within the DPSIR-Framework

In the PLUREL project numerous experts cooperate to analyse rural-urban relationships and their interactions on a variety of spatial scales. Specific knowledge chains analyse the logical cascades of Rural-Urban Interlinkages - Land use changes – Sustainability Impacts and Land use changes – Rural-Urban Interlinkages - Sustainability Impacts. To agree on a coherent thread and structure the PLUREL XPLOER, the DPSIR framework (Smeets and Weterings, 1999) was employed. To mediate between different disciplinary viewpoints and agree on a common understanding of causal chain relationships between society and environment, this concept was developed by the European Environment Agency (EEA). It is an advancement of an earlier version developed by the OECD (OECD 2001) and is defined as “The causal framework for describing the interactions between society and the environment adopted by the European Environment Agency: *Driving forces, Pressures, States, Impacts, Responses*” (EEA).

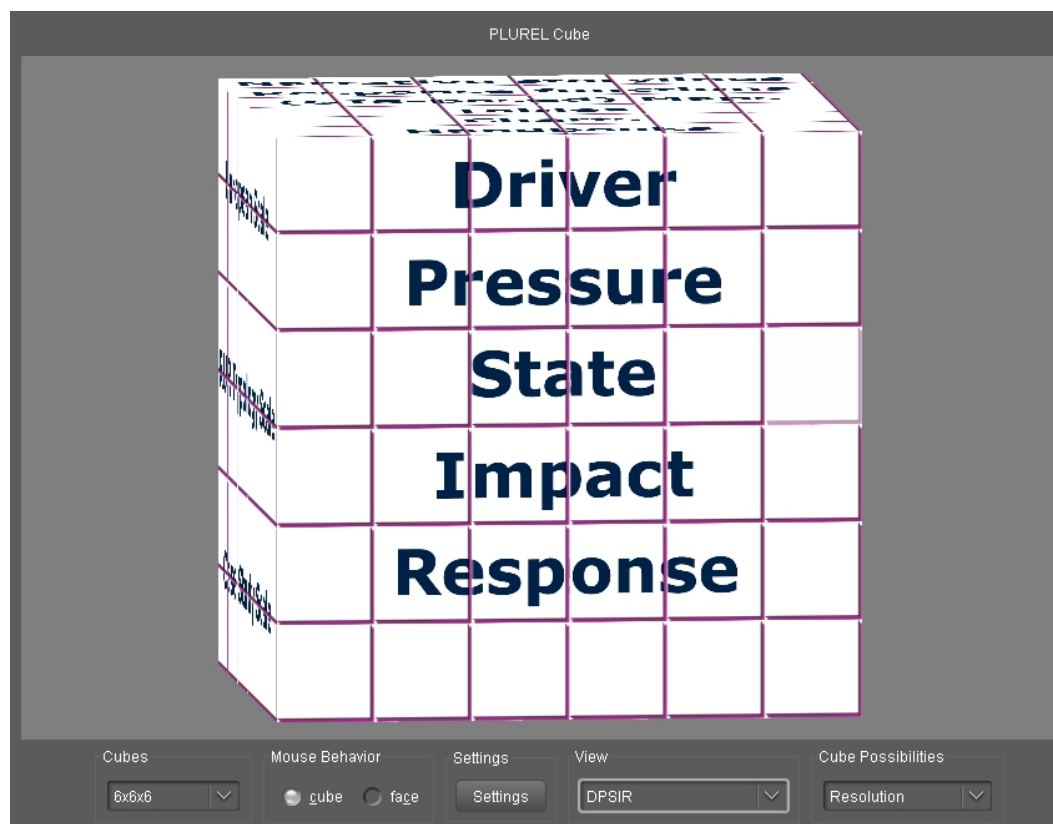
This approach has since been adopted in various studies whenever interaction between human behaviour and environment was a matter of concern (Niemeijer and De Groot, 2006). It is particularly useful when scientific process knowledge has to be translated into knowledge for policy support. The specific strength of the DPSIR concept lies in its adaptability to many different objectives and scales of analysis.



**Figure 5:** Simplified analytical scheme of impact assessment in the PLUREL XPLORER integrating top-down modelling with bottom-up participatory approaches and extending on the DPSIR scheme of the EEA. (*D=Drivers, P=Pressures, S=State, I=Impact, R=Response*)

In the PLUREL context, the basic definition of *Drivers*, *Pressures* and *Impacts* is straightforward. Land use change is defined as the central *Pressure* (also see above). It is affected by external economic, social, environmental and technological *Drivers*. The role of *States* is taken by numerous social, economic and environmental parameters that are affected by land use changes. The analysis chain departs from the economic setting (*Drivers*) that is translated into a geophysical setting (land use *Pressures*) and further into an integrated system of the social, economic and environmental settings (sustainability *Impacts*). While the first part translates drivers into pressures by quantitative modelling and stakeholder involvement for scenario visualisations, the second part of translating pressures into impacts needs to also include normative components in order to embrace the value based character of the sustainability definition (WCED, 1987).

This was obtained by expanding the impact component of the DPSIR framework into two complementary impact steps by regarding Quality of Life indicators as well as Ecosystem Services and Land Use Functions. Subsequent, a multifunctionality approach is undertaken to aggregate indicators and their valuations into an integrated assessment of the room for manoeuvre within sustainability choices (Potschin and Haines-Young, 2008). This analytical design aims to integrate the top-down data and indicator based modelling with a bottom-up, value driven participatory approach. The component of *Responses* within the DPSIR scheme is also taken up in the analytical design of PLUREL. In its logical setting, the *Response* component is covered by policy decisions in reaction to simulated impacts. Hence, best practice examples give an idea of possible development options.



**Figure 6:** Depiction of the **products' position in the DPSIR causal chain relationship of land use changes** in the PLUREL XPLORER interface

The DPSIR scheme of the PLUREL XPLORER core element and structuring the PLUREL products according to the above mentioned finally results in the structural design of the graphical user interface.

To be more concrete, the DPSIR dimension of the PLUREL XPLORER comprises merely all products of M1, M2, M4 and M5. Some of them cover the complete analytical chain, such as the Assessment of Sustainability Impacts of (peri-) urban land use changes (M2) and the Pan-European spatially explicit model linking changes in socioeconomic indicators and land use (M4).

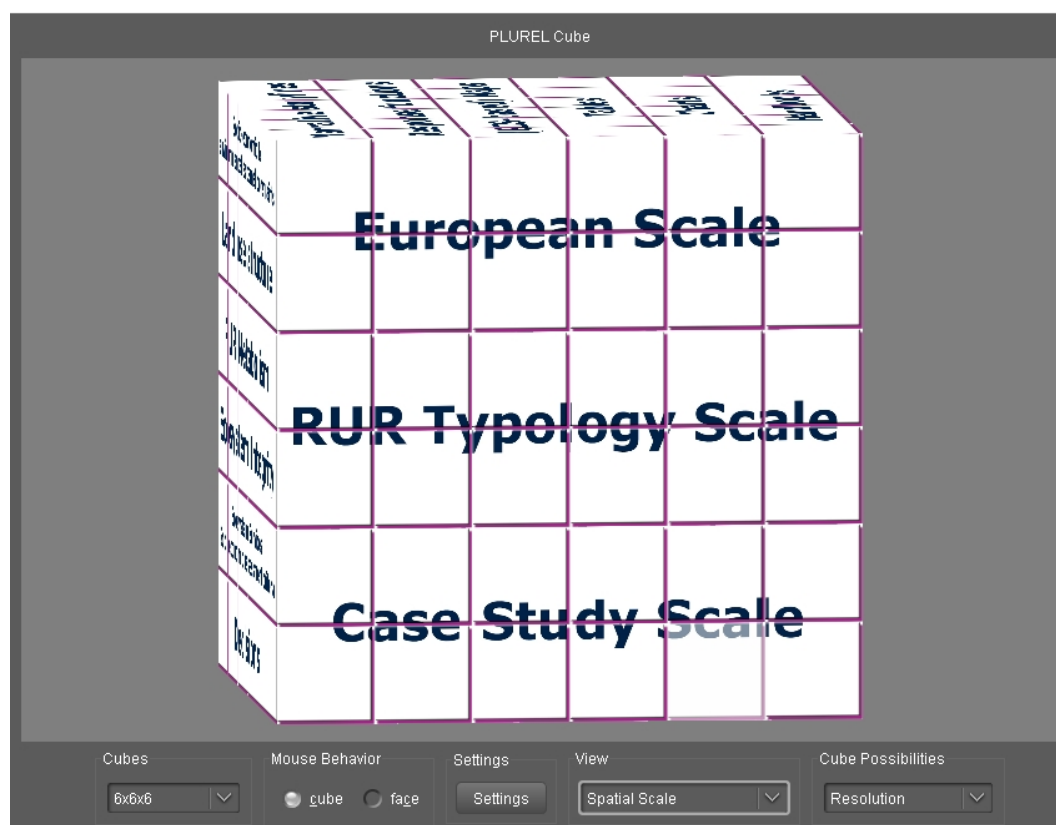
Drivers are displayed by Four scenario storylines on different global change drivers (M1), Probabilistic forecasts on demographic change under four scenario storylines (M1), Scenario Regionalisation maps and descriptions at European scale (M2), Driver-State relationships are covered by Transforming of driving forces and technological change into land use change: Maps on land use distribution (urban/ non urban) and on population density in four scenarios based on (probabilistic) modelling outputs derived from the RUG model (M1) and sub-regional delineation map and driver dependent RUR elasticities (M2), Driver-State-Impact relationships are displayed by RUR-type specific response functions (M2), spatially explicit response functions for land use change modelling (M2) and the Implementation of response functions at NutsX-scale. State-Impact relationships are covered by the application of regional variability of urbanisation-impact-relationships to land use maps (M2), Impacts by Maps on demographic and economic change impacts - scenarios for 2015, 2025 and 2050 at NUTS0-NUTS2 (M1), External costs and benefits of selected environmental and social impacts of LU change (M4), Marginal external cost and benefit values from existing studies (M4), Classical CBA on existing policies (M4) and the Simpson Index of land use diversity (M4). Responses are integrated in the national spatial planning policies and governance typology (M2), the compendium on national spatial planning policies in Europe (M2), Migration Hot Spots

(M2), the MOLAND application in the case studies Leipzig, Haaglanden, Koper and Montpellier (M2), the report on FAQ on peri-urbanisation in Europe (M5), Training and teaching materials (M5) and the handbook for practitioners (M5).

### *Dimension 2: Spatial scale*

In the context of the spatial scale, the PLUREL analyses are operating at specific spatial scales from European (M1) to regional (M2) to local city region (M3, M4) level.

From an end user perspective, most of the European stakeholders do have an interest in European issues, illustrated by detailed exemplary case studies, while the local stakeholders are interested in a more regional perspective. A careful design of case study examples here allows for a general comparability among other cases and on the level of RUR-Types, among comparable regions in Europe. National level stakeholders might be interested in linking the overall European perspective with the detailed knowledge gained in case study examples.



**Figure 7:** Depiction of the **spatial scale** in the PLUREL XPLORER interface

In terms of PLUREL analyses, the most results of M2 will have a spatial level that is more detailed than the general view of M1 (NUTS0, NUTS1). If necessary, a local resolution (NUTS5) might be used to work with spatially explicit situations of the cases. Methodologically M2 deals primarily with rather regional aspects relating these to EU-policies relevant on that spatial and organisational level. In order to address the Pan-European impact of EU-policies on the land use relationships, M2 cooperates with M 1, where European trends in driving forces and their impact on the relationships between NUTS1 and NUTS2-regions will be studied. From that discussion appropriate adaptations or specification of the results will be forwarded to M3, M4 and M5 in order to enhance the discussion with the local stakeholders in the cases as well as the modelling approaches. It is important to notice, that the same or similar topics are analysed at different spatial scales. Hence, the operational spatial level of PLUREL XPLORER always depends on the respective modules' output.

On the European Scale, the following products could be identified so far: Maps on demographic and economic change impacts - scenarios for 2015, 2025 and 2050 at NUTS0-NUTS2 (M1), Probabilistic forecasts on demographic change under four scenario storylines (graphs) (M1), Four scenario storylines on different global change drivers (M1),

Climate change and environmental drivers (M1), Transforming of driving forces and technological change into land use change: Maps on land use distribution (urban/ non urban) and on population density in four scenarios based on (probabilistic) modelling outputs derived from the RUG model (M1), The national spatial planning policies and governance typology (M2), the compendium on national spatial planning policies in Europe (M2), the Scenario Regionalisation maps and descriptions at European scale (M2), the basic (generic) Response Functions (M2), the application of regional variability of urbanisation-impact-relationships to land use maps (M2), the implementation of Response Functions at NUTSX (M2), the assessment of Sustainability Impacts( or degree of objective achievement) of (peri-) urban land use changes (M2), Migration hot spots (M2), the qualitative typology of regional planning strategies and policy measures (M2), the framework for the evaluation of economic impacts of transportation provision (M2), the indicator framework (M4), external costs and benefits of selected environmental and social impacts of LU change (M4), marginal external cost and benefit values from existing studies (M4), pan-European spatially explicit model linking changes in socioeconomic indicators and land use (M4), classical CBA on existing policies (M4), the Simpson Index of land use diversity (M4) as well as the Report on FAQ on peri-urbanisation in Europe (M5) and the Multi-criteria assessment tool (M5).

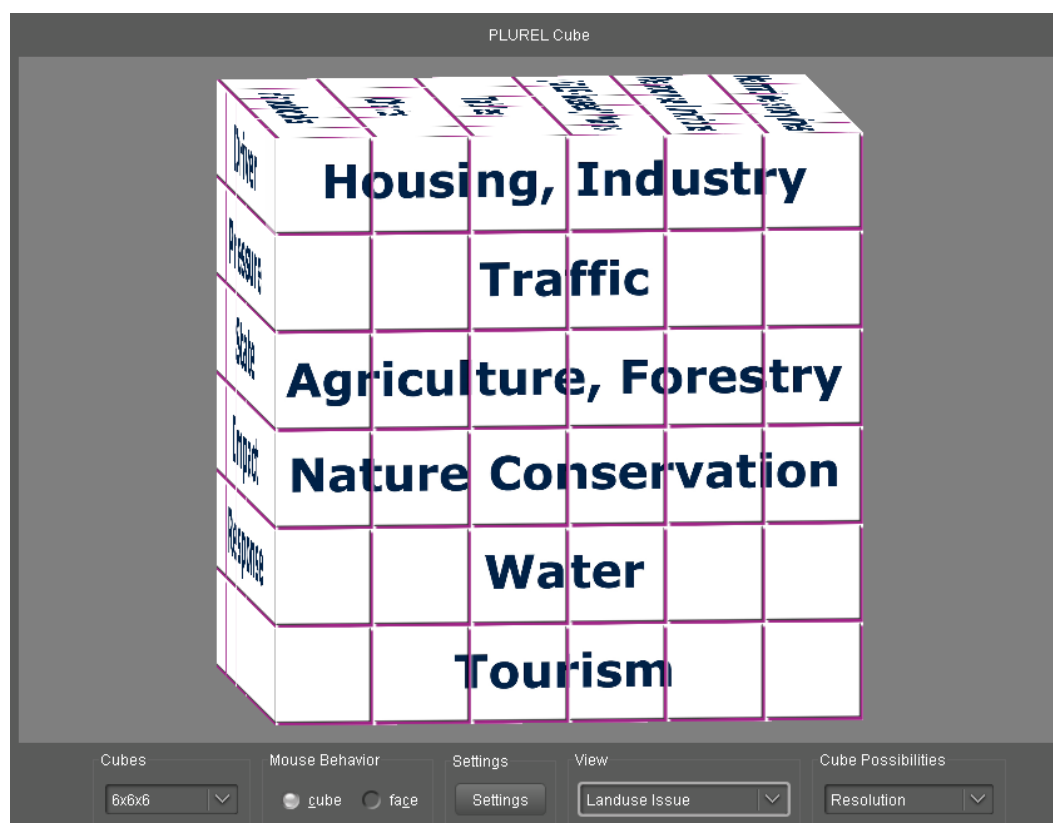
On the RUR-Typology scale, the following products were identified: The RUR typologies (M2), the sub-regional delineation map (M2), the driver dependent RUR elasticities (M2), the qualitative typology of regional planning strategies and policy measures (M2), and RUR-type specific Response Functions (M2).

On the case study scale, the following products can be found: The Scenario Regionalisation description at case study level (M2), the MOLAND application in the case studies Leipzig, Haaglanden, Koper and Montpellier (M2), the Joint Analytical Framework of governance and strategic planning scenarios (M3), Assessment Framework of Case Study Planning Strategies (M3), Overview of spatial planning and governance and government possibilities with insight in the sustainability effects of different detailed and assessed approaches (M2, M3), Scenario Application within the case study regions (M3 with M2, M4), generic System Dynamics Model (M4), generic ABMland (M4), ABMland application (M4), preference simulator for Quality of Life (M4), demonstration of Generic ABMland (M4), demonstration of Generic System Dynamics Model (M4), evocative events (M5) and the handbook for practitioners (M5).

### *Dimension 3: Land use types*

The key issue and focal lens of the analytical string of PLUREL is land use respectively land use change. Therefore the land use types play a significant role in characterising the main products. Certain interest groups, e.g. farmers' associations, are presumably interested in a certain form of land use, e.g. agriculture.

The PLUREL XPLOER therefore enables the user to regard causal chain relationships of land uses changes from a specified perspective of land use. The related topics are Housing, Industry, Traffic, Agriculture, Forestry, Nature Conservation, Water, Recreation and Tourism. Presumably most of the PLUREL results cover several or all issues.



**Figure 8:** Depiction of **Land Use Types** in the PLUREL XPLOER interface

In order to compare case studies and derive common understandings of causal relationships in rural-urban interlinkages, the regions' stakeholders identified six issues of high significance for Sustainable Development in all the regions. These topics are correspondent to the land use types.

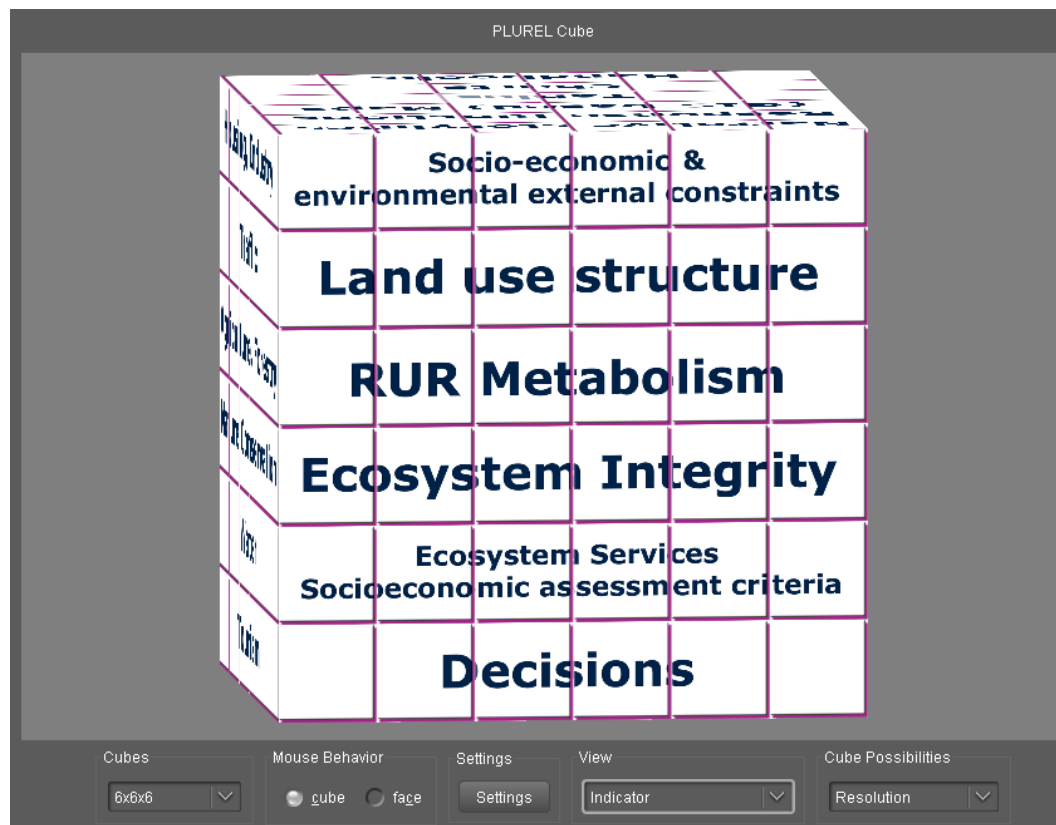
Sorted by the land use types they are covering, the following products can be identified starting from this entry point into the PLUREL XPLOER: The national spatial planning policies and governance typology (M2), the compendium on national spatial planning policies in Europe (M2), application of regional variability of urbanisation-impact-relationships to land use maps (M2), spatially explicit RF for land use change modelling (M2), assessment of Sustainability Impacts (or degree of objective achievement) of (peri-) urban land use changes (M2), the qualitative typology of regional planning strategies and policy measures (M2), framework for the evaluation of economic impacts of transportation provision (M2), the Scenario Regionalisation description at case study level (M2), Assessment Framework of Case Study Planning Strategies (M3), the overview of spatial planning and governance and government possibilities with insight in the sustainability effects of different detailed and assessed approaches (M2, M3), external costs and benefits of selected environmental and social impacts of LU change (M4), the



Simpson Index of land use diversity (M4) as well as the pan-European spatially explicit model linking changes in socioeconomic indicators and land use (M4).  
All these results can be split up into the mentioned land use types they are touching upon in their sectoral or spatial explicit analyses.

#### *Dimension 4: Indicators*

End users interested in certain themes, e.g. the ecosystems or more specific, biodiversity, have the possibility to look at the PLUREL results under their focus of interest. All PLUREL results relating to this certain perspective can be displayed.



**Figure 9:** Depiction of **Indicators** in the PLUREL XPLOER interface based on an overview of Task Force 2 (Indicator Framework)

In general, all aspects and elements are described with help of a specific indicator framework. The indicator selection for this PLUREL indicator framework is based on a decision-focussed framework model originating from the DPSIR approach of the EEA. The main idea behind this model is to describe environmental and socio-economic consequences of a land use decision and hence provide criteria for the following decision process (for further information compare to Preliminary Task Force Paper M6.2.7). In an iterative process of the indicator task force and all modules, different methodological features have to be taken into account, for example

- technical variables which are necessary to optimize the information flow between PLUREL work packages, models and data bases (technical indicators),
- variables which are significant to understand the functioning of the human-environmental systems of RURs (systemic indicators),
- variables which are basic fundamentals of the decision process (policy indicators, key indicators).

Further on, results from the conjoint analyses, economic valuations and the expected results concerning quality-of-life indicators influence the indicator selection.

As mentioned above, certain impact issues may describe a state while on the other hand being a driver of land use change in the rural-urban context. So the position of the indicators and related impact issues within the DPSIR framework is quite variable, while

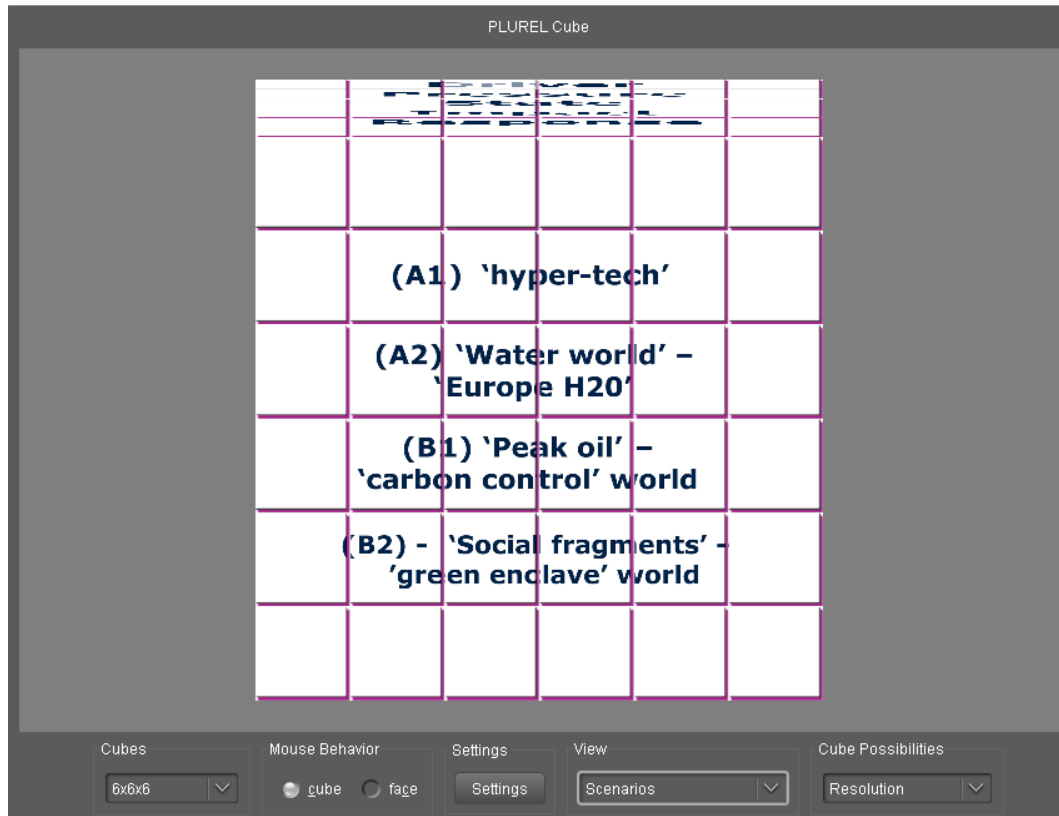
being always related to land use change. Nevertheless, the chosen indicators have to be assigned to the DPSIR framework as applied in PLUREL.

The following products can be found by starting from the indicator entry point of the PLUREL XPLOER: Climate change and environmental drivers (M1), Indicator framework (M4), The basic (generic) Response Functions (M2), External costs and benefits of selected environmental and social impacts of LU change (M4), Marginal external cost and benefit values from existing studies (M4), Pan-European spatially explicit model linking changes in socioeconomic indicators and land use (M4), Land use change valuation questionnaire (M4), Classical CBA on existing policies (M4) and the Simpson Index of land use diversity (M4).

All these rather broad thematic areas will be specified by single indicators during the remaining project lifetime until the final version of the PLUREL XPLOER. These single indicators can also be grouped according to the three main indicator categories of Ecosystem Services, Quality of Life and Economic indicators elaborated within PLUREL so far.

### *Dimension 5: Scenarios*

End users are interested in different development options of the future. Therefore the PLUREL scenarios are an important entry point for the display of PLUREL results. Different development options and predictions can be compared and analysed, depending on the end users assumptions of a likely future.



**Figure 10:** Depiction of **Scenarios** in the PLUREL XPLORER interface

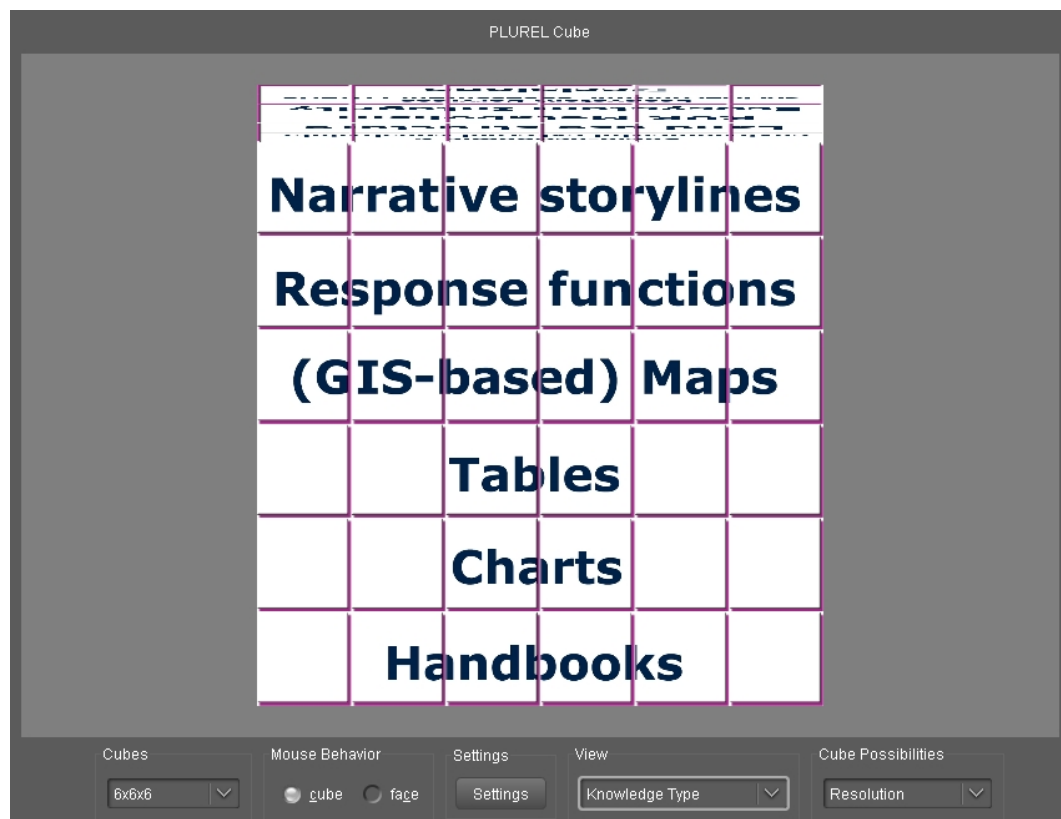
The M1 scenarios are an important driver for most of the PLUREL results. The information, whether a product acts scenario-sensitive is an important sort indicator. The scenarios present and interpret results from the modelling of different drivers on urbanisation pressures. On the one hand these are changes in population density, resulting from demographic changes, on the other hand land use resulting from global economic changes. At regional level the scenario storylines are specified by practitioner interpretation and development strategies and translated into spatially explicit modelling. The resulting maps for the case study regions provide land use changes in much more detail and allows for e.g. observing gradients in space and time.

Starting from the topic of scenarios, the user can find the following information: Maps on demographic and economic change impacts - scenarios for 2015, 2025 and 2050 at NUTS0-NUTS2 (M1), Probabilistic forecasts on demographic change under four scenario storylines (M1), Four scenario storylines on different global change drivers (M1), Climate change and environmental drivers (M1), Transforming of driving forces and technological change into land use change: Maps on land use distribution (urban/ non urban) and on population density in four scenarios based on (probabilistic) modelling outputs derived from the RUG model (M1), the Scenario Regionalisation maps and descriptions at European scale (M2), application of regional variability of urbanisation-impact-relationships to land use maps (M2), the Scenario Regionalisation description at case study level (M2), migration hot spots (M2) the assessment of Sustainability Impacts (or degree of objective achievement) of (peri-) urban land use changes (M2) and the Scenario Application within the case study regions (M3 with M2, M4).

#### *Dimension 6: Knowledge type*

Generally speaking, there are two kinds of knowledge. On the one hand, explicit knowledge is expressed in words and numbers and shared in the form of data, scientific formulae, product specifications, manuals, universal principles, and so forth. This kind of knowledge can be readily transmitted across individuals formally and systematically. On the other hand, tacit knowledge is highly personal as it is rooted in an individual's action and experience and hard to formalise. At first, there is a “technical” dimension, which encompasses of informal skills or crafts often captured in the term “know-how”. Highly subjective and personal insights, intuitions, hunches and inspirations derived from bodily experience also belong into this dimension. Nevertheless, tacit knowledge also contains an important “cognitive” dimension. It consists of beliefs, perceptions, ideals, values, emotions and mental models shaping the way of perception. [Edvinsson&Malone, 1997]

The PLUREL XPLOER allows the exploration of the knowledge gained in PLUREL from different perspectives. The end users are enabled to view all results that are e.g. compiled in maps, or compare all tables. Browsing through the different knowledge types gives the user the possibility to choose results according to his preferences not only in content, but also in the form of display.



**Figure 11:** Depiction of **Knowledge Type** in the PLUREL XPLOER interface

The PLUREL XPLOER will comprise narrative storylines, response functions, charts and tables or GIS-based maps that will be stored in the data management system. Criteria will be developed in close interaction with other modules on how results have to be treated, interpreted and documented to be fed into the PLUREL XPLOER. One fundamental criterion is to identify and trigger the complementarities between the different research elements of PLUREL. This dimension requires continuous updating with other developments within the project. So, the information input from other modules will be specified in inter-module discussions. The complementarities between

the different activities in the modules will be highlighted and means of interaction will be identified.

As narratives and storylines the following products could be identified so far: Four scenario storylines on different global change drivers (M1), the qualitative typology of regional planning strategies and policy measures (M2), the compendium on national spatial planning policies in Europe (M2), the Scenario Regionalisation maps and descriptions at European scale (M2), the Scenario Regionalisation description at case study level (M2), Joint Analytical Framework of governance and strategic planning scenarios (M3), Assessment Framework of Case Study Planning Strategies (M3), Overview of spatial planning and governance and government possibilities with insight in the sustainability effects of different detailed and assessed approaches (M2, M3), Land use change valuation questionnaire (M4), the Questionnaire for Quality of Life (M4) and the Report on FAQ on peri-urbanisation in Europe (M5).

The topic maps and typologies comprises Maps on demographic and economic change impacts - scenarios for 2015, 2025 and 2050 at NUTS0-NUTS2 (M1), Transforming of driving forces and technological change into land use change: Maps on land use distribution (urban/ non urban) and on population density in four scenarios based on (probabilistic) modelling outputs derived from the RUG model (M1), the national spatial planning policies and governance typology (M2), the Scenario Regionalisation maps and descriptions at European scale (M2), the RUR typologies (M2), the sub-regional delineation map (M2), the driver dependent RUR elasticities (M2), the qualitative typology of regional planning strategies and policy measures (M2) as well as the Data and map portal (M5).

The response functions comprise: the basic (generic) Response Functions (M2), the application of regional variability of urbanisation-impact-relationships to land use maps, RUR-type specific Response Functions (M2), Spatially explicit Response Functions for land use change modelling (M2) and the implementation of Response Functions at NUTSX (M2).

Under the topic of handbooks and training material, the following items are summarised: the qualitative typology of regional planning strategies and policy measures (M2), Generic System Dynamics Model (M4), Generic ABMland (M4), ABMland application (M4), Preference simulator for Quality of Life (M4), the Handbook for practitioners (M5) and Training Material (M5).

Depending on the final output format of the final results, these above mentioned knowledge types can be enhanced/ changed during the project lifetime. If applicable due to Intellectual Property Rights, also scientific papers may be included.

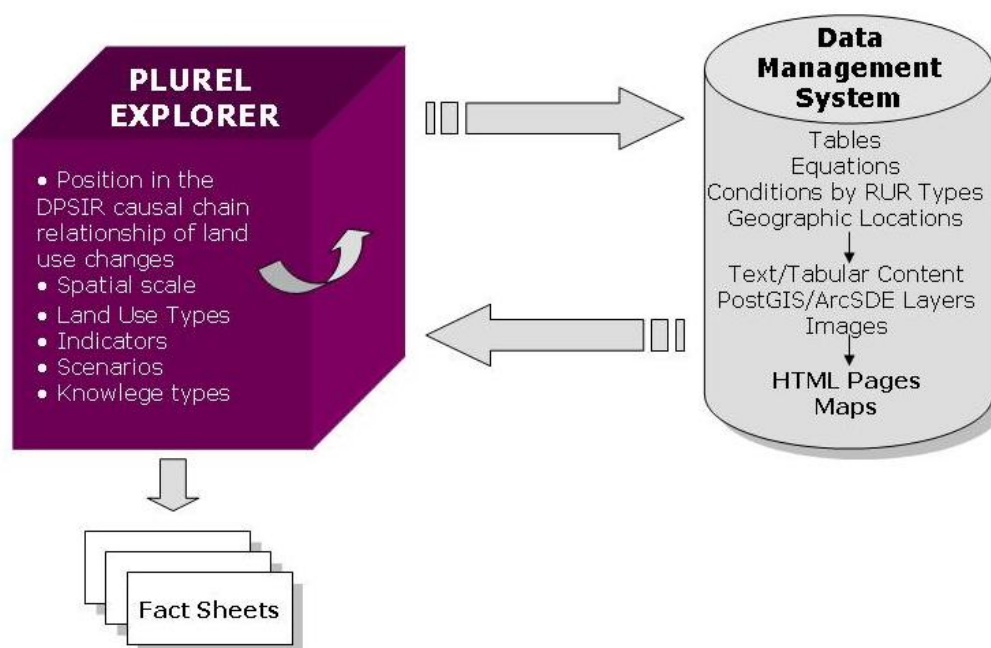
## Technical Implementation

### *Graphical -User-Interface solution*

As mentioned above, the PLUREL XPLOERER is defined as a user interface of the data management system. Here, the basic idea is to guide the end-user of the PLUREL XPLOERER through the contents of the data management system in a structured way by using the PLUREL XPLOERER's Graphical User Interface (GUI), which was designed for the enhanced PLUREL XPLOERER concept.

The core of this interface is an interactive/animated cube, serving as PLUREL XPLOERER result browser. Within the browser a combination of the PLUREL XPLOERER's analysis dimensions can be selected by rotating the cube and clicking on certain raster cells building the 6 cube-surfaces.

Each click will link the user to further pages containing the PLUREL products such as factsheets, images, graphs, tables and interactive maps via the PLUREL GeoPortal.



**Figure 12:** WP5.3 & WP5.1 - Interface between data management system and PLUREL XPLOERER

The PLUREL XPLOERER's user interface will be called through a dedicated button from the data management system's web page or could also be called from the PLUREL homepage for easier access.

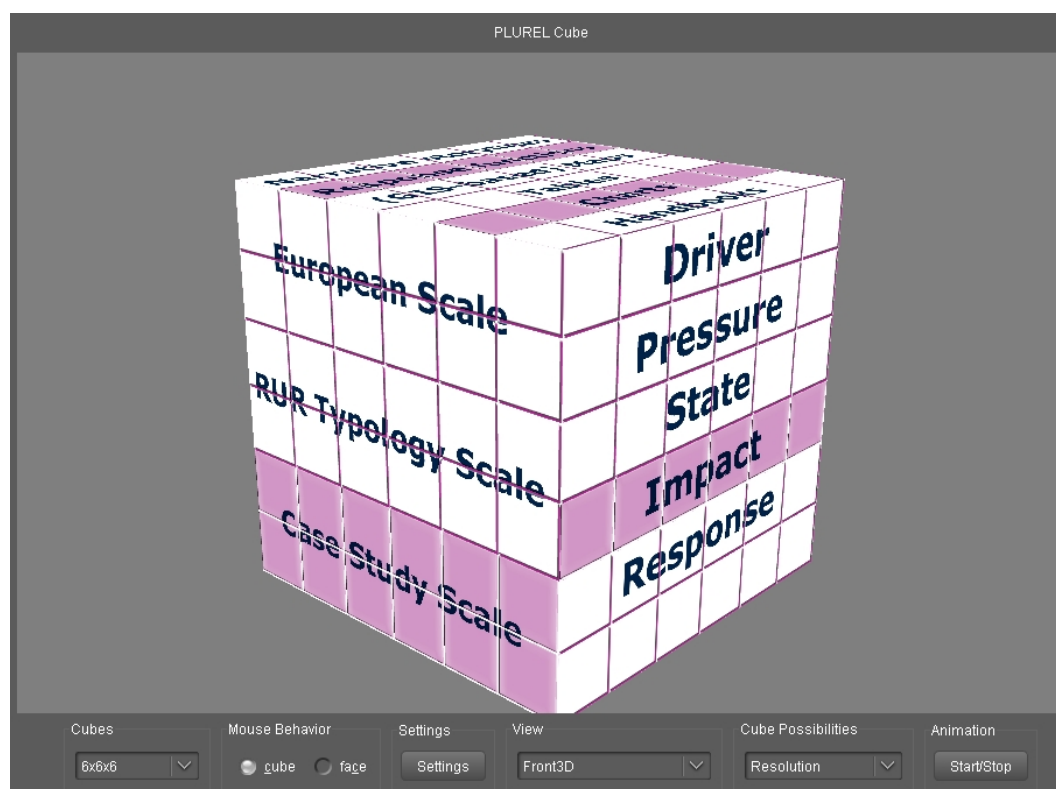
The PLUREL XPLOERER-button will guide the users to the result browser. This browser allows for rotating the PLUREL XPLOERER cube to focus on one or more of the six dimensions. The cube's 6 surfaces, divided into raster cells, will allow for discriminating the various dimensions addressed inside the application. While rotating the cube and facing the surfaces, certain raster cells can (but do not have to) be clicked to conduct a combined search to look for all details of the desired issue combination (*e.g. show information regarding GDP \* peri-urban population density \* NUTS3 scale*)

Each of the clickable raster cells allows for selecting an issue combination. The sequence of the clicks defines which of the further issues can be selected for proper issue



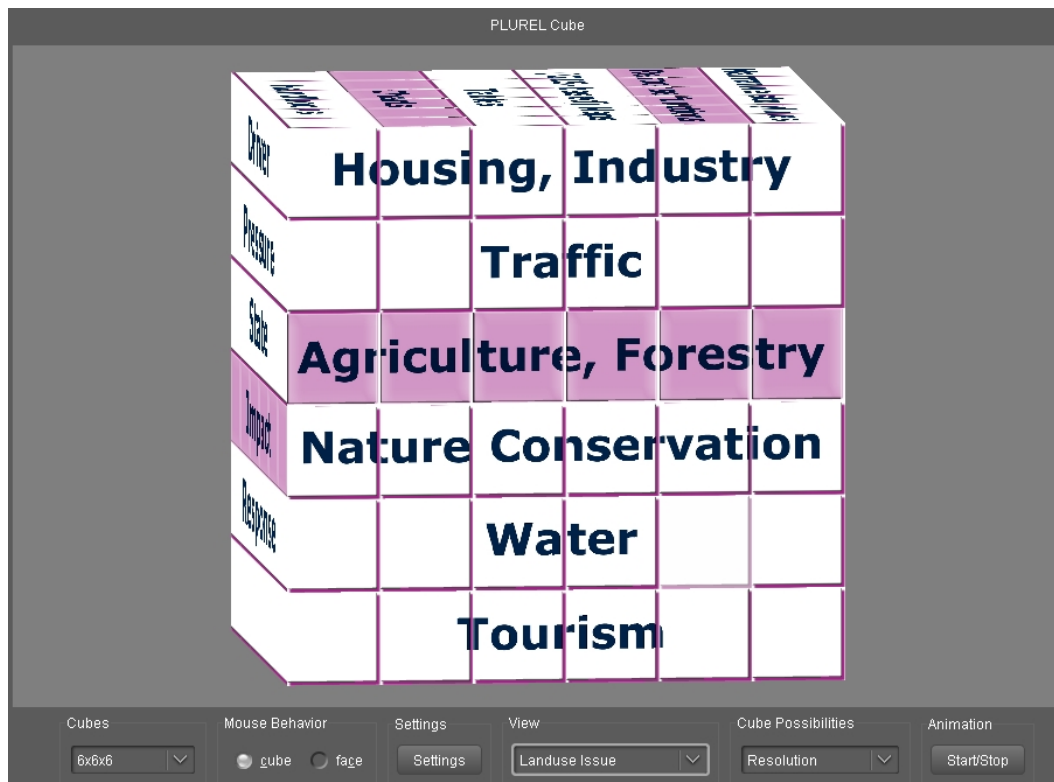
combination (i.e. mutually excluding combinations are disabled). A “finish”- click will link the user to further pages containing factsheets, images, graphs, tables and interactive maps via the PLUREL GeoPortal which are selected through the issue combination. The cube interface will directly link to a certain map and will make use of the GeoPortals map-server functionality for further geospatial data exploration (zooming, panning, geo-location, logical search (e.g. show all spatial units with values larger than x) and identification). The map selection - in this context - will not be accessed through a metadata search but directly through the search combination algorithm.

In accordance to the needs of the 3D cube visualisation and a background database connection, ARCSys is building on Java 3D technology to develop the PLUREL XPLOER cube (whose exact surface design is currently under development by ZALF). At the moment the test interface consists of a Java 3D cube with clickable surfaces and is ready to be adapted to the needs of the end-users.



**Figure 13:** PLUREL XPLOER 3D data visualisation cube: Second prototype

The current ARCSys design of the cube mirrors the ZALF draft design of the cube presented at the PLUREL meetings in The Hague in September 2008 and in Koper in March 2009 and is capable of selecting raster cells by clicking on the cube’s surface. Currently the cube can be rotated freely via mouse and keyboard actions and has a zooming function for better readability of the thematic descriptions on the cube’s surface’s raster cells. It is also capable of switching geometric projections for better orientation (Figure 13a).



**Figure 13a:** PLUREL XPLORER 3D data visualisation cube: Parallel projection

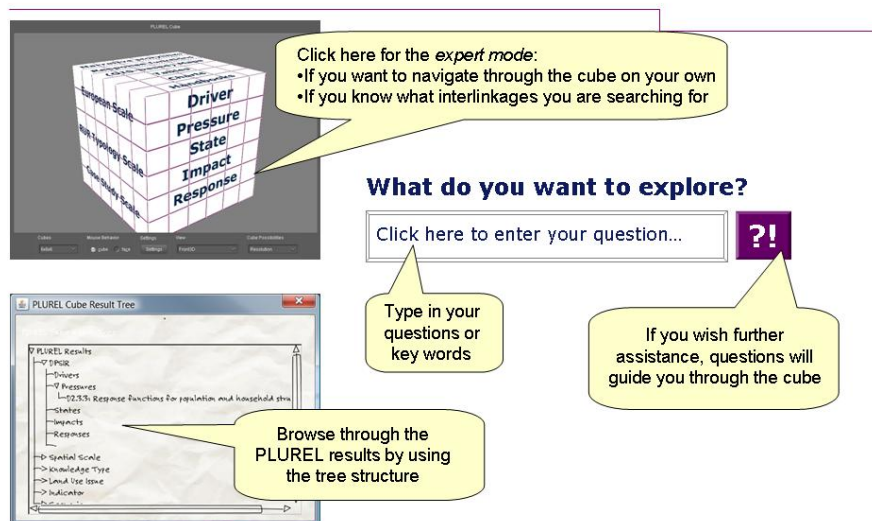
The final PLUREL XPLORER system will consist of a JNLP application which will manage the linkages to the factsheets, images, graphs etc. A map server (PLUREL's GeoPortal / UMN Mapserver (optional)) will serve data that is available in the form of maps or which is stored in a background database (i.e. PLUREL's Data Management System (DMS)) holding, e.g., the equations (in case of dynamic map output base maps might be stored as PostGIS layers). The PLUREL XPLORER will be situated on one of ArcSys' servers and will be accessible via the Internet.

### *Latest developments concerning stakeholder consultation*

During the meeting with the board of stakeholders concern regarding the usability of the tool for practitioners was uttered. Therefore the following alternative start screen (compare to figure 14) for this application that presents the scientific results of PLUREL was suggested to the stakeholders and is iteratively discussed in the mentioned online forum.

Here, the cube itself will remain as a navigation tool for the more experienced user who knows exactly what he or she is searching for within the PLUREL results. Further on it serves as visual support by showing the different entry points into the cube and the different perspectives on peri-urban relationships. Additionally, a tree-structure (on the left-hand side) allows browsing the PLUREL results in windows-explorer style as a second way to explore the scientific results. For specific questions or information on certain topics, a search engine functionality could be provided as a third way of exploring the content.

To provide further assistance, a small questionnaire guides the user through the six dimensions of the cube. The questions are mentioned in Table 2 above.



**Figure 14:** Alternative opening screen for the PLUREL XPLOER

## Knowledge Integration

In order to best integrate PLUREL results into the PLUREL XPLOER, the following concrete events and activities are foreseen until the end of the project. Besides the further development of the PLUREL XPLOER concept (compare to D 5.3.2), the main focus of WP5.3 lies in the integration of the PLUREL products into the PLUREL XPLOER.

To fit into the overall design of the PLUREL XPLOER, all research results need to be classified among the mentioned six dimensions of the cube. A close cooperation with all modules respectively work packages responsible for product chains or parts of it, is necessary to fill the PLUREL XPLOER matrix with the product chain results.

To arrange all the products (i.e. PLUREL results) in the cube so that they can easily be found by the user, a so-called Input Matrix was built that requested the mentioned six dimensions by module leaders for each product respectively sub-product. To gather this information, an input matrix was circulated among the partners. These matrices were successfully discussed in Koper with Module 2 and 4. Currently a time schedule for individual meetings with the responsible working groups of each module in order to further specify the information input into the SIAT-RUR is elaborated.

			1	2	3	4	5	6					
Product chains			subproducts	DPSIR	Spatial Scale	Land Use Issue	Indicator	Scenario	Knowledge Type	Sustainability Dimension	Research Group Involved	Contact person	Module/Work Package
1	European Scenario Chain	Probabilistic forecasts for demography and economy at NUTS2 level							maps, graphs (?)		UPI, IASA, UOM		WP 1.2
		Cellular automata model for spatial allocation of urban growth in EU							model		UEDIN, SYKE, UOM		WP 1.4
		12 situations/scenarios of Landuse states (2015, 2025 and 2050)							maps		UEDIN, ZALF, ARC, SYKE		WP 1.1, WP 1.2, WP 1.3
		narrative descriptions of											WP 1.3

**Figure 15:** Screenshot of the **PLUREL XPLOER Input Matrix** (Excel-Table)

Further on, the new PLUREL template for all deliverables queries the six dimensions and the related fact sheets for each of the results produced within the PLUREL context. This way it is ensured that the required meta-information is provided together with the product deliverable. It is the role of WP5.3 to assist all PLUREL partners in correctly compiling all meta-information and dimensions for all PLUREL products. Nevertheless partners have to contribute targeted towards the PLUREL XPLOER.

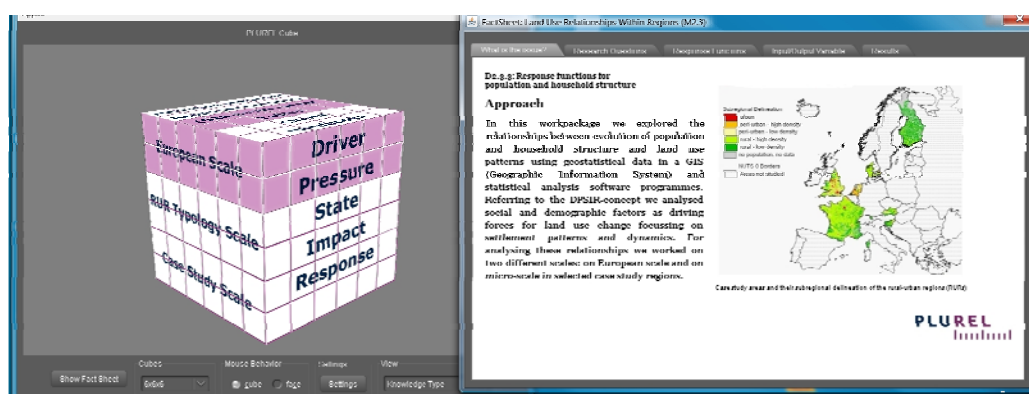
One fundamental criterion is to identify and synthesise the complementarities between the different research elements of PLUREL. This activity requires continuous updating with other developments within the project beyond the time span of this implementation plan.

The PLUREL XPLOER tool will provide a highly usable human interface, integrating links to a text file repository, where all results provided to the public will be stored as short, easy readable pdf-files, to data via the data warehouse, to maps via the map portal, to the IAT application, to the LUC-model results as well to the land LUC policy and a collaboration impact demonstration tool. PLUREL results/products will be accompanied by structured fact sheets describing the six characteristics mentioned above and containing e.g. maps, graphs, tables, and reports. PLUREL XPLOER will feature both, quantitative and qualitative information. Based on this concept and a careful analysis of the expected outcomes of other modules activities the design features, operational elements and resultant structure of PLUREL XPLOER will be further specified in the following months.

So far, interactive action will be provided through the IAT application for case study regions and for the European level depicting maps and dynamic spider graphs, triggered by alternative sustainability dimension weighting, through applying the LUC policy and collaboration impact demonstration tool allowing interactive LUC simulation for one exemplary reference case and through the map exploration functionality provided by the map portal for all addressed maps.

### *Fact Sheets in the PLUREL EXPLORER*

Each product and information in the PLUREL XPLOER is accompanied by a fact sheet that provides very short but concise information about the type of knowledge entailed in this product, the methodology employed to derive it, the scale and extend of the information, the application context and the author. The purpose of the fact sheets is to maximise transparency and user friendliness of the EXPLORER.




**Figure 16:** The PLUREL XPLOER and an adjacent fact sheet

In order to gather the information that describes the final PLUREL results, a preliminary web-form was set-up. Here, PLUREL partners can write and edit the specific fact sheets related to their products that will be the main input for the PLUREL XPLOER. This web-form was already presented to PLUREL partners and serves as a discussion basis for the further development of the PLUREL XPLOER.







The results of the project partners are queried in an easy to edit form that minimises the work load of PLUREL partners while ensuring comparability in structure and a pre-defined format that supports the end user in finding the information he or she is looking for.

**PLUREL Fact Sheet Upload v0.02b**

Info Responsible People Dimensions **Fact Sheet**

**PLUREL**  


Dimensions chosen:

	Click to choose...
	Click to choose...
	Click to choose...
	Click to choose...
	Click to choose...
	Click to choose...

**What is the issue?**

Click here to enter content...

**Why is the issue important?**

Click here to enter content...

**Material/Methodology**

Click here to enter content...

**Input/Output Variable**

Click here to enter content...

**Results**

Click here to enter content...

**Conclusion**

Click here to enter content...

Person Responsible For This Fact Sheet: Max Mustermann

[Preview Fact Sheet](#)
[Upload Fact Sheet](#)

**Figure 17:** The web-form template

As a rough estimation there will be one fact sheet for each (sub-)product, e.g. for each response function, for each scenario, for each case study and for each indicator. Based on the Input Matrix (see figure 15 above), WP 5.3 elaborates a list with responsible persons. From approximately mid June onwards, partners have the opportunity to enter their preliminary results and the accompanying descriptions as mentioned above. Responsibilities will be clearly indicated in the list that will be circulated then and the web form for uploading the fact sheets.

By mid of September all fact sheets drafts need to be submitted. After a final editing and technical adjustments, the draft fact sheets will be presented within the PLUREL XPLOER prototype I during the Montpellier meeting in the mid of October 2009.

#### *Time schedule for knowledge integration and subsequent technical implementation*

A detailed time schedule for the knowledge integration and the subsequent technical information is summarised in the table below.

**Table 3:** Time schedule for the knowledge integration, also stating concerned products and involved modules and work packages.

Until / Finished by	Activities of WP5.3	Concerned issues; Products	Modules involved
Month 29 (June 2009)	1. Survey of existing deliverables regarding their compatibility towards the PLUREL XPLOER 2. adaptation of the PLUREL XPLOER concept to the adaptation of DoW	All products	WP5.3
	Online web-template for fact sheet upload available	All products	WP5.1 (technical implementation)

			with WP 5.3
From month 29 on	Fine tuning of activities, meeting with respective modules / working groups	All products	WP5.3 with all modules
Iteratively, month 32 (M5.3.5)	Specify the plan for the technical implementation of PLUREL XPLOER. Since PLUREL XPLOER is planned to be linked to the data management system, this activity will be conducted in close interaction with WP5.4	PLUREL XPLOER	WP5.3 with WP5.4
Month 33	First prototype of PLUREL XPLOER functionalities with draft fact sheets, presentation to PLUREL consortium in Montpellier	PLUREL XPLOER	WP5.3 (ZALF, ARCSys for technical implementation)
From month 33 on	Focus on cooperation with M3, presentation of further developed PLUREL XPLOER, gather feedback for 2 <sup>nd</sup> iteration the dissemination tool	Stakeholder involvement	WP5.3, M3
Month 36	Final agreement with WP 5.2 about the linkage of the Good practice guidance handbook to the PLUREL XPLOER	Good practice guidance: Actors roles and governance strategies	WP5.3 with WP 5.2
Month 36, update month 42	1. Specify the results 2. Associate results within the context of the PLUREL XPLOER 3. Gather results according to developed criteria for quality assurance (meeting with responsible module/ work groups)	description of sustainability issues arising from rural-urban land use interactions – concentrating on pressures in peri-urban areas	WP5.3 with all modules
	1. Specify the results 2. Associate results within the context of the PLUREL XPLOER 3. Gather results according to developed criteria for quality assurance (meeting with responsible module/ work groups)	driving forces, scenarios: storylines and graphs for land use changes in rural-urban regions	WP5.3 with M1
	1. Specify the results 2. Associate results within the context of the PLUREL XPLOER 3. Gather results according to developed criteria for quality assurance (meeting with responsible module/ work groups)	Land use change (LUC) model results: European and regional applications, approach and results	WP5.3 with M2
	1. Specify the results 2. Associate results within the context of the PLUREL XPLOER	Pressures on the environmental and socio-economic development	WP5.3 with WP 1.3; WP 2.3



	3. Gather results according to developed criteria for quality assurance (meeting with responsible module/ work groups)	conditions arising from land use changes in urban, peri-urban, rural sub-regions	
	1. Specify the results 2. Associate results within the context of the PLUREL XPLOER 3. Gather results according to developed criteria for quality assurance (meeting with responsible module/ work groups)	Case study examples: regional structure (land use, drivers), planning and governance processes, resulting pressures on urban-rural dynamics and land uses	WP5.3 with M3
	1. Specify the results 2. Associate results within the context of the PLUREL XPLOER 3. Gather results according to developed criteria for quality assurance (meeting with responsible module/ work groups)	LUC - policy and impact demonstration tool based on the ABMland applied for one case study example	WP5.3 with WP 3.4, 3.5
	1. Specify the results 2. Associate results within the context of the PLUREL XPLOER 3. Gather results according to developed criteria for quality assurance (meeting with responsible module/ work groups)	Sustainability impact assessment for land use related pressures	WP5.3 with WP 5.5
	1. Specify the results 2. Associate results within the context of the PLUREL XPLOER 3. Gather results according to developed criteria for quality assurance (meeting with responsible module/ work groups)	Cost-impact analysis at European and cost- benefit case study scale for RUR – sub-regions	WP5.3 with WP5.5
	1. Specify the results 2. Associate results within the context of the PLUREL XPLOER 3. Gather results according to developed criteria for quality assurance (meeting with responsible module/ work groups)	Planning guidelines overview	WP5.3 with WP5.2
Month 45, 2010	Knowledge Integration and Technical Implementation	PLUREL XPLOER	WP 5.3; WP 5.1 (technical implementation)
Month 47	2 <sup>nd</sup> iteration of PLUREL XPLOER development – incl. integration of stakeholder requirements	PLUREL XPLOER	WP5.3; WP 5.1 (technical implementation)

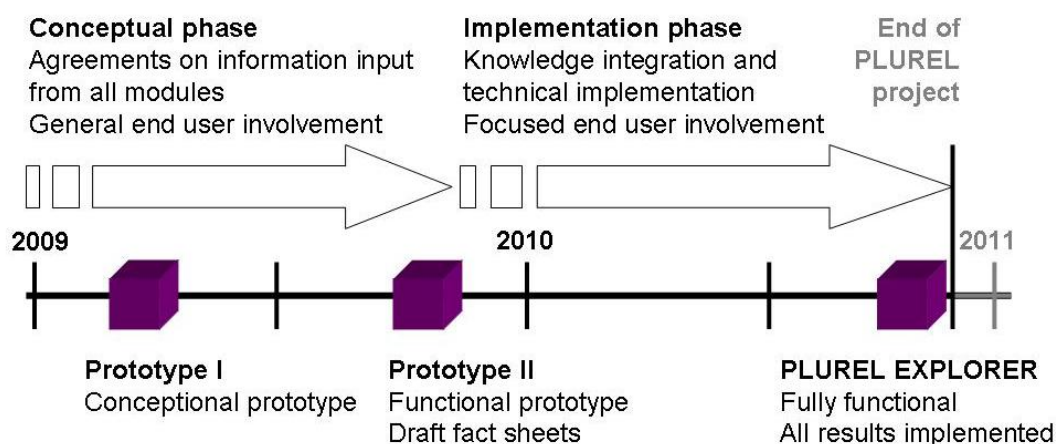
The overall general time schedule foresees an intensive review of reports and products that have been elaborated so far in the first half of 2009 in terms of their compatibility towards the PLUREL XPLOER. Based on this survey, first input versions for each of the products will be specified. The next step is then the fine-tuning of activities in mid 2009 to set up a detailed meeting and workshop plan to assure a consistent information flow between modules respectively work packages concerning the input for PLUREL XPLOER. Parallel to these processes of knowledge integration, the technical implementation of the PLUREL XPLOER will be specified. Since PLUREL XPLOER is planned to be linked to the data management system, this activity will be conducted in close interaction with WP5.1.

Until the end of 2009, the input information of the single products will be gathered in cooperation with the respective responsible modules. In this second phase, a closer cooperation with M3 is planned in order to fine-tune also stakeholders' expectations towards the PLUREL XPLOER. Nevertheless, information and discussion workshops are planned iteratively during the project meetings.

The main aim of the last PLUREL year 2010 then lies on the full integration of the gained knowledge, the technical implementation of the contents into the PLUREL XPLOER and the subsequent fine-tuning of these activities. To secure consistent knowledge dissemination with the tool, a continuous updating with other developments within the project and so the final outputs is necessary. Therefore a draft version of PLUREL results is foreseen in month 36 that will be updated in month 42.

Until month 45, the Knowledge Integration and Technical Implementation will take place. Then the last 3 months of the will be dedicated to the 2<sup>nd</sup> iteration of the PLUREL XPLOER, integrating stakeholder requirements that have been taken into account in general during all project meetings.

Therefore the task of WP 5.3 in the last 1.5 years of the project lifetime is twofold: the ongoing conceptual phase will be finalised by the end of 2009. Agreements with all modules regarding the information input into the PLUREL XPLOER will be reached and draft versions of the information input will be integrated in the second prototype of the PLUREL XPLOER that will be presented to the stakeholders and the project consortium during the meeting in Montpellier. The second phase then is dedicated to the implementation. A full system integration of the technical requirements and the implementation of knowledge, i.e., PLUREL results, are reached in the final version of the PLUREL EXPLORER. Especially this phase comprises iterative stakeholder involvement, discussing and developing further prototype II of the PLUREL EXPLORER.



**Figure 18:** The twofold tasks of WP 5.3 within the project lifetime of PLUREL

Concluding, it is to be noted that success of PLUREL XPLOER is subject to targeted contributions from all PLUREL partners.

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## Partners

Participant no.	Participant organisation	Role in the consortium	Contact persons	Country
3	ZALF Leibniz-Centre for Agricultural Landscape Research	M5: WP 5.3 PLUREL XPLOER development	Katharina Fricke Katharina Helming	Germany
Contributions (Technical Implemen- tation)	ARCSYS	M5: WP 5.1	Wolfgang Loibl Jan Peters-Anders	Austria

# Annex

*Discussion Paper “Concept for the SIAT-RUR”*

## Discussion Paper: Concept for the SIAT-RUR

This paper is meant to serve as a discussion basis for the next project meeting in October 2007 and therefore specifies the concept for the SIAT-RUR. It is based on the discussion at the preparation meeting for the first end-user meeting in Brussels on the 28<sup>th</sup> of June 2007. Present were the Project Coordinator, the PLUREL module leaders and the responsible WP 5.3 team.

### SIAT-RUR concept

PLUREL aims to develop (among other products) a tool box for sustainable rural-urban land use relationships, among them the SIAT-RUR to conduct a generic impact assessment of policies affecting peri-urban land use relationships in Europe. This tool forecasts the consequences of European and regional policies on the land use in urban, peri-urban and rural areas and supports end users in assessing these policy impacts on the RUR regions’ social, economic and environmental sustainability. In doing so, socio-demographic, economical and technological drivers of land use change are equally taken into account.

The following proposed concept for the SIAT-RUR comprises the above mentioned features and serves as a discussion basis for the further development of the tool and the related information input from other modules.

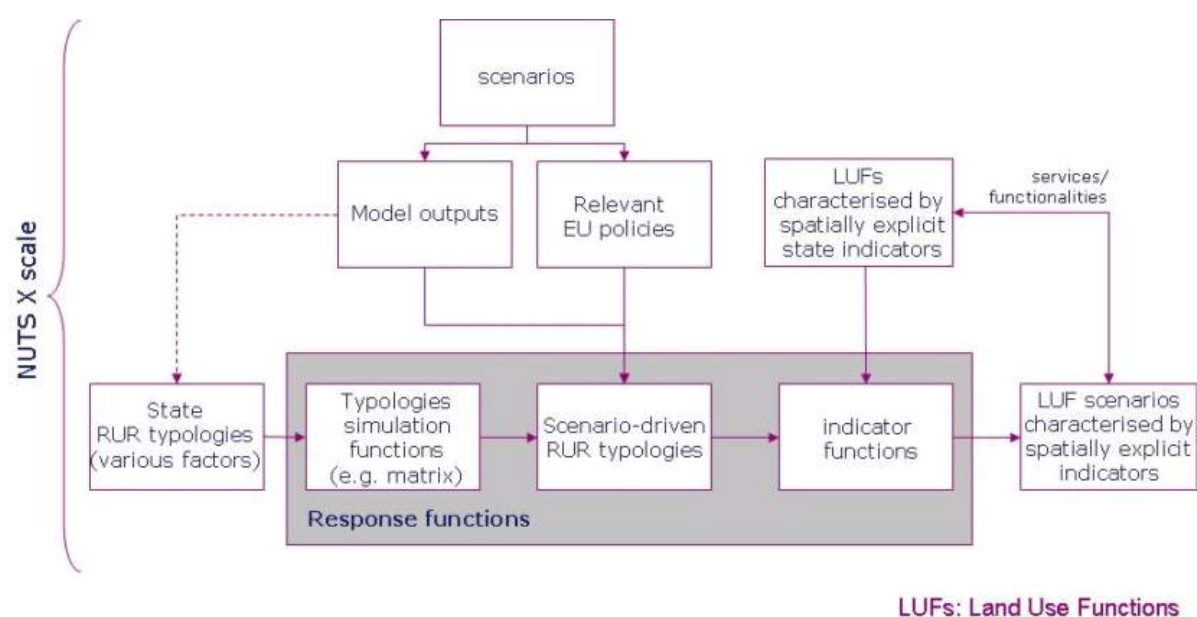


Figure 1: Concept for SIAT-RUR

As the SIAT-RUR covers the European scale of impact assessment of policies affecting peri-urban land use relationships in Europe, it operates on a **NutsX scale**. This scale was

defined within the SENSOR project ([www.ip-sensor.eu](http://www.ip-sensor.eu)) and represents a combination of NUTS 2 and NUTS 3 regions clustered by the criteria of data accessibility and a comparable area size.

The **scenarios** of M1 are the basic input for the SIAT-RUR. They reflect the behaviour of global drivers such as economy, demography, social dynamics, technology and environment on a pan-European level in narrative storylines as well as in modelled quantitative scenarios. As background for the impact assessment procedure, the scenarios carry out a foresight analysis particularly of environmental change. In shock scenario variants, shocks will reflect an immediate change of one of the main drivers. Since especially urbanisation processes as compact, peri-urbanisation and rural urbanisation depend predominantly on land use planning policies; they are regarded among other **relevant EU policies** that are likely to have a direct or indirect impact on rural-urban linkages.

The **modelled outputs** of these scenarios flow into the state rural-urban region typologies (state RUR typologies). They comprise the state land use as well as the modelled change of land use. Regarding the state RUR typologies, the modelled outputs depict the present situation of land use within the rural-urban regions.

A special focus is set to the **state RUR typologies** that are made up by several factors, among them settlement morphological patterns as well as demographical factors. Under the assumptions of the modelled outputs, these typologies form the basis for the scenario-driven typology. The dynamics of the RUR typologies depends on the features used to define them; e.g. if the state RUR typologies are basically defined by settlement morphological attributes, only these settlement morphological attributes can be influenced by the scenarios and their respective driver behaviour.

This procedure of deriving the scenario-driven typologies is an iterative process, for the modelled scenario outputs flow as well into the analysis of the state RUR typologies (as a kind of “baseline assumption”) as they drive the dynamics of the RUR typologies. Here, the modelled scenario outputs constitute the development of the RUR typologies via the **typology simulation functions** that depict the changed patterns of activities respectively the behaviour of the RUR typologies under the scenario assumptions for certain global drivers. The outcomes of these simulations are the **scenario-driven RUR typologies** that are, as mentioned above, made up by the changed activity patterns of the state RUR typologies, the scenario assumptions with the modelled outputs of land use change as well as relevant EU policies that may have direct or indirect impacts on the behaviour of the scenario-driven RUR typologies.

The grey box illustrates the **response functions** mentioned in the DoW. They are to be seen as mathematical derivations that describe the causal relationships between the state RUR typologies, the scenario-driven RUR typologies and the impact they have on certain indicators (the indicator functions). It consists of two sub-equations, namely the before-mentioned typology simulation function and the indicator function that both describe mathematically the behaviour of the RUR typologies and the respective indicators that form the land use functions under the modelled scenario assumptions.

The **Land Use Functions** (LUFs) are not to be seen as pure mathematical functions, but as functionalities or services that define the potentiality of human and natural resources,



the use and non-use values of those resources as well as the economic and social construction of space. They are characterised by spatially explicit state indicators which change for each of the RUR typologies respectively the scenarios. This procedure is summarised in the last sub-equation of the response function, the **indicator function**. It describes the mathematical function of the indicator behaviour under the scenario assumptions. As a final finding, scenario-driven land use functions with corresponding, spatial explicit indicators depict the behaviour of the services and functionalities in the rural-urban regions of Europe.

**Next steps:**

- Compile in an iterative process with WP 2.3 the Land Use Functions relevant for rural-urban linkages
- Define a variable list with the respective variables, indicators and data demands
- Cross-check this list with the stakeholder discussion outcomes (meeting in Koper, September 2007)

*New deliverable Template (extract) querying the PLUREL XPLOER categories*

**Classification of results/outputs:**

For the purpose of integrating the results of this deliverable into the PLUREL Xplorer dissemination platform as fact sheets and associated documentation please classify the results in relation to spatial scale; DPSIR framework; land use issues; output indicators and knowledge type.

<b>Spatial scale for results:</b> Regional, national, European	? (please specify)
<b>DPSIR framework:</b> Driver, Pressure, State, Impact, Response	? (please specify)
<b>Land use issues covered:</b> Housing, Traffic, Agriculture, Natural area, Water, Tourism/recreation	? (please specify)
<b>Scenario sensitivity:</b> Are the products/outputs sensitive to Module 1 scenarios?	? (please specify)
<b>Output indicators:</b> Socio-economic & environmental external constraints; Land Use structure; RUR Metabolism; ECO-system integrity; Ecosystem Services; Socio-economic assessment Criteria; Decisions	? (please specify)
<b>Knowledge type:</b> Narrative storylines; Response functions; GIS-based maps; Tables or charts; Handbooks	? (please specify)
<b>How many fact sheets will be derived from this deliverable:</b>	?