Impact Assessment of Land Use Changes

International Conference

Book of Abstracts

April 6th-9th, 2008

Humboldt University
Unter den Linden
Berlin, Germany

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Rationale

Land use represents a key human activity which drives socio-economic development in rural regions and manipulates structures and processes in the environment. At the European level, policies related to land use intends to support efficient use of natural resources and to improve socio-economic developments. Social cohesion should be considered and economic growth should not favour environmental degradation. Thus, tools are required that help during the anticipation of cross-cutting impacts of land use related policies on environmental, social and economic dimensions.

Impact assessment is a growing scientific field that includes a variety of methods and involves a range of disciplines. At the European Commission level, sustainability impact assessment is designed to integrate a range of impact assessment types. The Integrated EU Project SENSOR develops ex-ante Sustainability Impact Assessment Tools (SIAT) to support policy making related to multifunctional land use in European regions. SENSOR is part of a cluster of large projects launched by the European Commission to build science based support tools for sustainability impact assessment related to land use. This cluster includes the projects EFORWOOD (forestry wood chain), PLUREL (rural-urban linkages) and SEAMLESS (agriculture). These projects jointly prepared this conference.

This book containing the short abstracts of the international conference 'Impact assessment of land use changes' intends to stimulate the scientific community by integrating expertise on impact assessment, land use and landscape research, agriculture, forestry, environmental economics, rural sociology and the science policy interface. Within a wider scientific forum, we wish to share ideas, approaches and innovative results on impact assessment of land use and policy support for sustainable development.

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Impact Assessment of Land Use: An Economist's Perspective

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Land has long been seen as a critical resource in determining the economic and social structure of a society and the wellbeing of its people. Indeed it was more important in the work of classical economists such as Malthus, Ricardo and Smith than it was to the later 'neoclassicals' such as Marshall, Pigou and Walras.

As we now turn to the theme of sustainability in our economic and social planning we need to revisit the role of land as a resource and how it plays a distinctive part in determining economic development. This paper looks at how economic tools of analysis can be brought to bear on this distinctive role. Land is different from other resources in being fixed and in having a spatial dimension that prevents it being moved in response to the forces of supply and demand. This has a number of consequences for social and economic planning and policy. A key aspect is that decisions about land use affect other markets in complex and important ways. Moreover these effects imply that allocating land to the highest bidder can fail to achieve economic efficiency. In technical terms we face market failures often resulting from non-convexities in the economic decision-space.

This paper will explore these market failures, how they can be resolved and what they imply for land allocation and land impact assessment. Areas covered include: housing and land use, transport systems and land allocations, irreversibilities of specific land uses and externalities arising from different forms of land use and the role of property rights in efficient land use.

Keywords: Land, economics, market failures, impact assessment

Sustainability impact assessment of policy induced land use changes – the SENSOR approach

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Land use is a key human activity, which, through the exploitation of natural resources, fosters socio-economic development and alters structures and processes in the environment. At the European level, the Sustainable Development Strategy stresses the need for real integration of economic, environmental and social issues across policy areas. In particular, land use policy aims to promote sustainability pathways of natural resources use and rural development through the decoupling of economic growth from environmental degradation. Manifested with the idea of multifunctional land use, the environment is understood to provide a portfolio of functionalities, which, through proper land use management, can be exploited as environmental goods and services for the benefit of society. A sustainable way of managing land use requires tools that can provide anticipations of possible impacts of land use decisions.

Impact assessment is an emerging scientific field involving a range of disciplines and methods. At the European Commission level, sustainability impact assessment is designed to promote better regulation and foster sustainable development. To substantiate impact assessment procedures and develop science based tools, the European Commission launched a series of integrated research projects in it's sixth Framework Programme for Research. The Integrated Project SENSOR is one of these. It involves 39 partners from Europe, China and Latin America and develops ex-ante Sustainability Impact Assessment Tools (SIAT) to support decision making on policies related to multifunctional land use in European regions. Transferabilities of analytical approaches to extra European conditions are tested in China and Latin America.
The analytical approach is based on three key assessment streams: (1) European-wide, indicator-based driving force and impact analysis of land use policy scenarios; (2) region specific risk and threshold assessment making use of spatial reference systems, land use functions and participatory processes; and (3) case study based, exemplary sensitive area studies in mountains, islands, coastal zones, post-industrialised areas using detailed information on specific sustainability issues, and engaging with stakeholders at local level. Data management systems and institu¬tional analysis complement these assessments.
The impact assessment tools consider policy cases that affect land use in relation to six economic sectors: agriculture; forestry; tourism; nature conservation; transport and energy infrastructure. Based on qualitative and quantitative indicator analyses, impacts of simulated land use changes on social, environmental and economic sustainability issues are assessed at regional (NUTS2/3) scale. Valuation of these impacts is based on the concept of multifunctionality of land use. This presentation provides the contextual background analytical approach in SENSOR, it analyses so far achieved results and gives an outlook on ongoing work.

Keywords:
Land use, scenario studies, integrated impact as-

sessment, indicator analysis, modelling, participation, land use functions, multifunctionality, sustainability valuation

Integrated assessment of agricultural systems – on methods, models and interdisciplinarity

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Introduction: Agricultural technologies and agricultural, environmental and rural development policies are increasingly designed to contribute to the sustainability of agricultural systems and to enhance contributions of agricultural systems to sustainable development at large. The effectiveness and efficiency of such policies and technological developments in realizing desired impacts could be greatly enhanced if the quality of their ex-ante assessments were improved. Four key challenges and requirements to make research tools more useful for integrated assessment in the European Union are defined: (a) overcome the gap between micro-macro level analysis, (b) decrease the bias in integrated assessments towards either economic or environmental issues, (c) poor re-use of models and their use for indicator assessment and (d) hindrances in technical linkage of models. Tools for integrated assessment must have multi-scale capabilities and preferably be generic and flexible such that they can deal with a broad variety of policy questions. At the same time, to be useful for scientists, the framework must facilitate state-of-the-art science both on aspects of the agricultural systems and on integration. This paper presents the rationale and design, and gives results from an application of a component-based framework for agricultural systems (SEAMLESS Integrated Framework). It discusses merits and limitations of interdisciplinary research for integrated assessment, using experiences from a large European research project.

SEAMLESS Integrated Framework: SEAMLESS-IF is a framework that allows integrated ex-ante assessments of agricultural and agri-environmental policies and technologies across a range of scales, from field-farm to region and European Union. SEAMLESS-IF has been developed as a component-based system and is aimed to facilitate synthesis of scientific knowledge in the domain of agriculture and its environment.
The components in SEAMLESS-IF consist of a pan-European data base with data on soils, weather, farming systems, agro-management, prices and trade flows, indicator systems and a number of quantitative models. The models simulate various aspects of the system at different levels of organization and scale:

- APES (Agricultural Production and Externalities Simulator) is a modular simulation model calculating agricultural production and externalities at field level.
- FSSIM (Farm System Simulator) is a bio-economic farm model quantifying the integrated agricultural, environmental and socio-economic aspects of farming systems, partly using the output from APES.
- EXPAMOD (Extrapolation Model) is used for up-scaling the outcomes from FSSIM to the European scale, in the form of price-supply relationships.
- CAPRI (Common Agricultural Policy Regional Impact Analysis), an existing model but adapted to SEAMLESS-IF, is a comparative static

equilibrium model providing information on price-supply relationships, solved by iterating supply (from EXPAMOD) and market modules, and applied to the agricultural sector of the European Union.

Application: The described test case is the integrated assessment of a trade liberalisation proposal by the so called G20 group of developing countries at the current Doha Round of the World Trade Organisation (G20, 2005). We take the year 2013 as time horizon of the assessment, for which a baseline and policy scenario is defined. The baseline scenario for 2013 is interpreted as a projection in time covering the most probable future development of the European agricultural policy, based on the Luxemburg Agreements on Common Agricultural Policy Reform, and including all future changes already foreseen in the current domestic, EU and international legislation (e.g. sugar market reform). The aim is to provide a baseline that is used as a reference point for counterfactual analysis. The baseline scenario should capture the complex interrelations between technological, structural and preference changes related to agricultural production and commodities world wide in combination with changes in policies, population and non agricultural markets. The policy scenario differs from the baseline scenario only in terms of implementing the G20 proposal on the reduction of tariffs for agricultural products and the additional abolition of subsidised exports by the EU.

The application of the market model CAPRI within SEAMLESS-IF under the policy scenario results in changes of agricultural market indicators such as prices and corresponding production and consumptions quantities. In general, trade liberalisation of agricultural products impacts differently on different commodities. Prices of products where the original degree of protection is relatively small (cereals, oilseeds or pork meat) do not decrease much, whereas highly protected products like beef and dairy show larger price reductions, which consequently results in significant reduction of production quantities of beef. However, the decrease is differentiated by region due to variations in the development of profitability of products competing for limited resources such as land. Overall, results per commodity are rather small in relative terms. However, aggregation across commodities reveals a considerable impact of the G20 proposal, as agricultural income is reduced significantly due to decreasing producer prices for almost all commodities. In a next step, the farm model FSSIM within SEAMLESS-IF simulates consequences of the price changes due to the liberalisation proposal, in terms of the supply of commodities at farm level, as well as the associated production plans, input use and a range of externalities including nitrogen surplus and emissions, pesticide use and irrigation water use.

Conclusion: SEAMLESS-IF aims to address the introduced four key challenges as to quantitative scientific tools for integrated assessment. The reuse and linkage of models developed to address environmental and socio-economic issues at different hierarchical levels of agriculture systems, and the inclusion of social and institutional aspects aims at overcoming the fragmentation in modeling agriculture across research groups and disciplines. Initial applications demonstrate the merits of this approach. The experiences of the SEAMLESS project also point at the significant investments needed from research institutions and individuals. A high level of interdisciplinarity is essential, which must go together with willingness from researchers in agreeing upon conceptual, methodological and technical integration methods. The use of ontologies to streamline the flow of information

between different components provides a concrete means of how this can be facilitated and achieved. Even though SEAMLESS focuses on agricultural systems, the conceptual approach and experiences obtained may well apply to different research domains related to land use and its integrated assessment.

Keywords: bio-economic farm model, cropping system model, impact assessment, indicators, interdisciplinary research, market model, ontologies, sustainable development

Sustainability Impact Assessment of the Forest-based Sector

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The European Union‘s introduction of Sustainability Impact Assessment to set standards in the WTO negotiations (1999) and its ambition to use SIA to estimate the impacts of policy changes on sustainable development (2001) stimulates the development of new methods for objective assessment of the impact of anthropogenic activities on sustainable development. The EU integrated project EFORWOOD is launched with the aim to develop a quantitative decision support tool for Sustainability Impact Assessment (ToSIA) of the European Forestry-wood Chain covering forestry, industrial manufacturing, consumption, recycling, and end-of-life. The multi-functionality of the forest-based sector is taken into account by using indicators to assess the sustainability of production processes and by including in the analysis the various products and services of the sector. The basis for the decision support tool ToSIA, which is under development, is the flow of material through the processes which constitute one or several production chains. Indicator values identified to represent economic, social and environmental aspects of sustainability are calculated for each process. ToSIA will include functionalities, based on Multi Criteria Analysis (MCA) and Cost Benefit Analysis (CBA), which make it possible to convert indicator values to standard measuring units, keeping in mind that some indicators do only allow for qualitative measuring units. In a holistic assessment the importance of each indicator is determined by the user. ToSIA will, in a transparent way, offer preference tools such as scoring techniques.
A special characteristic of ToSIA is the possibility to assess the impacts of changes in land-use further down the forest-based value chain. As an example the trade-offs on sustainable development between intensive forestry for maximising biomass or round-wood production and conservation forestry for maximising biodiversity could be analysed, including the effects on the forest-based sector as a whole. Another example is the trade-offs of between using an increased share of the forest production for bio-energy production compared to production for industrial raw-material. Some general examples are given for the impacts of such land-use alternatives on selected indicators, reflecting environmental, social and economic indicators for the complete forest-based sector.

Strategies and tools for sustainable rural-urban land use relationships

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Changing land use relationships within emerging rural-urban regions, and their manifestation in phenomena such as urban sprawl and development of large transport corridors have long-lasting consequences for the regions' sustainability. The drivers of land use changes and how they interact with regional, national and European policies need to be better understood to minimise negative consequences of urbanisation and to enhance the adaptive capacity of rural-urban regions. Rural-urban regions can become centres of sustainable development, but this requires strategies that are developed by means of participatory planning and decision making.

These challenges form the basis for the PLUREL project. PLUREL is a large integrated research project funded within the 6th Research Framework Programme of the European Union. 31 partners from 14 European countries and China participate in the project, which is coordinated by the Danish Centre for Forest, Landscape and Planning at the University of Copenhagen.

PLUREL's main study object is the so-called Rural Urban Region (RUR). The idea of a RUR is an extended form of a Functional Urban Region, i.e. the concept used to describe an urban core and its surrounding commuting ring. The RUR extends beyond today's rings of intense interaction with the core city, as it also includes lands for recreational use, food supply, nature reserve and ecological service functions in predominantly rural areas. In seven case study regions; Montpellier (FR), Leipzig (DE), Warsaw (PL), Koper (SI), Haaglanden (NL), Manchester (UK) and Hangzhou (CN), local stakeholders are involved in analysis of the regional context as well as development of scenarios and strategies.

The work in the case study regions is paralleled by a pan-European approach to impact assessment for rural-urban regions. Future scenarios for Europe is translated into conditions for European rural-urban regions in 2015, 2025 and 2050, and the likely impact on indicators of economic, social and environmental sustainability.

A toolkit will be produced to support integrative analysis, assessment and planning of sustainable rural-urban land use relationships in Europe. This toolkit will include ways to forecast the effects of global drivers and trends on peri-urban land use relationships, as well as contributions to the development of site-appropriate strategies, including participatory processes. A central element of the toolkit will be a Sustainability Impact Assessment Tool for Rural Urban Regions (SIAT-RUR), which can be used for sustainability assessment of European, national and regional policy options related to urban-rural relationships.

Keywords:
land use scenarios, environmental impact assessment, urban sprawl, compact cities, rural urban regions, stakeholder integration

Sustainability Impact Assessment Tools (SIAT) for European Analysis

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The EU Integrated Project SENSOR develops ex-ante Sustainability Impact Assessment Tools (SIAT) for land use in European regions, which involves (a) indicator-based driving force and impact analysis of policy scenarios; (b) region-specific risk and threshold assessment based on spatial reference systems, (c) case-study-based sensitive area studies including local participatory processes and (d) indicator aggregation to land use-functions indicating regional provision of good and services. SIAT is the major product of SENSOR that enables end users to simulate policies by means of a novel meta-model concept. The second prototype of SIAT will be released in March 2008. SIAT identifies by 45 implemented indicators region-explicit sustainability impacts across the six sectors agriculture, forestry, energy, transport, tourism and nature protection with a full coverage of EU 27. The tool is defined as a transparent quick-scan and knowledge-based meta-model that offers a large number of applied "real" EU policy options towards the target year of 2025; ranging from non-monetary (e.g. soil directive) to monetary instruments as taxes and subsidies. Response protocols (mathematical functions) are assessed by an interacting macro-economic- and sectoral model framework. These functions are integrated into the meta-model for rapid response time. The correlation between policy variables via land-use (interim results) to indicator variables is computed for a specific standard range for each region. Impact values can be estimated by means of quantitative vector / matrix forms as well as knowledge rules in the mode of qualitative indicators. Both are applied for clustered regions that reflect the same biophysical and socio-economic structural site conditions with a similar multi-criteria profile at regional scale of NUTS 2/3. Transparency of knowledge is guaranteed by directly accessible 'fact sheets' for all implicit knowledge and explicit back tracing of the knowledge is used during calculations.

Keywords: SIAT, Meta-model, cross-sectoral trade-off, sustainability impact assessment, spatial policy analysis

The role of micro-economic models for policy impact assessment - the MEA-Scope experience

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The demand for publicly documented `objective' evaluations of policy programmes arises from the need of transparency and justification of policy programmes against the public. Particularly ex ante impact assessment is above all part of the EU impact assessment strategy to improve the efficiency and effectiveness of political instruments. This situation has induced the development of a variety of decision support tools acting at different spatial and temporal scales that are proposed for assessing the suitability of government programmes. However, no existing single approach can lay claim to primacy, all have their advantages and disadvantages This paper describes the modelling approach of the EU-STREP MEA-Scope (2004-2007) which is based upon three already existing economic and bio-economic farm-level models. The models are loosely coupled in following hierarchical order: AgriPoliS (agent-based; simulates the interactions among the farms and their investment decision), MODAM (linear-programming, simulates the cropping and livestock patterns of the farms which are the basis for a fuzzy-logic-based environmental impact assessment) and FASSET (bio-physical; simulates the N-matter flows on the farms). The MEA-Scope approach is a complement to those tools that act exclusively at regional scales and above or those that neglect the interactions among the farms and their investment decisions. The particular advantage of MEA-Scope lies in its dynamic perspective and its spatial explicitness. All the farms the MEA-scope regions are composed of are spatially located; the farms own or rent particular plots of land with different soil, climate and elevation characteristics. Building upon the experiences and results gained in the project, the paper will also critically reflect the limitations and challenges of ex ante impact assessment approaches in general, and of the MEA-Scope approach in particular.

Keywords: MEA-Scope, farm-level modelling, AgriPolis, MODAM, FASSET

Integrated Impact Assessment and Land Use Optimisation Using the Land Use Management Support System (LUMASS)

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Today's GIS offer a wide range of powerful tools and methods, but they fall short of providing the user with intelligent spatial analysis and planning tools for solving ill structured spatial problems (e.g. multi criteria resource allocation optimisation). Hence more and more users combine the GIS toolbox with further software packages for modelling spatial processes and/or decision support. This leads to the development of spatial decision support systems (SDSS) or environmental decision support systems (EDSS) respectively. The paper gives an overview of the structural and functional specification of SDSS based on a review of the actual scientific literature and introduces the land use management support system (LUMASS) as an example. According to SDSS specification, LUMASS implements methods and tools for all accruing individual operations in sustainable land use management. In general terms, these are - spatial data management and analysis (GIS), - assessment of human impacts on landscape functions (process modelling), and - multi-criteria optimisation of land use patterns (decision support). Concerning the modelling realm the initially integrated methods and tools for assessing landscape impacts focus on soil and watercourse protection as prescribed by the EU Soil Protection Framework Directive and the EU Water Framework Directive (2000/60/EC) (e.g. erosion risk, groundwater recharge, soil compaction, etc.). Inherent model parameters may be customized by the interactive user interface in order to trade off the impact of different land use scenarios. In Addition to these tightly coupled models nearly any kind of model may be integrated following a loose coupling approach. Thus, economic and social criteria may be assessed as well in order to serve as input for the integrated multi objective optimisation module to automatically generate and map an optimal (i.e. sustainable) land use pattern.

Keywords: spatial decision support system, land use management, multi-criteria optimisation, modelling landscape processes

The LUMOCAP PSS, impact assessment of agricultural policies in an integrative context

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As agriculture covers about half of the EU-territory, the Common Agricultural Policy (CAP) is a main driver determining land-use structure and landscape quality. It aims at ensuring adequate market prices, satisfactory income to farmers, food availability and rural development. The latter includes policy instruments such as agri-environmental schemes which are designed for achieving sustainability of agri-ecosystems and the preservation of landscapes. The LUMOCAP Policy Support System (PSS) aims to assess how different policy scenarios will impact efficiency in meeting sustainability objectives. It focuses on the relations between the CAP and landscape changes and emphasizes the spatial and temporal dimension of this process. To capture processes occurring at different spatial levels, the LUMOCAP system includes sub-models at these different levels (EU-27, country, region, 1000x1000 m cells, 100x100 m cells). The system utilizes an existing spatially explicit dynamic land use modelling framework called METRONAMICA. Based on the knowledge of agricultural policies, driving forces of land use change and end-user requirements, the METRONAMICA model is adapted and improved to fulfil the requirements of policy makers at the EU, national and regional level. The end product is an open-ended, transparent, PC-based, analytical system enabling users to interactively enter policy options under a specific set of natural and socio-economic conditions as external driving forces, to formulate potential land use scenarios, and to assess the impact of both on the quality of rural landscapes through the analysis of selected landscape indicators. Besides model development, special attention is given to the interaction with the end-users in order to incorporate their requirements into the final system – this is needed to ensure acceptability of the overall approach and to provide an added value to decision making at administrations. Therefore the LUMOCAP system is developed in an iterative process in which frequent end-user consultations provide information for upgrading and adjusting the final product.

Keywords: Impact assessment, Policy Support System, Model integration, Common Agricultural Policy, Linking science to policy-making

Eururalis - A scenario study on Europe‘s Rural Areas to support policy discussion

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Eururalis What will happen to Europe’s rural areas in the forthcoming time? What kind of threats as well as opportunities for socio-cultural, economic and ecological values can we expect? Can Europe’s rural communities maintain their livelihood? In the past decades European rural areas have changed considerably. Agriculture intensified whilst in other areas it marginalized. Population dynamics and urbanization changed the rural landscape and will continue to do so. Global driving forces such as demography, economic growth, climate change and international policies will have their impact on rural Europe. The Eururalis project assesses the impacts of these combined driving forces. The results show that the future of EU will be shaped by global forces. Especially the development of (global) demography and macro economic growth outline the trends. EU policies can only facilitate the global trends but cannot stop them. Especially for issues such as farm income, farm structure and agricultural abandonment EU policies on CAP and bio-energy make a difference. Despite these policies land abandonment will be the main land-use change the next decades in the EU. Especially in the globalizing scenarios. The discussion support tool Eururalis can help policy makers to obtain insight in the future of rural Europe towards 2030. The four scenarios cover the uncertainties around the degree of globalization versus regionalization and the role of the government, leading to different direct and indirect drivers of land-use change. Eururalis deals with sustainability and provides indicators in the people, planet and profit dimensions. Eururalis is developed with help of Dutch Ministry of Agriculture. The results have been presented on several international meetings with policy makers and scientists and are being used in education programs. It has proven to be a helpful tool in discussing the future of rural Europe amongst policy makers and stakeholders.

Keywords: agriculture, land-use, sustainability, rural areas, scenario

Modelling Multi-Sectoral Land Use in a Macro-Economic Model for EU-27

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This article describes the introduction of a land-use module in the macro-economic model NEMESIS (New Econometric Model of Evaluation by Sectoral Interdependency and Supply) for EU-27, realized for the European Commission integrated research projects SENSOR and MATISSE. The land-use sectors the model represents are Agriculture, Forestry, Urbanization, Transport Infrastructures, Tourism and Nature Conservation. The land claims for these 6 sectors are endogenously calculated in NEMESIS, with the exception of Nature Protection that follows National plans and European legislations. The different land claims are of course competing for the available land which leads to sectoral tradeoffs. The article first details the modelling work realized for representing these claims in the model, how Land claims for all sectors in one particular European country can be summarized in a common land market balance, which confrontation with a land supply function allows calculating the land equilibrium price in this country. Then an application of the model is presented that forecasts multi-sectoral land-use in European countries at the horizon 2025, for 9 land categories, respectively: Arable and Grass Land, Forestry, Housing and Other Buildings, Rail and Road Infrastructures, Tourism and Protected Areas.

Keywords: Cross-sectoral land-use, Macroeconomic modelling, Land-use forcasts

A methodological framework for integrated assessment of land use policies and sustainable development in developing countries

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Poverty, food insecurity, uncontrolled land conversions, loss of biodiversity, pressure on forested areas: they are part of an unsustainability spiral in developing countries. Therefore, enhancement of sustainable development is an important issue in developing countries. Land use patterns and land use changes are considered critical to sustainable development. In the EU-funded LUPIS project (Land Use Policies and Sustainable Development in Developing Countries; www.lupis.eu) we will develop integrated assessment tools to address the impact of land use policies and global trends on sustainable development in the context of a range of developing countries. Attention will be given to both natural and agricultural ecosystems. Building blocks for this project are the methodologies developed in the EU Projects SENSOR (www.sensor-ip.org) and SEAMLESS (www.seamless-ip.org). The SENSOR methodology develops ex-ante impact assessment tools for EU policies related to land use at regional scale, with a focus on cross-sectoral trade-offs and sustainability side-effects. The SEAMLESS methodology targets at assessing agricultural and environmental policies and agricultural innovations at multiple scales. In LUPIS, a framework is developed to enable complementary use of the methodologies from SENSOR and SEAMLESS and other tools for assessment of land use policies in developing countries (i.e. China, India, Indonesia, Mali, Kenya, Tunisia and Brazil). The framework comprises guidelines on how to set up a case study, derive scenarios, select indicators and select assessment tools (models or knowledge rules), and how to perform a sustainability impact assessment. A common indicator framework is used for all the case studies, including environmental, economical, social and institutional indicators. The selection of assessment tools can vary per case study and depends on data and model availability. A common procedure is used for the post-modelling phase of sustainability impact assessment, which allows a cross-country comparative analysis of the impact of different scenarios and land use policies on sustainable development.

Keywords: land use change, sustainable development, integrated assesment, agriculture, land use policies

Quantifying and spatial analysis of land use and land cover changes between 1990 and 2000 in the 440 German districts and 30 city regions

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Our paper describes selected results of the quantification and spatial analysis of the land use and land cover structures and changes between 1990 and 2000 in the 440 German districts and 30 largest city regions by using CORINE (Co-ordination of Information on the Environment) Land Cover data. In the first part of the present paper we give a short discussion about land use/cover structures in the light of the concept of Eco-efficiency. Today, there are wide interests and needs to measure and analyze geometric forms as a basis for understanding spatial patterns and processes. The concept of the com-pact city can be used in land use planning to reduce spatial inefficiency. Urban compaction is the opposite to urban sprawl which represents the scattering of new development on isolated tracts, separated from other areas by vacant land. Urban sprawl has been criticized for inefficient use of land resources and energy and large-scale en-croachment on agricultural land. To measure and monitor urban sprawl we need indicators for capturing the characteristics of the land use development. Therefore the authors calculate the jaggedness degree for the measurement of the compactness of urban patterns and the degree of interlinkage between urban fabric (CORINE code 11) and industrial, commercial and transport units (CORINE code 12). This interconnect-edness degree can be used for the operationalisation of horizontal physical intercon-nectedness between residential housing and industry/commerce. Our results indicate a number of significant land cover and land use changes between 1990 and 2000 in the 440 German districts and 30 city regions. Especially significant changes of built-up and traffic area in a number of districts have been mapped. European wide CORINE Land Cover data can be used to get a more sophisticated picture of the patterns of land cover and land use changes in districts and city regions.

Keywords: land use and land cover change, German districts, German city regions, Eco-efficiency, jaggedness degree, interconnectedness degree

Multi-scale, multi-model approaches for land use change impact assessment

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In recent years a number of global, European and national projects have used modeling approaches to make impact assessments of land use change. It is well-acknowledged that multi-sectoral approaches covering a wide range of scales are needed to include the driving factors of land use change that operate from global to local levels. Global trade negotiations and climate change may lead to changes in demands for agricultural land use while local land use history and the environmental and socio-economic context shape the local response to these large scale pressures. Most projects addressed this multi-scale challenge by linking different models operating at different scales. This project will review the modeling approaches used in a number of different projects, including EURURALIS, SENSOR, SCENAR2020 and FARO. Based on this review a number of important challenges for enhancing the impact assessment tools will be addressed. One major issue is the consistency of data and concepts between the different models. Large discrepancies are apparent in comparing the simulated agricultural area in economic models based on census data and the agricultural area as observed in remote sensing data and land use inventories. Furthermore, land cover changes are often difficult to translate into changes in the (multi-)functionality of land use which is the major interest of policy makers and other stakeholders. Inconsistencies in the definition of different land cover types also have large implications for model linkages, calibration and validation. Many model linkages in impact assessment systems are based on weak links between the different models and levels of analysis. It is a major challenge to better address feedbacks between the different levels since land use change is the consequence of the interplay of top-down and bottom-up processes. In order to achieve improved systems for impact assessment the focus should shift from improving the individual models to strengthening the linkages between models, achieving consistency and better linking the simulation results to impact assessments. Finally the ability to visualize modeling efforts is discussed.

Keywords: impact assessment, land use models, scale, consistency, visualization

Are rates in land use change in Río de la Plata grasslands slowing down?

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Grasslands of Río de la Plata Basin are amongst the most dynamics zones in terms of land use change. These changes include the transformation of natural cover into agricultural use and forestry. Land use categories were developed from Landsat TM images from 1990 and 2000 in order to construct markovian matrix models that account for transition rates between three land uses: grassland, annual crop and forestry. 2899 models were calculated, each representing 64 km2 cells located in Brazil, Uruguay and Argentina. Asymptotic properties analysis of markovian models showed that present day land use covers are similar to steady proportions of use cover predicted by the models. This suggests that transformation rates will slow down in the future. Change trends were different between countries. Forest cover loss in Brazil was related to grassland increase. But in Uruguay forest cover increased. In Argentina this trend was higher, but varied between zones.

Keywords: Río de la Plata Basin, land use change, markov matrix models

Sustainable land use against the background of a growing wind power industry

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Among the instruments, measures, policies, practices and technologies discussed as remedies for CO2 emissions reduction and climate change mitigation, renewable energies are prominent. Particularly in the short and medium run until 2030 they offer a great potential for the avoidance of CO2 emissions as they already provide marketable alternatives to fossil fuels. This holds true especially for wind power, which has multiplied more than twelve-fold on the global scale from 4,800 MW to over 59,000 MW between 1995 and 2005. This is the highest growth rate compared to all other sources of renewable energy. However, as this impressive expansion is expected to continue at least in the near future, it challenges the prevailing practices of land use and causes adverse environmental and spatial effects. Although wind power as a clean technology helps to combat global warming and, furthermore, as a renewable energy reduces the dependency on the supply (and suppliers) of exhaustible fossil fuels, it is not without flaws. Some of these problems are environmental concerns over adverse effects on human beings, on wildlife (in particular birds and bats), and on the landscape. Other problems refer to the integration of wind power into the power grids and the land used up for the installation of great numbers of wind turbines. The paper uses ecological-economic modelling as an integrative approach to assess and balance the antagonistic effects of wind power. The model will be applied to the region of West Saxony in Germany. It integrates economic non-market valuation (choice experiments) and a specific land use planning tool based on geographical information systems. This allows to reveal important trade offs and to highlight different policy strategies towards sustainable land use in order to minimize conflicts over site selection for wind turbines under the constraint of contradictory environmental objectives. (295 words)

Keywords: land use, wind power, ecological-economic modelling, choice experiments, geographical information systems

Integrating stakeholder participation in agro-economic and hydrology modelling for assessing nature conservation policies

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Integrated and adaptive water resources management (IWRM) is becoming a major policy-relevant issue for public administrations and civil society. Relying on new governance structures with strong stakeholder involvement, IWRM is aimed to resolving competing uses of water and land in a sustainable and socially accepted integrated framework. The objective of this research is to analyze the effects of the implementation of different agricultural policy and water policy options on the agrarian systems of a central region in Spain where groundwater depletion for agricultural uses is causing severe environmental impacts on valuable aquatic ecosystems. The methodology developed is based on an integrated vision of water resources management combining a qualitative and a quantitative component where the stakeholders' participation is considered a key issue to achieve an adaptive water management in the area. The qualitative stage consists on the development of a participatory process in which all stakeholders are involved in a dynamic interactive process. The quantitative stage consists on the integration of an agro-economic (MPM) and a hydrologic model (WEAP). Supported by an ample field work, several policy-driven scenarios (PAC, WFD, water quotas) as well as stakeholder-driven scenarios (water bank) have been simulated for analyzing their effects on the different components of the system, such as the environment (land and water use), the private sector (framers' income) and the public sector (cost-effectiveness). Results show that water conservation policies that impose strict water quotas to irrigators may reduce water use and induce land extensification at low public costs but inflict considerable income losses to the farmers leading to social unrest and difficult enforcement. Conversely, socially accepted income compensation mechanisms (CAP agri-environmental programs) can lead to aquifer replenishing and wetland restoration at high public costs and their cost-effectiveness is questioned. CAP decoupled SFP is contributing to a more extensive use of land and water in the area encouraging ecosystems' protection and CAP-WFD synergies. Current water conservation policies in the area will not be capable of attaining the aquifer's recharge and the restoration of the associated wetlands unless gradual elimination of unlicensed drillings is achieved and a new governance structure with decisive stakeholder participation is reinforced.

Keywords: water policies, agricultural policies, agro-economic models, hydrology models, stakeholder analysis

ToSIA – a Tool for Sustainability Impact Assessment of Forest-Wood-Chains

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Within the forest sector, the concept of sustainability has evolved from a narrow focus on sustainable wood production to a much broader evaluation of environmental, social, and economic sustainability for whole value chains. Within the EU funded EFORWOOD project a new tool – ToSIA – has been developed for assessing sustainability impacts of Forest-Wood Chains (FWCs). In this paper we introduce the approach and demonstrate its application to assess the sustainability of a chain, which is focusing on spruce-based production with different forest management alternatives. In the approach, FWCs are analysed as chains of production processes (e.g. harvesting – transport – industrial processing) which result in products (e.g. a wooden timber-frame house). Sustainability is determined by analysing environmental, economic, and social sustainability indicators for all the production processes along a FWC. The ToSIA software can read information related to pre-defined FWCs from a database or allow for users/stakeholders to customize FWCs, and then calculates the differences in sustainability between selected chains. A ToSIA application is presented in which spruce, the most important tree species in Germany, is managed in different ways using natural regeneration or planting. Both management systems produce timber for use in the construction of a timber-frame house. While the management alternatives differ in resource management, harvesting and transport technology, the same production processes are used in the wood industry and the industry to consumer interaction. We demonstrate the application of ToSIA by comparing the sustainability impacts of the management alternatives using sustainability indicators. Data for the sustainability of the alternative spruce chains has been collected in the Federal State of Baden-Württemberg in Germany. The presentation will discuss strengths and weaknesses of the approach and provide an outlook on further developments in the methodology.

Keywords: forest wood chain, sustainability assessment, spruce, forest management

Sustainability assessment of entire forest value chains: Integrating stakeholder perspectives and indicatorts in decision support tools

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There are numerous indicator sets for sustainable development of forests and sustainable forestry available at different levels, ranging from local, regional and national to global scale assessments. Some efforts have also been made to integrate later production stages of forest value chains (such as wood processing) in the assessment criteria (e.g. for chain-of-custody certification). However, no indicator set has so far been available covering environmental, social and economic aspects for the entire value chain of building with timber. This has been closed through applied sustainability research in the project „Sustainable future market for wood in the building sector“, conducted for the German Ministry of Education and Research. First, the paper illustrates the value chain concept drawing on work of Gereffi (1994) and Kaplinsky (2000). Then the authors argue for a value chain wide indicator set as a crucial basis to govern a systemic change in value chains towards sustainability. The value chain assessment provides the opportunity to systematically address life cycle wide impacts and chain acteurs. The value chain approach may also engage corporate actors in voluntary activities on corporate social responsibility. Next, a methodical approach to develop an indicator set considering relevant stakeholders as well as the resulting sustainability indicator set are presented. The indicator set which enables the assessment of the entire value chain has been integrated into a software tool and an internet based learning platform. Experiences from applying this tool in practical projects in the building sector will be highlighted. Conclusions will be drawn on the benefits of value chain coverage and improved! utilisation of sustainability impact assessments as conditions for sustainable development.

Keywords: value-chain forst-based indicators sustainability assessment

Pan-European Impact Assessment Tools – A comparison between the Integrated Modelling Approaches of SENSOR and PLUREL

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Addressing land use changes in a Pan-European perspective implies the analysis of land use impacts on landscape functions and services in the urban, peri-urban and rural continuum. For decision support, tools are required that facilitate the ex-ante assessment of land use and planning decisions on the multifunctional performance of rural land use as well as of rural-urban linkages. While the FP6-founded project SENSOR is developing Sustainability Impact Assessment Tools (SIAT) to analyse European policy options related to rural land use, the project PLUREL aims inter alia at developing a Sustainability Impact Assessment Tool for Rural-Urban Regions (SIAT-RUR) to support policy decisions at European level. This paper focuses on the differences in the conceptual modelling approaches reflecting the altering prerequisites of the two projects. Taking this into account, SIAT is a scenario-driven meta-model based on response functions describing relations between (1) policy options and land use changes and (2) land use changes and sustainability indicators. These response functions are derived from existing economic, environmental models and expert-driven knowledge rules at national and regional level. Building upon this analytical design of the SIAT, the SIAT-RUR (1) anticipates 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 services and functionalities of the rural-urban regions. Depending on the different focal points of the ex-ante assessment, a broad variety of different input variables is considered to assess results consistent to different spatial scales. The differentiating requirements of end users, stakeholders and scientists accompany the development of these Impact Assessment Tools. The paper analyses the conceptual approaches towards the SIAT and the SIAT-RUR taking into account the different requirements, focuses especially on the developed approach for the SIAT-RUR and serves as a discussion basis for the further development of the tool.

Keywords: Impact Assessment Tool, Conceptual approach, Land Use Functions, Rural-Urban Linkages, Ex-ante impact assessment

Multifunctional land-use change in post-socialist Eastern Europe - mapping and modeling on a regional scale

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Eastern Europe has undergone drastic changes in its political, societal, and economic structures following the fall of the Iron Curtain and the accession to the European Union in the case of several countries. These changes had large impacts on land management and land-use decisions. Land reforms were carried out to privatize and individualize land-use. The result was widespread land-use and land-cover change, including the abandonment of agricultural land, increased urbanization, increased logging (both legal and illegal), and the parcelization of farmland. Yet, little is known about the rates and spatial patterns of land-use change in Eastern Europe since 1989. The underlying causes of land-use change and its consequences for ecosystem services and biodiversity remain largely unknown; so do possible future trajectories. In this presentation we provide insights on how to assess and model land-use change in Eastern Europe from different ongoing projects at the Geomatics Lab of Humboldt-University Berlin. Studying land use change in Eastern Europe is challenging because conventional data such as maps, agricultural censuses, and statistical data often differ in temporal coverage, spatial scale and accuracy. Our approaches strongly rely upon high resolution satellite data to monitor rates and spatial patterns of land-use change and to assess the consequences of these changes for ecosystems and specifically biodiversity. Detailed case studies underpin a better understanding of causal relationships relevant to post-socialist land use change. Spatial statistical models are used to link changes in land use to proximate and underlying drivers. Spatial simulations are employed to reveal areas that are likely to change under different future land use scenarios. Main land use changes include changes in forest harvesting, farmland abandonment, suburbanization, and farmland parcelization. Alternative scenarios are developed to assess the impacts on ecosystem services and biodiversity. These new findings are of particular importance to assess and model the impacts on land-use in postsocialist countries, where empirical evidence on the local driving factors and possible future developments is scarce.

Keywords: Land Use change, Mapping, Modeling, Eastern Europe

A conceptual framework to analyze the applicability domains of different land use modelling approaches

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A large diversity of land use simulation models is used to analyze, predict and explore future land use changes. This paper presents a framework of different land use modelling approaches by analyzing the underlying conceptual model and its translation into modelling algorithms. It is common practise that modellers describe the processes of land use change as observed by a conceptual model. In fact, this conceptual model forms the set of principles according to which 'real world' land use change processes operate. Different kinds of conceptual models exist to translate reality into a model, each with its own pros and cons. Moreover, a conceptual model is codified into algorithms, and different algorithms can be used to perform this codification, which will lead to different land use simulation models. An example of a simple conceptualization of the ongoing land use change processes is the usage of historical land use conversions as a perspective for future changes. Model algorithms based on this conceptual model use extrapolation and trend-analysis techniques. In this paper insight into the applicability of different land use change concepts and algorithms is provided by evaluating current land use modelling concepts and algorithms in practice according to a set of assessment criteria, derived from literature research and workshops with experts. Subsequently, based on this evaluation the domain of application of different conceptual models can be defined which will help to select the appropriate modelling concepts and algorithms to match land use change study objectives and case study characteristics.

Keywords: Land use modelling, Conceptual model

Assessing policy impacts on European land-use change through cross-sectoral modelling

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Land use change is caused by processes at different scales: from trade of commodities at the global level down to soil conditions of a specific farm field. Within SENSOR land use change is analyzed by several research groups that each focus on a particular process, scale and sector. Five sectors related to land use are modelled individually: Forestry, agriculture, urban land use, transport infrastructure, and tourism. The cross-sectoral level is reached by linking the individual sector models to take into account interaction with others economic sectors and global economic perspectives. The global economic processes that drive these sectors are captured by the NEMESIS model, while a more detailed allocation (disaggregation) of land use change at local level is done by the CLUE-s model. The linking of such a diverse set of models in a consistent way poses both conceptual and practical problems. The conceptual problems include identification of so-called "linking items" through which the models communicate with each other; how to obtain a stable joint baseline scenario; and how to obtain a joint equilibrium solution for all models simultaneously in simulation. Practical problems concern the actual implementation of linkages and to provide a feasible technical solution. The linked system allows the user to introduce a shock in either of the models, and the set of results provides a joint solution for all sectors modelled in SENSOR. This is demonstrated by introducing a number of policy incentives to promote bio-energy production. The impact of these incentives is analysed by projecting land use changes up to 2025 and comparing the results to the reference scenario; without such incentives. The linked models provide a comprehensive set of results for the analysed scenarios involving all five sectors on regional level.

Keywords: model linking, iterative recalibration, land use, regional analysis, cross sector analysis

Dynamic impacts of a financial reform of the CAP on regional land use, income and overall growth

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In 2005 there was considerable debate in the European Council of Ministers on the long-term EU budget (known as the financial perspective) for the period 2006-2013. There was pressure from some members to reduce or abolish the Common Agriculture Policy (CAP), and there was a British proposal to spend the funds which would be released towards achievement of the Lisbon Agenda — by spending them on research & development (R&D). These proposals were unsuccessful, but in 2012 a new financial perspective will have to be decided upon, and undoubtedly two major issues will be: 1) How large the budget of the European Union should be; and 2) What it should be spent on. Abolishing the CAP altogether is likely to have a direct effect on land use in agricultural rural areas of the EU. To the direct effect comes the indirect effect of alternative use of the released funds. If invested in R&D, such a large amount of money in such a long time perspective may have a significant effect on productivity and growth in all sectors of the society. It is not immediately clear what the net effect will be for regional land use and growth of different sectors. In this paper, a linked system of models, developed within the www.SENSOR-IP.eu European research project, is used to analyze the effects of a financial reform as laid out above. Specifically, a macro model with endogenous technical progress is linked to sector- and land use models to obtain a comprehensive set of impacts down to the square kilometre level. The main conclusion is that the reallocation of funds from agricultural support to R&D would mean a large productivity boost for the overall economy. On the regional level, agricultural land use and income generally decline, though effects are diverse and depend on regional characteristics.

Keywords: land use,, impact assessment,, structural reforms,, common agricultural policy,, model linking

Modeling of flows and tourism attractiveness in Europe

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Within the SENSOR project the modeling of pressures from tourism were modeled through several sub-sequent steps: the exchange of tourist were modeled based on country level data, to allow inputs from the macro-economical model NEMESIS for future scenarios; attraction factors and the allocation of incoming tourists within the countries where identified and modeled at the NUTSX-level; and finally the attraction factors have been tentatively mapped and summarized into an index of suitability for tourism by 1x1 km grid cells. The paper presents the modeling results of the three steps: between country flows, attraction factors below the country level, map of suitability for tourism, and discusses future improvements to the overall methodology.

Keywords: tourism, flow, cost of travel, attractiveness, disaggregation

EUruralis: model linkages

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What will happen to Europe's rural areas in the forthcoming time? What kind of threats as well as opportunities for socio-cultural, economic and ecological values can we expect? Can Europe's rural communities maintain their livelihood? In the past decades the rural areas of Europe have changed considerably. Agriculture intensified whilst in other areas it marginalized. Population dynamics and urbanization had their effects on the rural landscapes. In the next decades changes will continue. Global driving forces like demography, economic growth, climate change and international policies regarding agriculture and energy will have their impact on rural Europe. The Eururalis project have assessed the impacts of these combined driving forces and the resulting spatial patterns. With pro active policies the EU and its Member States can influence developments in rural Europe. But what is the right direction? How effective are policies and which trade offs are involved? With the discussion support tool Eururalis policy makers can obtain insight in the future of rural Europe in the context of four scenarios (till 2030). The scenarios cover the uncertainties around the degree of globalization versus regionalization and the role of the government, leading to different direct and indirect drivers of land-use change. Eururalis deals with sustainability and provides indicators in the people, planet and profit dimensions. In this paper we discuss the model framework of EUruralis and their linkages. EUruralis uses the LEITAP model, a gobal economic general equilibrium model, the IMAGE model, a global biofysical climate model and the CLUE-S model, a land-use allocation model.

Keywords: land use, global, Europe, future

EXPAMOD - a tool for linking farm level and market level models

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Farm management models help quantifying changes in land use patterns and agronomic practices for a given set of prices and policies, which indirectly have an effect on indicators of multifunctionality like the visual character of agricultural landscapes, biological diversity, and pollution levels. However, prices are unlikely to remain exogenous in any economic analysis, so that farm level optimization results may no longer be valid. Market level models, on the contrary, are able to capture the supply and price impacts derived by policy shocks at the farm and regional level, but are generally not sufficiently detailed for the calculation of environmental impacts, since they lack differentiated agronomic practices. By linking farm level and market level models we seek to mitigate this weakness and endogenise the price-quantity response in farm management models. The main steps in our approach are as follows. A collection of farm models, FSSIM, is run for several representative farm types with different exogenous price sets for a baseline and a policy scenario. Next, the proposed econometric model (EXPAMOD) estimates the differences in supply responses, and statistically propagates these responses to out of sample farm-region combinations. Changes in relative farm level profits are then used to assign new weights to the farm types covered by the analysis. The supply changes at the micro level and the revised weights for the farm types are then used to adjust supply in the market model CAPRI, so that revised prices are obtained. These prices are then fed back in a last step to FSSIM . The main modeling benefit of our approach is that it combines the strong points of farm management and market level models. From a policy analysis perspective the resulting farm type and acreage responses provide a much improved base for various environmental and landscape modeling exercises.

Keywords: economics, farm level, market level, aggregation, disaggregation

The Integrated Tool for Economic and Ecological Modeling (ITE2M): Assessment of Trade-Offs in Landscape Services

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The current European Common Agricultural Policy emphasises direct payments to farmers as the best way of guaranteeing farmer incomes, food safety and quality, and environmentally sustainable production. But what are the effects of the changes in agricultural policy with respect to landscape services? The Integrated Tool for Economic and Ecological Modeling (ITE2M) was developed within the Collaborative Research Centre 'Land Use Options for Peripheral Regions' (SFB 299) at the University of Giessen, Germany, to answer such questions. ITE2M is a network of models addressing agro-economy, agricultural policy and environmental issues with respect a broad range of landscape services. The bio-economic model ProLand (Prognosis of Land Use) is a central part of the network as it is used to predict site-specific land use maps as well as a set of economic measures such as land rent or labour. The ProLand land use maps and further model specific information on land management form the basis for all ITE2M component models to simulate further landscape services. ITE2M further comprises models addressing the risk of soil pollution (ATOMIS), water quantity and quality (SWAT) as well as faunal (GEPARD) and floral (ProF) biodiversity. The agricultural policy tool CHOICE can finally be applied to evaluate landscape services from the perspective of land users or stakeholders. In principle the network is open to the inclusion of new models simulating new targets for the evaluation of further landscape services, such as quantifying carbon sequestration, emission of trace gases, tourism, or genetic diversity. The concept of ITE2M is demonstrated for a case study. In the first step ITE2M is applied to investigate the current conditions (base scenario) in the research area, while two agricultural policy scenarios are investigated in contrast thereafter. The ITE2M models generate a set of spatial distributed agro-environmental indicators as economic performance (e.g. land rent, capacity of work), water quality and quantity (e.g. flood risk, NO3-load), species diversity (e.g. weed species, floristic habitat), and soil quality (e.g. heavy metal enrichment) facilitating the evaluation of landscape services and the sustainability of agricultural production for different scenarios.

Keywords: integrated modelling, impact assessment, land use scenarios, policy analysis

Xplorah, A multi-scale integrated land use model

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Processes of land use change as well as its drivers take place at different spatial and temporal scales. The fact that these processes are very often interacting with each other throughout these scales, provides major challenges to modellers. The Xplorah system is a tailor made Spatial Decision Support System (SDSS) for the three major islands of Puerto Rico. It has the aim to assess the impact of different scenarios on the development of the island. The application encompasses an integrated set of dynamically linked models working at different scales and incorporating knowledge from numerous disciplines. These models simulate activities that take place in four scales: global, national, regional and local. At the global level, climate change has an important impact on the national economy by influencing tourism, agriculture and the demolishment and reconstruction of buildings. A national macro-economic model is tied with an age-cohort model that simulates structural demographic changes and population levels. This model incorporates immigration patters and provides the labour force supply. Economic conditions, in turn, have an impact on migration and mortality rates. At the regional level, socio-economic changes take place based on the relative attractivity of regions and the costs required to travel from one region to another. These costs are provided by the transport model that uses information from the regional and local models to generate trips. This provides the basis for the distribution of national growth as well as migration of jobs and people over regions. Furthermore, on the local level, land use demands from the regional model are allocated in cells based on several elements including local accessibility. The local land use finally feeds back to the attractivity at the regional level. The Xplorah system thus aims to integrate important processes and feedback loops for the assessment of land use changes.

Keywords: Integrated assessment, Model integration, Land use modelling, Spatial Decision Support System

Challenges in bio-economic modelling of land and water use on the global scale

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Spatial land-use patterns are determined by a multitude of environmental, economic and socio-cultural conditions and their interactions. The challenge of projecting future land-use patterns is to account, within one modelling framework, for the socio-economic determinants of agricultural demand as well as for the spatial heterogeneity of the land's suitability for agricultural production. The disciplines involved in studying land-use change processes differ significantly in methodologies and data used. Land-use models that address both demand and supply side conditions and constraints need to overcome differences in thematic, temporal and spatial scales. We have chosen a mathematical programming approach, which is coupled to a process-based dynamic vegetation model, to simulate spatially explicit land-use and water-use patterns. This approach provides most flexibility to integrate various types of biophysical constraints into an economic decision-making process, i.e. it provides a straightforward way to link monetary and physical units and processes. Instead of using empirically based, but rather static yield functions, potential crop productivity and related water use is explicitly modelled. The dual solution of a mathematical programming model provides valuable insights into the internal use value of resource constraints. Another feature of our approach is the treatment of technological change. Instead of prescribing expected future trends in yield increase (i.e. area productivity), required minimum rates of technological change can be derived as a residual to solve the model under a large set of spatially-explicit constraints. This is especially important for the analysis of water scarcity, as water constraints become only meaningful at a spatially disaggregated level.

Keywords: Land use, Water scarcity, vegetation modelling, mathematical programming, technological change

Assessing the impacts of climate and market changes on agrarian land use in Europe

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Farmers and farming regions in the EU are increasingly concerned about whether they can remain competitive in a liberalising economy. Until now, climate change, which poses an additional stress to agriculture, is not included in recent assessment studies on the future competitiveness of the sector. In this paper future changes in agricultural production and land use are projected considering combined effects of market and climate change. The study aims to identify regions in Europe that are likely to remain agricultural or that are likely to convert to other land uses. Two IPCC scenarios A1Fl (global market with extensive fossil fuel use) and B2 (regional markets) are considered for three time slices: 2005, 2020 and 2050. Europe is restricted to the EU-27 including Norway and Switzerland. The paper focuses on the arable crops wheat and potato and on dairy farming. The assessment methodology includes three steps. 1) Calculation of the achievable food supply for wheat, potato and milk considering effects of climate change and technology development. Productivity changes are made for agro-environmental zones using climate change projections from the HadCM3 General Circulation Model and scenario-specific assumptions about technology development. 2) Calculation of the demand for wheat, potato and milk based on the GTAP (Global Trade Analysis Project) model. The model uses a world-wide database on trade and considers changes in technology, demography, diet and economy for the calculation of food demand. 3) Adjustment of achievable supply to demand by adapting the area cultivated. This adjustment is based on the economic size of the farms used as competitiveness indicator. The results presented suggest spatial changes (at NUTS1 level) of agricultural production across EU-27. Possibilities for alternative agricultural and non-agricultural land uses are indicated. Advantages and limitations of the presented methodology are discussed.

Keywords: climate change, market change, agriculture, Europe

The Interaction of water policies and agricultural policies on land use and the rural economy: An integrated modelling framework

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In Spain, as in other arid and semi-arid countries worldwide, irrigation has been a crucial driver for socioeconomic development and has contrived to shape rural landscape and overall land use. Fostered by past policies, irrigation expansion has resulted in massive water consumption at subsidized costs, increasing water scarcity and environmental degradation. Consequently, water policies and agricultural policies are at the center of public policy debates and the necessity to integrate both sectors is crucial in the new policy context of the EU but it is still not fully explored. The objective of this research is to analyze the joint application of the EU agricultural policies (CAP) and water policies (WFD) currently in place an other potential policies and their effects on farmer's decisions, regarding changes in land use, water consumption, farm income, and public expenditure. The methodology used is based on the integration of an economic model (MPM) and an agronomic model (Cropsyst). The integrated model has been applied to different regions in Spain characterizing the continental and the Mediterranean agrarian systems. Results show that the new decoupled CAP has not produced drastic changes in land use but entail negative effects on farmers' income. However, full decoupling and reduction in crop prices (EU trade agreements) are likely to produce a reduction in farm intensification and potential benefits to the environment but will involve negative socio-economic impacts for less profitable farms. The introduction of cross-compliance is contributing to protect the environment even though it inflicts additional costs for farmers. Water conservation policies, such as water quotas or water tariffs, will promote a land use shift towards less water-intensive and input-intensive crops, increasing the potential synergies of agricultural polices and water policies. It will be advisable for land use and territorial policies to reinforce the convergence of agricultural policies and water policies to mutually compatible objectives of nature conservation and competitive multifunctional agriculture.

Keywords: agricultural policies, water policies, agro-economic model, land use

Integrated assessment of future CAP policy scenarios and their impact on the spatial characteristics of land use patterns in Mugello (Central Italy)

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The effects of policies impacts on land use changes are investigated with the integrated bio-physical and economic MEA-Scope modeling tool in order to provide support for the policy decision process. In order to account for the interrelationship between land use intensity, terrain features, soil capability, erosion and water quality, an upscaling procedure was specifically developed for a case study area in Northern Tuscany (Italy) characterized by a high degree of heterogeneity. This allowed for a spatially explicit application of the modeling tool and for an integrated analysis and impact assessment through the application of a number of georeferred biotic and abiotic indicators. Results, presented in this paper for abiotic indicators, show that under the specific scenarios the indicators responses are highly variable within the region depending of the landscape component considered and that scenarios induced changes result in significant modifications of land use patterns with major consequences on the spatial variability of georeferred site specific indicators. Furthermore, the changes in crops spatial pattern appear to be clearly differentiated in term of responses depending upon the policy scenario settings. The spatially explicit approach adopted proved to be necessary to properly evaluate the impacts of policy scenarios on the environmental services provided by agriculture. Variogram analysis provided a valuable tool to quantify and compare analytically the spatial structure of the land use intensity under the different policy scenarios.

Keywords: Land use patterns, Policy scenarios, Upscaling, Abiotic Indicators, Variogram analysis

Modelling the spatial distribution of livestock in Europe

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Livestock remains the world's largest user of land and its use is strongly related to grassland and feed-crop production. Europe's livestock sector is very dynamic, characterized by varying developments between livestock sectors but also by big structural and quantitative changes between countries and regions. Especially far-reaching reforms of the European Common Agricultural Policy have shaped the European livestock farming. While some regions experienced a decline in at least one livestock sector persist others as important center for livestock farming or are even growing. Besides quantitative changes in European livestock systems also dynamics in their spatial distribution are expected. Livestock distribution is driven by several multi-scale processes, such as global trade, regional changes in land suitability, and local implementation of policies. Shaped by these processes European livestock distribution is very heterogeneous, being characterised by regional concentrations which potentially conflict with environmental targets such as the Water Framework Directive. To better explore possible impacts on the environment but also to assess the impact of environmental policies, a robust understanding of the spatial dimensions of livestock production systems and their dynamics is required. A multi-scale modeling framework was developed to simulate spatial and temporal dynamics of livestock in Europe. On global scale the demand for land use and livestock was calculated for each country separately by taking into account across-country trade of resources and products. Taking these demand data land use changes and livestock distribution were simulated on regional level for all European countries. This was done by applying a downscaling procedure to allocate the national demand data on regional scale. Carrying capacities, location preferences, and implementation of policies were considered on regional scale. The presentation gives an overview on this novel modeling approach. Emphasis is placed on the applied methodology and the final European livestock distribution maps are presented.

Keywords: European livestock, scenarios, spatial pattern, multi-scale modeling

Farm Nitrogen balances in European landscapes - methods for modeling and scaling

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The aim of this study is to present methods to model farm Nitrogen (N) balances and N flows in European landscapes. The critical factors to include in the models are reviewed, and examples of the modelling of farm N balances in a number of European landscapes are shown. The results draw on experiences from the EU funded research projects NitroEurope (www.NitroEurope.eu), MEA-scope (www.MEA-scope.org) and SENSOR (www.SENSOR-ip.org), and from national Danish and British research projects outlined in the publications from the previous international Nitrogen conferences. In particular, we focus on the use of the dynamic whole farm model FASSET (www.FASSET.dk), and the Farm-N tool (www.farm-N.dk/FarmN-Tool) to calculate yearly farm N balances, and distribute the surplus N between different ty¬pes of N-losses (volatilisation, denitrification, leaching). In MEA-scope these two models are linked to economic modelling, whereby effects of farm structural developments induced by policy changes can be assessed. In NitroEurope the farm models will be linked to other ecosystems models as well as atmospheric and hydrological N-flow models, thereby enabling modelling of the whole N cascade and the overall N balance for whole watersheds or landscapes. The importance of handling spatio-temporal dynamics and the effect of structural changes are outlined with results from the above projects, and the problems of integrating information from different scales in the modelling of landscape level farm N balances are discussed. It is concluded that landscape level modelling of farm N balances and N flows is an important and often neglected discipline, which allows upscaling of farm N-balances and N-emissions results from plot/field/farm level to regional/national or international levels.

Keywords: Nitrogen, modeling, landscape, scaling, farm N-balance

Developing tools for land users and policy makers to assess the impacts of land use change and intensification – a New Zealand perspective

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New Zealand's economy depends greatly on land-based industries; agriculture, horticulture and forestry contribute about 65% of the total export value. The continuing dominance of land-based industries in the New Zealand economy has been achieved through increased productivity from both intensification and land use change. This has also been achieved despite the lowest governmental support to producers of any OECD country. However, there has been increasing public concern about the environmental impacts associated with recent rapid and large scale land use changes, especially impacts on water quality. A five year research programme was developed to provide integrated knowledge and new tools to enable land users and policy makers to assess the environmental impacts associated with land use change and intensification. This research has provided improved understanding of soil organic matter cycling and soil mineralisation, and nitrogen and water uptake and movement in crops and soil. This information has been incorporated into a field-scale "LUCI Framework model" that simulates crop yield and quality, nitrogen cycling and nitrate leaching and drainage from sequences of major crops and pasture systems for a range of management and weather scenarios. Predictions from the model have been validated with field data. The LUCI Framework model has been used to guide land use policy development to limit leaching losses from different land uses in different regions in New Zealand. Several crop/soil on-farm decision support tools have also been developed. These tools are being successfully used to minimise nitrate leaching losses, increase water use efficiency, while producing high yields ensuring farm profitability. It is estimated that 60% of wheat crop grown in New Zealand is influenced by the use of the "Sirius wheat calculator".

Keywords: land use change, intensification, cropping, pasture, nitrate leaching

Integrated assessment of agricultural production practices

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Today's agriculture is facing new challenges driven by pressures such as WTO-negotiations aiming at market liberalisation, further adaptations in the current EU agricultural policies going along with changing societal demands in terms of environmental concerns and health issues. This paper presents an integrated assessment approach referring to sustainable development in agriculture which should be economically viable, environmentally friendly and socially acceptable at the same time. The approach is indicator-based and evaluates single agricultural production practices. Environmental, economic and social indicators are taken into account. To do so, a method mix is employed, making use of qualitative and quantitative data in equal measures. The economic and environmental indicators were implemented within the modelling system MODAM (Multi-Objective Decision support system for Agro-ecosystem Management), in order to assess their economic performance and effects on the abiotic and biotic environment. The modelling approach was applied to a case study region in north-eastern Germany, in the state of Brandenburg. To tackle the social dimension, a survey was done in this region asking farmers about their acceptance of different production alternatives that are known to have environmental benefits, e.g. regarding soil or water conservation. Respondents were interviewed about their personal experiences with these production alternatives and requested to assess them with respect to costs, time and labour demands, attached risks, effectiveness and other influencing factors. The results of the assessment are dimensionless index values indicating the suitability of certain agricultural management practices with respect to an indicator. The integrated assessment enables to show inter-dependencies between the indicators and thus allows for statements about the convergence or divergence of different objectives. The approach helps to identify production alternatives that are assessed to be economic, environmentally beneficial and socially accepted likewise, although at different levels.

Keywords: agriculture, modelling, MODAM, integrated assessment, indicators

Beyond the PSR-Framework: evaluating the environmental performance of human-nature systems

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The Pressure-State-Response (PSR) framework addresses different issues regarding sustainable development and has been widely adopted within the OECD countries. With its adoption different issues can be causally addressed, and it has been modified and adapted to specific purposes like in the Driver-Pressure-State-Impact-Response (DPSIR) framework adopted in the SENSOR Project. The PSR framework is based on a classical epistemology and on the assumption that it is possible to establish a causal linear relationship among Pressure-State-Response. In this paper we present and discuss the Potential-Process-Performance or "PPP Framework" as an alternative to PSR and DPSIR. The focus of PSR and DPSIR is to identify causal relationships (or linkages) among factors related to the environment used by humans. Differently from that, the PPP aims to evaluate the performance of relationships that humans establish with their environment (the land use chosen, for example). The assessment of the quality of these relationships is the epistemological basis of PPP. We argue that PPP overcomes the logical limitation of PSR to deal with the complexity of human-nature systems. In any natural or human-made process, a result can be quantified and compared to the existing potential to achieve it (the maximum result possibly achievable). The proportion of result achieved in relation to the potential is a measure of human performance in promoting or controlling a process. We present a case where the PPP framework was applied to evaluate human performance in controlling erosion in watersheds.

Keywords: environmental performance, human-nature systems, framework

Assessment of agricultural land use changes using a DPSIR approach: A case study from a river basin in Northern Italy

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A study was conducted on the upper part of the basin of the Lamone river, in the Northern Italian Appennines, to evaluate the agricultural land use changes occurred in the last decades due to social and economical trends. Agriculture has shifted both towards intensification and abandonment. A DPSIR analysis has been conducted on the actual situation of the basin, which has identified the conceptual model of the relationships between the indicators; an important cause-effect chain has been highlighted, connecting the agricultural land uses (Driving force) with the shortage of water in the river (State and Impact). The agricultural uses have been then evaluated for three different years (1976, 1994 and 2003) using land use maps and statistical data, in order to assess the impacts of the land use changes on the river discharge. The analysis has showed a shift from extensive to intensive agriculture, with a growing prevalence in fruits with high water requirement (i.e. Kiwi fruit); this causes a growing need of water for agricultural activities (Pressure). Currently, the irrigation water is withdrawn from the river, which in the summertime does not usually reach the Minimum Vital Discharge (State) and presents a reduced fluvial ecosystem quality (Impact). An integrated assessment of possible responses has been conducted, using the MULINO-DSS software as a support. The evaluation criteria included the preservation of the river, the economical feasibility of the proposals, the re-establishment of a high nature value farmland. The evaluated solutions were the creation of artificial basins, the shift to different crops, the realisation of hedgerows and combinations of these. The responses are ranked differently according to the weighting of the criteria. This study can be an important contribution in the process of environmental management and planning and a valid support in a participatory decision process.

Keywords: land use changes, agriculture, indicators, DPSIR, responses

Synthetic assessment of sustainability performance at a farm level with an application to the group of commercial farms in Poland

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In the research on sustainable farm development the need to take into accounts both economical and ecological aspects of agriculture production is widely recognized. High complexity of this problem is a cause of methodological difficulties in an advancement of the more practically oriented measurements methods of sustainable developments in agricultural systems. The aim of the paper was to obtain an overall index of farm sustainability performance via data envelopment analysis (DEA). Assessment of the synthetic sustainability index was achieved in a two-step process. In the first step, the sub-indexes of environmental efficiencies, land cover and economic performance were derived from DEA models. In the second stage, we used these sub-indexes, grouped in "outputs", in another DEA model to create synthetic indicator of farm sustainability. The adopted approach allowed us to eliminate the subjectivity of weights used for aggregating in constructing composite indexes. By integration of component sub-indexes, describing different activities, into one composite index (by DEA method), it was possible to exclude bias preferences for the analyzed sustainability dimensions. Exemplification of the evaluation method applied to the data set of 58 farms showed that only around 5.2% reached the value of synthetic index equal to 1. The remaining farms fell behind more or less the reference standard (index value below 1). A type of farming exerted a marked influence on the level of synthetic index of sustainability. Dairy farms and mixed-type farms had the highest values of this index, whereas the crop farms showed the lowest values. Among the analyzed area intervals, the most favourable sustainability performance index was recorded in the farm group of 28.51-62.3 ha. The presented method of sustainability evaluation can be considered of importance in aiding the multicriterial assessment of farms, setting up directions of future farm development and their adaptation to the external conditions.

Keywords: sustainable development, synthetic index, farm, DEA model

Use of dynamic system modeling for prediction of energy crop expansion in Silesia post-industrial region

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There is a growing interest in energy crops expansion, particularly in post-industrial regions. This is responding to policy instruments which are promoting renewable energy production. Post-industrial areas are often contaminated and therefore replacing food crops by energy crops contributes to reduction of food chain risk. Prediction of future demands for biomass from fuel and energy sector and spatial distribution of crops grown to meet these demands is an important element of regional planning strategy. Development of system dynamic models is based on knowledge capturing by using dedicated software tools. These tools are capable of formalizing verbal knowledge and mental models into a language of mathematical algorithms describing flows of modeled variables and interactions between drivers controlling modeled processes. Dynamic system modeling tools and framework enable experts groups without extensive knowledge of calculus to develop even very complex models. Our approach demonstrates a utility of a simple system dynamic model for energy crops driven by marginal profits as a parameter controlling farmers' crop choice. A competition for space between different crops is retrieved by supply and demand interactions responding to claims by different sectors (food, energy, forestry etc.). Input variables considered in the model to reflect cost/profit relationship include: labour cost, oil prices, potential land productivity, food and feedstuff demand. Model structure and projections for different policy scenarios as implemented in SENSOR framework project are presented and compared with SIAT outputs.

Keywords: energy crop, land use change, system dynamic modelling

Modelling changes in evapo-transpiration within the integrated land use model SITE. A case study in the Kharaa river catchment, Mongolia

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Mongolia is characterised by a semi-arid continental climate with cold winters, hot summers and corresponding high evapo-transpiration rates during the growing season. After Mongolian's new constitution was ratified in 1992, agricultural land use intensity decreased considerably with respect to fertiliser application and irrigation. Simultaneously, the demand for grazing opportunities was growing, due to the growing livestock production. From 1990 to 2000 Mongolia's cereal production, which was heavily subsidised in the previous decades, decreased by 80 percent, contrasting the livestock sector which increased by 15 percent. Even in regions with a traditionally diverse utilisation of natural resources environmental problems appear. In the Kharaa river catchment north of the capital Ulaan Bataar, where Mongolia's main agricultural areas are located, water resources get successively scarcer. The reasons are related to climate change, mining activities, livestock production and water withdrawal by the increasing population. New projections of the Mongolian government are aiming to expand the irrigated areas in the catchment several fold. It is expected that the agricultural sector would severely increase the competition for already scarce water resources in the region. In this study, actual evapo-transpiration rates of major crops were simulated with the biophysical model DayCent under realistic (= water limited) soil and climate conditions. Results are compared to simulations in which unlimited evapo-transpiration was assumed, to study differences in crop-water demand and the potential deficits in soil water content, and the impact on crop yields. In a second step, using irrigation efficiency factors, the demand for irrigation water could be estimated. The envisaged expansion of irrigated areas was simulated using the integrated land-use model 'SITE' (Simulation of Terrestrial Environments). Based on irrigation scenarios and the application of irrigation efficiency factors, the agricultural water demand for the study region was estimated. This study provides first results of the potential water demands of the agricultural sector, which might be useful to support decisions for sustainable use of water in the sense of an integrated water resources management in the Kharaa river region.

Keywords: Evapo-transpiration modeling, Biophysical model DayCent, land-use model SITE, Mongolian agriculture

Assessment of natural and semi-natural meadow ecosystems and their preservation possibilities in Lithuania

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Under temperate climatic conditions, meadow ecosystems have formed as a result of centuries-long traditions of land use, which facilitated the formation of meadow communities characterized by high diversity of vascular plant species. Large biodiversity of natural and semi-natural meadows had hardly been perceived to have any value for the public until the second half of the 20th century. Biodiversity was a side-effect of production-oriented grassland management and it was common in grassland regions. After restoration of private land property rights in Lithuania, the economic value of meadows declined and this had an ecological effect on landscape stability and allowed botanical diversity restoration to increase. Changes in land-use and farming traditions have stimulated naturalisation of abandoned agricultural lands allowing increase in their biological diversity, but also caused rapid degradation of abandoned natural meadows. Management and traditional usage of natural and semi-natural meadow ecosystems seem to be insufficient in order to maintain favourable conservation status of biodiversity. Investigations on the status of natural and semi-natural meadow communities were carried out in 2000–2006 on different geographical regions of Lithuania. The aboveground phytomass and economic value of meadow communities included into 4 systematic classes (Molinio-Arrhenatheretea elatiori, Festuco-Brometalia erecti, Trifolio-Geranietea sanguinei, Nardetea strictae) were ascertained. Meadow communities (Ass. Alopecuretum pratensis, Ass. Festucetum pratensis) with rather productive and economically valuable grassland have more chances to survive. Nevertheless, to preserve biological diversity, meadows producing small amount of vascular plant phytomass (Ass. Molinietum caeruleae, Ass. Anthoxantho-Agrostietum tenuis, All. Mesobromion erecti, Ass. Polygalo-Nardetum strictae) or those of low economic value (Ass. Cirsietum rivularis, Ass. Deschampsietum cespitosae, Ass. Molinietum caeruleae, Ass. Trifolio-Agrimonietum eupatoriae, Ass. Polygalo-Nardetum strictae) are also important. Therefore, it is necessary to observe and evaluate natural meadow status, leave the areas for preservation of biodiversity as well as select a proper way of their management.

Keywords: meadow ecosystems, biodiversity, botanical diversity, aboveground phytomass, economic value

High resolution Earth Observation for monitoring post-socialist land use change in the Carpathian Ecoregion

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The Carpathian mountain range is Europe's largest continuous mountain forest ecosystem, a biodiversity hotspot with many endemic species, and an important carbon pool. The region has experienced drastic changes in political, social, and economic structures after 1989. Forests were overexploited across Eastern Europe during socialist times. The transition from command to market oriented economies had strong implications for forest management practices and institutions. Also, the abandonment of farmland likely led to an increase in forest cover, while forest damage through environmental pollution decreased considerably during the transition period. The extent and spatial pattern, however, of post-socialist forest cover changes in the Carpathians are not well understood. We studied post-socialist forest disturbance, the removal of forest cover by way of natural events or anthropogenic activities, in Poland, Slovakia, and Ukraine. The study region, the Bieszczady Mountains, covered approximately 4,500 km2. The Bieszczady Mountains are characterized by a high percentage of forest cover due to the depopulation of parts of the region after 1947 (Augustyn 2004). Much of the farmland in the region was managed by the state during socialist rule and was partially set aside after 1989. The forest disturbance index was used to derive forest change maps from Landsat MSS/TM/ETM+ images acquired between 1978 and 2000. The results show clear differences in forest disturbance among the three countries: Increased harvesting occurred in all three countries in 1988–1994, right after the system change. Forest disturbance rates differed markedly among countries. Forest fragmentation increased in all three countries but experienced a stronger increase in Slovakia and Ukraine (5% decrease in core forest) than in Poland (Kuemmerle et al. 2007). Our findings thus suggest that differences in disturbance rates among countries appear to be most closely related to broadscale socioeconomic conditions, forest management practices, forest policies, and the strength of institutions.

Keywords: high resolution remote sensing, post-socialist change, policies and institutions, forest ecosystems, Carpathian Mountains

Supporting land use change modelling with automated monitoring of land use dynamics in the La Plata River Basin

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A critical part of sustainability impact assessment lies in the process of building models that can actually capture public policies´ essential socio-economic-environmental consequences. However, in order to build, test and validate such models, it is necessary to gather a wide range of data regarding the observed behavior of these complex interactions. In this context, the observation of actual processes of land use dynamics constitutes essential input information for better understanding and modeling the factors that drive land use change. Unfortunately, however, the land use information available in many regions of the world is often scarce, spread out across different institutions and above all inconsistent. This is particularly true for developing countries that do not share a central government, as is the case of the Plata Basin in South America, a SENSOR-TTC study area comprising 5 different countries (Argentina, Bolivia, Brazil, Paraguay, and Uruguay). Thus, it is suggested that a land use monitoring process for the whole region is crucial in order to provide reliable land use information that is consistent over time. In order to address this issue, an automated system for monitoring land use changes over time is being developed, based on the interpretation of annual temporal profiles of vegetation indices provided by the Moderate Resolution Imaging Spectroradiometer (MODIS). As such, the generated information will serve to better understand and identify the drivers of land use change, so as to set up an appropriate configuration for the CLUE-s land use change model. More than that, this information will be crucial for validating land use change predictions given by the model, enabling not only a refinement of the modeling process as a whole but also an assessment of the reliability of its output results, an information that is essential for the policy maker, the intended final user of the system.

Keywords: remote sensing, land use classification and monitoring, land use change modeling, regional scale, MODIS

Monitoring the intensity of grassland agriculture using remote sensing data and object-based image analysis

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Besides runoff, surface drainage contains also nutrients and pollutants of diver‘s origin. While point sources mostly are easily identified, the diffuse inflow through different channels is difficult to account for. The analysis of the annual land-use can contribute to a spatial quantification of the im-pact on the substance flow in mesoscale catchments. In the framework of the project „SeenLand-Wirtschaft“ grassland areas of the Mondsee catchment were evaluated in regard to the intensity of agricultural activities. The number of cuts per growing season (here during the year 2005) were taken as the measure for the intensity. The assumption is that a higher percentage of intensively used plots (more than two cuts per year) will result in a higher amount of nutrients been offloaded. The nutrients dynamics imply that mate-rial is removed in the form of harvested grass, but also an increase in disseminating manure for balancing out the removal, whereby the timing of the manure offload is critical with respect to pre-cipitation. An increase in nutrient transport into surface drainage seems most likely. Several path-ways are possible: surface runoff, drainage channels, interflow, groundwater system and erosion. The aim of this study is to develop a methodology for timely monitoring land-use change and to locate the parcels affected by using data captured monthly by the ASTER sensor. The result ob-tained is a spatial representation of the variance and intensity of land-use, documented by the fre-quency of cuts during the growing season 2005. The accuracy and the effectiveness of the satel-lite-based methodology are discussed as well as the relevance for monitoring the impact of meas-ures aiming at the reduction of nutrient inflows assessed.

Keywords: grassland intensity, remote sensing, OBIA, ASTER

Green in the expanding urban and semi-urban complex: application of detailed field data and IKONOS imagery

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Urbanisation of the countryside may occur according to different patterns and densities and can eventually lead to stabilizing complexes composed of new and former landscape elements. Unlike the general perception, and especially in the morphologically looser patterns of urbanisation, the outcome may be more rather than less greenery in the landscape. In order to help investigate at regional level the spatial and functional relationships of hard elements of urbanisation (roads, buildings etc.) with green elements, more specifically woody vegetation, we call in high resolution IKONOS data, to be correlated with a contemporary field survey of all elements of sealing and of woody green at square meter level, in the vicinity of Roeselare in western Belgium. This investigation helps to assess how urbanisation rather than just be an unsustainable process or equivalent to desertification, can be also partly a process contributing to enhanced sustainability conditions through its associated vegetation. The results can also be used to upscale to broader regional ranges in using coarser resolution satellite imagery

Keywords: IKONOS, private gardens, urbanisation, green

The use of satellite imagery to identify landscape permeability through observed landscape structure and land cover

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Earth Observation is a powerful tool to monitor the Earth surface at different spatial and temporal resolutions enabled through the wide array of available air-borne and space-born satellites. With increasing spatial resolutions, small biotopes and linear landscape elements can now be measured directly by the use of very high resolution satellite data with spatial resolutions below one meter. However, the disadvantage of such satellite imagery is that it is mostly used for limited areas and certainly not throughout Europe. High resolution satellite imagery from Landsat or SPOT, with spatial resolutions for multispectral data between 10 and 25 meters, do cover the globe, but do have the limitation that in most cases linear landscape elements cannot be detected. The hypothesis is now that measuring landscape structure in combination with the present land cover derived from EO data within a biogeographical framework might be a good indicator for the amount of woody linear elements (read green veining) in the landscape. The habitat fragmentation or spatial cohesion at the regional level for specific species groups is not only determined by the size of the remaining habitat areas but also by the permeability of the surrounding landscape for the species to move between the remaining core areas. The quality of the landscape matrix is a major issue to assess in the decline in biodiversity in the countryside caused mainly through dramatic changes in land use and associated management. For this purpose the usability of the IMAGE2000 is being assessed. Image2000 was produced from ETM+ Landsat 7 satellite for the reference year 2000. Image2000 covers Europe almost entirely (image2000.jrc.it) and is the main data source for updating the CORINE land cover database. However, CORINE provides very limited information about the landscape structure and therefore the Landsat images were further segmented as a start for this study.

Keywords: Landscape structure, Landsat satellite imagery, Segmentation, Land cover, Spatial Cohesion

Landscape structure analysis as tool for sustainability impact assessment on the regional level

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The assessment of sustainable use in European landscapes is the main objective of the SENSOR-project. Therefore, "landscapes" are of interest as spatial units in sustainability research. The concept of "landscape structure" is dealing with the spatial and functional relationship between distinct local ecosystems by describing the distribution of energy, resources and species in relation to size, shape, number and type of ecosystems in a particular landscape. It is reflecting not only the natural settings of the landscape but also its history and the impact of mankind throughout the centuries. Therefore, the present spatial patterns are a result of former activities and processes in the landscape. Hence, many European cultural landscapes developed their own regionally distinct pattern of landscapes elements over time and their changes are influenced by current processes in the landscapes. Since landscape structure has been linked to biodiversity and other important landscape functions by various authors, it seems worthwhile to further explore the potential of landscape structure analysis as a proxy for the evaluation of such land attributes and functions which are much more complicated to assess. Since modern technologies in the field of remote sensing and geo-data analysis are available, identifying landscape patterns on the larger scale has become a solvable problem and an applicable approach. A set of various landscape indices, describing important features of landscape pattern, such as shape, diversity, fractal dimension of patches and classes served as basis to assess sustainability of Austrian landscapes and a similar concept has been transferred to the European scale highlighting main differences between SRRF regions in the view of different environmental indicators.

Keywords: landscape structure, remote sensing, landscape indices, environmental indicators

Landscape impact and perception of land-use change

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Landscapes are keys of the environmental quality and social well being. They reflect entirely the ecological and socio-economical health and sustainability of the regions. Land-use transformation is a permanently ongoing process, it is the most relevant and perceivable characteristics of the landscape dynamics. That is why SENSOR enlarged the scope of the official sustainability impact assessment issues, listed in the EC SIA Guidance toward landscape. Policy induced land-use changes are reflected in a transforming land-cover pattern and its impacts on landscape are twofold: ecological and cultural. Ecological effects are related to the hemeroby, the diversity and the connectivity of the habitats. Most important impacts on cultural aspects concern landscape identity reflected in the persistence of landscape heritage. Transformation processes result in change of identity and aesthetical quality. The Greek word aesthetics means perception. Visual perception is the most important way of understanding of being aware of the landscape change. An attempt to tackle the complex issue of cultural heritage and aesthetics of the landscape within SENSOR has been the assessment of the continuity or change of land-cover and visual attractivity. The questions the presentation seeks to gives answers: - Continuity in the landscape can be considered as positive for sustainability? - What role appreciation and land-use play in the answer and in the persistence of the landscape heritage? - How land-cover change affects visual attractivity? - What degree of land-cover transformation is perceived by people? - What level of land-cover transformation causes definitely the change of landscape identity? The answers are based on spatial data analysis at NUTS2/3 level for the whole Europe and the assessment of photorealistic visualisation of land-cover change with the help of Goole Earth aerial photographs.

Keywords: land-cover change, landscape identity, perception

Earth observation as a prerequisite for biodiversity management in a Mediterranean forest landscape

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We used earth observation data for many different studies in Dadia NP, a Mediterranean hotspot of biodiversity, located in NE Greece. Satellite imaginary from IKONOS (July 2001, 1m pixel size) was used to produce several vector maps that differed in the numbers of habitat categories and were digitized according to the dominating tree species and the percentage of mixed forest. A raster map of nine land cover categories was used to evaluate dimensions and pattern of landscape structure, and to investigate relations between 55 different variables of landscape structure and the species richness of woody plants, orchids, orthoptera, amphibians, reptiles, and birds. Both of these studies were completed at multiple scales. A map of three landcover categories was used to evaluate changes in land use during the last 60 years. Comparing analytically the satellite images from 2001 with aerial photographs from the 40s and 70s, we detected for example a strong decline of forest openings. The most recent use of the satellite imagines was the development of a decision support system for the evaluation of the conservation of biodiversity in managed forests. Applying variables regarding geomorphology, land cover, land use, landscape structure, disturbance, and forest stand history as predictors, we created a series of spatially explicit models of the following five levels of biodiversity: diversity of landscape, of higher plants, of amphibians, of passerines, and of raptors. Then, we added a spatial model of the breeding habitat of Cinereous Vulture (Aegypius monachus), a species of conservation priority, because Dadia NP holds the last breeding colony of the whole Balkan Peninsula. The six spatial models were combined to an overall map of the local biodiversity and this information was compared analytically with another map regarding land use (forestry, grazing etc.) to detect potential conflicts and to establish integrated management concepts.

Keywords: GIS, Conservation, Satellite imaginary, Greece, Dadia

Land use, fire and vegetation responses to climate changes in south-central Chile

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Araucanian Chilean Region represents an interesting area to evaluate the human impact in the landscape, relationships with the climate changes during the Holocene. Sedimentological, palynological, and charcoal results from sediments cores from Purén-Lumaco peat-bog site (38ºS/73°W), shows the vegetation and land use changes in the landscape by indigenous people during the Holocene (pre-Mapuche and Mapuche populations). The valley floor constituted an extent lake surrounded by closed-forests until 10,500 14C years BP when occurs the most evident environmental change. The expansion of Myrtles forest and drained abruptly the lake into a swamp/bog reflecting the dry/warm climate of early Holocene in south-central Chile. Later, the sediments indicate variable lacustrine levels and increase of charcoal particles, associated to current climatic conditions. The pollen spectrum contrasts with a strongly disturb landscape of the area. Actually, the valley floor constitutes a complex peat-bog system dominated by grasses species and exotic forest species (Pinus radiata and Eucalyptus spp.). Some archaeological antecedents in the area document the human development as of 7000 14C years BP. The greater archaeological characteristic present in the valley is the kuel (a Mapuche earth accumulation). The presence and extension of almost 300 kuel in the valley reflect the social/economic development, and partly explains why the region was the major resistance area for Spanish colonizer during XVI-XVII centuries. The influence of climate and human impact in Holocene environments to provide a better basis for understanding and managing the present landscape in Purén area, and prediction and modeling of future changes in climate. Almost the absence of native forests in the area makes urgent strategies for the recovery and rehabilitation of a relict ecosystem that today represents their regional analog only in the tops of the Chilean Coastal Range (Cordillera de Nahuelbuta). Acknowledgments: Universidad Austral de Chile (FORECOS P04-065-F, BSN-34567-04).

Keywords: Human impact, landcape change, regional scale, Holocene, Temperate rainforest

Linking models to explain and predict cropland abandonment in post socialist Eastern Europe

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Land use change and particularly cropland abandonment happened at unprecedented rates in most countries of Central and Eastern Europe and the Commonwealth of Independent States. This land use process requires an interdisciplinary approach to study the influencing human-environmental interrelationships and processes, such as governance, economy, management, and the environmental boundary conditions. This research investigates two different modeling techniques and their application for explaining and predicting land use change. The focus is on cropland abandonment in the Romanian foothills of the Carpathians, based on remote-sensing derived land-use maps from 1990 to 2005. Driving factors include biophysical variables that are integrated with socioeconomic and political indicators from primary census data. Underlying factors that led to cropland abandonment are estimated by spatially explicit logit regressions that combine land-cover data with hypothesized biophysical, socioeconomic, and political driving forces. Significant predictors were fed into an artificial neural network model (the Land Transformation Model, LTM) that served to predict the likely spatial arrangement of future cropland abandonment. Forecasts for a range of hypothesized future abandonment rates resulted in maps depicting the likelihood of future abandonment. Both modeling approaches have their strengths and weaknesses, and complement each other. The spatial logit model focuses on exogenous, underlying variables that foster land change and is valuable to rank the importance of factors and to test hypotheses. Artificial neural networks provide a data-driven tool allowing a possibility to predict future developments based on the results of the spatial logit model. The proposed linkage of modeling approaches can assist to develop more rigorous scenarios and can offer new insights to support impact assessment, decision-making, and land management politics.

Keywords: cropland abandonment, land use change, spatial logit model, neural networks, scenarios

The GEONAMICA® software environment for dynamic spatial modelling

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GEONAMICA is a software environment for spatial modelling and (geo)simulation. It offers (1) a framework to build new or couple existing (spatial) models, (2) a simulation engine and (3) a rich class library to build graphical user interfaces. The strength of the framework lies in the fact that it provides a structure for the models that allows them to be integrated more easily, while enabling efficient model execution. The framework builds on the Discrete Event system Specification (DEVS) formalism by encapsulating each part of a model in a model block. Inputs of model blocks are linked to outputs of other model blocks to form the entire model, which represents the state of the system at some point in time. The simulation engine advances this point in discrete time steps. Within one time step, each model block calculates its new state on the basis of its current state and either the current or new state of each of its inputs. The GEONAMICA implementation aims at efficient model execution, which is achieved by creating an order in which the model blocks must be computed. Model blocks facilitate model integration by providing a standardised interface through which models can communicate with each other. The framework uses an XML based model specification to interlink the integrated model at run-time. Hence, model blocks become components that can be replaced without the need for recompilation. The order in which model blocks must be computed is derived automatically. Parallel computation of the model blocks is applied where possible. The GEONAMICA software environment has been developed over the past 15 years and has been the basis for many integrated spatial decision support systems like WadBos, Environment Explorer, MedAction, Xplorah, Elbe-DSS and MOLAND. In the DeSurvey EU research project, the formalisms are laid down explicitly and applied in an integrated assessment model including many sub models.

Keywords: modelling framework, model integration, dynamic model coupling, integrated assessment, simulation

Advanced Visualisation Modules for Impact Assessment

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Within SENSOR advanced visualisation techniques are applied focusing on illustrating policy scenario's implication on the landscape. To ease data interpretation and ensure that the rather complex and vast amount of information is understood properly and quickly different graphical tools were developed. A Contextualisation Matrix combines all indicators' values into a grid illustrating the results on member state level as well as indicating the number of available 3D visualisations. Data mining tools explain absolute and relative change as well as trans-national similarities and clustering. A 3D Dialogue focuses on landscape change and lets the end user compare before and after utilising different types of 3D visualisation. Thematic maps with Spatial Comparators enable end users to relate numeric data to real places of their knowledge via Regional Embodiment. Finally Explanatory Overlays add great value to SIAT by explaining complex interaction patterns in a user-friendly way.

Keywords: communication, mapping, application design, usability, mapping

A generic platform for integrated regional land-use modeling

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Land use is a crucial link between human activities and the natural environment and one of the main driving forces of global environmental change. Gaining insight into the dynamic nature of land-use and land-cover often involves the use of simulation models to explore changes in time and space. With advances in computer technology and software development, a number of generalized frameworks for land-use modeling have become available. They can be seen as approaches to bridge the gap between conceptual models of landscape dynamics and their simulation on a computer. However, they have limitations with respect to their utility as integrative tools in interdisciplinary research projects, which pose specific requirements such as usability and communicability or the integration of models. In this paper, we present the SITE (Simulation of Terrestrial Environments) framework, a generic platform for integrated regional land-use modeling. SITE includes several advancements compared to existing frameworks, addressing technical problems like simplified implementation of case studies or model coupling. One of the main features of the component-based SITE architecture is the strict separation of generic land-use modeling functionality from the actual model specification. For model specification, SITE integrates a scripting language with extended, modeling-specific functionality. This allows in principle any regional-scale land-use model to be operated by the framework. In addition, we explicitly addressed the demands for a tool, capable of integrating insights and models from different disciplines, in the SITE design and architecture. In the field of land-use modelling, SITE offers a number of innovations, such as a detailed graphical user interface, support of model coupling and the integration of model test and calibration components. SITE has been developed and is being successfully applied in the context of the STORMA (SFB 552) collaborative research project.

Keywords: land-use modeling, integrated modeling, modeling framework

Data and knowledge management for integrated assessment: A SEAMLESS example

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Integrated assessment can be understood as an interdisciplinary process of combining, interpreting and communicating knowledge from a range or scientific disciplines to reach a better understanding of complex problems. In SEAMLESS, an Integrated Assessment Modelling project on agriculture, these complex problems have been tackled through an integrated framework of data-intensive models, which have posed great challenges for the management of data, data sources and connections between models and their data. In SEAMLESS we have integrated these different data-sources into one common data-schema, represented in both an ontology and a relational database. This presentation presents four aspects of this work: • the use of ontologies and ontology engineering to create a shared conceptual model, • the generation of relational data schema from the shared conceptual model, • the processing of data sources to populate the database. This includes adapting the data to a common spatial framework and aggregating source data to suitable typologies. • the access of the models to the data in the database through the ontology. Through the use of ontology, ontology engineering and relational databases, the first Pan-European database on soil, climate, farm and agricultural management was created that is directly accessible for the models operational in SEAMLESS. The database holds data on model inputs and model outputs as well as contextual data for the assessments. For our developments only open-source tools were used, so the ontology has been built in Protégé and the database schema generated through Hibernate. The data are stored in the relational database management system PostgreSQL running on a Linux server. To support visualization of results PostGIS functionality is added to a PostgreSQL database and Geoserver is used to provide Web Mapping and Web Feature services.

Keywords: Integrated assessment, agriculture, ontology, database

Sustainability Impact Assessment Tool; architecture and design

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The quick scan tool Sustainability Impact Assessment Tool (SIAT) enables the analysis of impacts of EU policies at regional level with focus on cross sector trade offs. SIAT will be the major product of the EU 6th framework program integrated project SENSOR. As a quick scan impact assessment tool SIAT supports both policy formulation and solution finding by indicating the strengths and weaknesses of different land use related policy options. Strengths and weaknesses are expressed in terms of indicators of the three pillars of sustainability (environment, social and economy) and land use functions. Land use functions are based on a multi-functionality approach in which regional sustainability limits are taken into account. To truly understand the implications of policy impacts it is important to understand why certain impacts occurred. This transparency is guaranteed by the SIAT by (1) offering fact sheets for all implicit knowledge and (2) explicit back tracing of the knowledge used during impact calculation based on the user defined policy. Back tracing shows how and with which assumptions the calculations for a specific region within the EU were carried out. The SIAT system is designed and implemented to guide users through the process of carrying out a quick scan impact assessment giving them as much information as needed to understand why their policy has what implications. The SIAT system is based on an enterprise application architecture in which the light weight front end is implemented as a Rich Internet Application (RIA). A RIA facilitates the development of complex tools like SIAT allowing interactivity via the internet which is known from desktop applications. Data rich model calculations are performed on the server using the modeling framework Open Modeling Interface (OpenMI). OpenMI standardizes model connections and data descriptions between models.

Keywords: Impact Assessment, modeling framework, OpenMI, siat

Geospatial data management – an environment encouraging project partners to contribute to a common data set for land use related impact assessment

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Collaboration of interdisciplinary teams to achieve a common impact assessment objective requires sharing of data. Within the SENSOR and the PLUREL project different teams are investigating various land use impacts requiring data at different scales ranging from a large European scale to regional and local case study scales. Besides explicitly spatial data, also tabular data related to administrative or census entities is an important source. All data sets have to be integrated into a common data structure in terms of content, spatial coverage and spatial entity hierarchy. With respect to complex thematic requirements and different skills of the teams regarding spatial data application, an easy to handle platform is necessary to store data with the related thematic and geometry-information. Not only upload but also data download and data pre-view is required to assure convenient data sharing for the various project teams. To allow easy data retrieval, accompanying information for all incorporated data sets is essential: Data have to be explained by metadata, containing complete information about the data sets to examine thematic content, data validity, quality and thus applicability of the provided data sets. Therefore data upload is combined with metadata upload through a metadata reporting system, carried out as web-based graphical user interface with forms and drop-down pick lists with pre-defined alternatives for data set types, keywords, units, etc. The presentation will firstly give an overview of the proposed data sharing principles and the data structure, the metadata reporting and data upload tool and will further describe the features regarding data retrieval, presentation, data download and interfacing with the project's sustainability impact assessment tool (SIAT).

Keywords: data management, metadata, geospatial and tabular data, data sharing, data upload, retrieval and download tool

Val.Te.R. indicator set and framework for ex-ante impact assessment of roads on rural landscape

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Among the research project agenda promoted by Regione Lombardia, in 2004 the project Rural Land Valorisation (Valorizzazione del Territorio Rurale) was financed with the goal to define a methodology for preliminary infrastructures impact assessment on the rural land system in Lombardy. The preliminary knowledge of infrastructure project impacts' type and intensity (environmental, economic, social) could make easier to enhance the quality of the project itself, to reduce the land consumptions, to avoid impacts on natural land covers and to facilitate a better negotiation for environmental mitigation and compensation requirements. The poster presents the logical framework conceived and adopted within the project, the developed GIS environment, the selected environmental and socioeconomic indicators, the spatial datasets and the derived thematic maps. It focuses on the graphical user interface that, drawing an infrastructure shape impacting an area, enables the computation of some basic indicators and statistics for the area of interest. Some of the selected indicators give a key description of some impacts just referring to land use changes; land use/cover data has been crucial in setting up the assessment framework. By mean of an exploring GIS tool developed in Visual Basic 6 with ESRI MapObjects, it has been possible to provide a simple interface for non-technical users that want to check or display impacts through a dashboard of indicators on. Such tool has became part of the prescriptive functional tool set provided by regional laws in order to verify, ex ante, projects feasibility and impacts on natural resource and on land use; whereas, when feasibility is verified, it is used to define compensation and mitigation measures to minimize impacts.

Keywords: impact assessment, indicators, gis, rural system

Model-based assessment of overgrazing effects on land use in Eastern Mediterranean ecosystems

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The presented work deals with the development of simulation methods to examine the environmental feedback between human decision making and impacts of land use, in particular grazing, on the landscape. Under the assumption of diverse grazing land management strategies, we investigate the impact of different intensities of grazing land utilization on land degradation and grazing land extent. In addition to the competition for land resources with other land use sectors (area demand for settlements or production of food crops), the livestock sector deserves special attention due to the fact that grazing is often performed on (semi-)natural vegetation. Expansion of grazing land is therefore in many cases associated with biodiversity losses and elimination of natural ecosystems providing ecosystem services, e.g. eco-tourism. For this study, that is conducted within the international and interdisciplinary GLOWA Jordan River project, we utilize and adapt the regional version of the modelling framework LandSHIFT, working on a spatial resolution of 1km x 1 km. To develop consistent land use scenarios up to 2050 for Israel, Jordan and the Palestine Occupied Territories, LandSHIFT integrates land use related information from different parts of the GLOWA JR project. Driving forces of LandSHIFT are information on population growth, future livestock numbers and the production of the major crop types. Model outputs are time series of land use and land cover maps and a set of environmental indicators. The analysis of impacts of grazing land expansion on natural vegetation is carried out using a set of landscape pattern metrics.

Keywords: GLOWA Jordan River, land-use change, LandSHIFT, grazing

Land use changes in Eastern Pyrenees: the challenge of multifunctionality

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Pyrenean regions have undergone deep changes in the past 50 years. These changes have affected their socio-economic structures, leading to a shift in land management. Traditional system was formerly based on forestry, extensive livestock breeding and self-standing agriculture. People were linked to their territory not only economically but also culturally. In the recent years, global trends and dynamics have affected those areas: forestry sector crisis, agriculture intensification in plains, migration flows to industrial areas as well as the entrance to the European context, which has had an effect upon agricultural policies. These factors have altered the relationship between society and environment, leading to changes in physical landscape structure, which as a last resort relates to landscape's multifunctionality. Landscape structural changes (1956-2003) have been quantified through GIS techniques and the use of landscape metrics for two sectors of the Catalan Pyrenees. Results point out a relevant forest invasion process, loss of agriculture and pastures, increasing trends of urban dispersion and an overall landscape mosaic simplification, with its economic and ecological consequences. Nowadays, two basic strategies have been undertaken in these regions: conservationism through natural parks versus "economic development" without planning. A conservationist approach has shown not to be linked to inhabitants, as it has been planed from governments in urban areas. Furthermore, it has hampered some traditional activities such as extensive farming (by preventing cattle grazing in protected areas), or has even induced urbanization processes in the natural buffer zones (for example, in the Aigüestortes National Park's buffer area). On the other hand, new economic activities are decoupled from territory management and are based on urban demands such as adventure sports, which led to seasonal demand of services and residences. In the present paper we propose economical development through a multifunctional landscape approach, which would link people and economic activity to the territory where it is based.

Keywords: land use change, landscape, multifunctionality, Spanish Eastern Pyrenees

Landscape function interactions in multifunctional areas

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Landscapes are able to fulfil many different functions such as agricultural production, provision of opportunities for recreation, plant and animal habitats, area for residential use, and provision of drinking water. The capacity of functions to provide goods and services to society can be interpreted from landscape function maps. In multifunctional areas, like many European rural regions, more than one function is present at one single location. At such multifunctional locations interactions between landscape functions are often taking place. These interactions include 1) conflicts, a combination of functions reduces the overall capacity of the landscape to provide goods and services to society, 2) synergies, a combination of functions enhances the overall capacity of the landscape, or 3) functions co-exist without reducing or enhancing one other, they are compatible. Function interactions do normally not follow constant linear relations as they are also influenced by the rate of goods and services that are provided. Quantifying interactions between landscape functions can be done using spatial explicit information on the location and capacity of landscape functions. Additionally, function indicators can be analyzed providing insight to important landscape components and underlying processes explaining landscape functionality. Policy makers can use information on landscape function interactions to design spatial policies and (ex-ante) evaluate the effect of their land use strategies on the capacity of the landscape to provide goods and services. Especially for areas with a high pressure on land resources, good management of interacting functions within a multifunctional landscape could promote sustainable land use.

Keywords: Landscape functions, Multifunctionality, System dynamics

Land-use consequences of changing functions in rural landscapes - searching for stability and changeability in space and time

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In this paper I focus on changing functions in rural landscapes and their consequences for land-use. In order to adequately assess land-use consequences, I argue that measures for stability and changeability in space and time a needed. Data from landscape monitoring in 12 sample sites in eastern Denmark show that since the early 1990s the area of small uncultivated landscape features, such as small woodlots and ponds, increased considerably. This underpins the growing importance of non-agricultural functions, such as hunting, environmental, recreational and aesthetic functions. Further analyses reveal that woodlots and ponds are very stabile landscape features. About 95% of all woodlots and ponds, which existed in 1991, were found in the same localities in 2001, meaning that new woodlots and ponds have been established, but very few removed. The area of uncultivated line features (hedgerows and field stripes) has since the early 1990s been largely unchanged. However, in comparison to woodlots and ponds, these line features are very dynamic in space and time. Less than 70% of all uncultivated line features which existed in 1991, were found in the same localities in 2001. The high changeability of uncultivated line features was a consequence of rationalisation of the agricultural production. Rationalisation increased the demand for large and rectangular field plots. As a consequence, average field sizes increased by about 10% from 1991 to 2001. Dynamics of uncultivated line features were closely related to these changes in field structure: New line features were established in relation to new field boundaries, while removal of line feature took place where fields were merged together. I conclude that relatively simple measures for stability and changeability in space and time unveil land-use consequences of two simultaneously ongoing processes. Limiting analyses to the investigation of net-changes in land-use would have hidden vital information.

Keywords: landscape functions, spatial and temporal dynamics, land-use change

Farming in Protected Landscapes

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Achieving multifunctionality on a parcel of land, or in a landscape as a whole, requires a delicate balance between the different functions. This is particularly so when one of the desired functions is agricultural production. This paper examines the special challenges involved when cultural landscapes are protected by law. Norwegian "Landscape Protection Areas" are intended to preserve the landscape character of special landscapes. Ideally these landscapes should preserve ecological functions, whilst at the same time allowing for recreation and tourism, and the economic returns to ensure continued use of the landscape in the future. Balancing these functions is fraught with difficulties. The former agricultural systems that shaped these cultural landscapes may no longer be viable from the perspective of food production, and biodiversity is notoriously bad at paying for itself. Are the farmers that own the land willing to take on new roles as landscape managers rather than food producers? And who will pay for this? We present results of a questionnaire to farmers that own or manage farmland in Landscape Protection Areas. Of the 893 respondents, almost a quarter claimed that their farm business had been negatively affected by landscape protection. Niche products or alternative income possibilities had not been realised. We found a generally negative attitude towards municipal authorities and 24 % of respondents were strongly against the establishment of new Landscape Protection Areas, even if the State paid compensation for their economic loss. Based on results of the study we suggest that major improvements to the protection system could be made simply by improving communication between management authorities and farmers and involving farmers in making management plans.

Keywords: Cultural landscapes, Farmer attitudes, Agriculture, Landscape character, Landscape protection

Land Use Functions – an approach to assess the impact of land use change on land use sustainability through multifunctionality

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The dramatic changes in land use observed in Europe in the last fifty years have generally resulted in improvement of human welfare and economic development. On the other hand, they have caused serious environmental problems. There is therefore a need for approaches that help to understand in an integrative way the economic, environmental and societal impacts that land use changes have on sustainability. Sustainability Impact Assessment (SIA), which assesses the impact of policies on sustainability, addresses this challenge. SIA partly builds on the concept of the multifunctionality of land which helps to deal with the complexity of interactions between different land uses, their temporal and spatial changes, and finally how policies might steer those changes towards sustainability. Following this need for true integration of economic, environmental and societal issues across policy areas at a meaningful spatial scale, an interdisciplinary team in the SENSOR project has developed an innovative conceptual framework to assess the impact of policies on land sustainability at various levels of spatial aggregation i.e. the Land Use Functions (LUFs) framework. LUFs are the goods and services provided by the different land uses that summarise the most relevant economic, environmental and societal issues of a region. The LUFs framework integrates the changes observed in a large set of impact indicators into nine Land Use Functions (LUFs), which are balanced among the three pillars of sustainability. The framework helps to identify the functions which are hindered or enhanced under various scenarios of land use change and potentially provide a basis to design for adequate compensation and stimulation of efficient resource allocation at the territorial scale. The LUF concept therefore allows making explicit the analytical links between multifunctional land use and sustainability. The rationale leading to the LUF concept, its definition and the conceptual framework will be presented in this session.

Keywords: Land Use Function, land use change, Sustainability Impact Assessment, multifunctionality

Assessing multifunctionalities of land use: a conceptual framework for China

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Human activities drive the land use changes in spatio-temporal dimensions which cause changes of land use functions in succession. Land use sectors in China are highly dynamic and of particular importance for the worldâ€™s sustainable development. However, as the same situation in EU areas, decision makers face significant difficulty to anticipate the complex interlinkages of determinants of land use and future impacts of policies on sustainability. Conception of policies designed to promote and protect sustainable land use requires robust tools for the ex-ante assessment of different scenariosâ€™ impacts on the environmental and socio-economic sustainability in China. The cross sectoral approaches to analyse ex-ante the impact of policy proposals on the land use covering the three sustainability dimensions, social, environmental and economics still a lack. The unique aim of the SENSOR Approach is determined to deliver ex-ante sustainability impact assessment tools to support decision making on policies related to multifunctional land use in Europe. In SENSOR, an approach to multifunctionality is undertaken that combines the three perspectives of sustainability in extending the concept of multifunctionality of agriculture to include other land use sectors, and by linking this concept with the spatially explicit concept of landscape and ecosystem functions. Based on the SENSOR Approach and with real needs and realistic condition in China being taken into account, a conceptual framework for assessing multifunctionalities of land use in China have been set up, in which the land use functions taken account include environment abiotic functions, environment biotic functions, social functions and economic functions as well as ecosystem functions and the three aspects including human activities, land use changes as well corresponding function changes are integrated. The establishment of the integrating conceptual framework is of the important theory instruction significance for governmental land management department at different levels to form and perform the reasonable land utilization policies that contribute derecectly to sustainability of development in China.

Keywords: land use, multifunctionality, assessment

Multifunctional Space and Rural Diversification: Contestation and Synergies in Land Use Planning and Policy

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This paper contributes to the debate about multi-functionality with reference to stakeholder perceptions and experiences of rural diversification within UK planning system. Rural diversification encapsulates the notion of rural areas producing something new and different thereby contributing to multi-functionality and rural resilience. It is the role of the planning system to facilitate this policy imperative set within tools of restraint and negotiation across rural space. A case study of Aberdeenshire involving planning policy analyses, development control data, stakeholder focus groups and diversification case studies reveal a complex and contested picture of rural diversification activity, experience and perception. Although diversification activity, where it occurs, is largely successful within planning procedures, there are significant spatial variations which reflect different planning priorities across Aberdeenshire. Furthermore, contested notions of rural diversification itself reveal planners to be out of step with the views of other participants. Such findings characterise a debate about the kind of rural policy that is now wanted and signal important tensions about the way national and local planning policies are operationalised. The paper concludes with an appeal for a spatial planning agenda to join up hitherto unexploited synergies with conventional rural and planning policy approaches.

Keywords: diverisification, contestation, planning

Land quality monitoring systems that integrate local and technical knowledge contribute to sustainability valuation in agricultural landscapes

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The increasing attention paid to local knowledge in recent years results from the recognition that the knowledge of people who have been closely interacting with their environment for a long time can offer many insights about the sustainable management of natural resources. It is argued that research efforts should further explore a balance between scientific precision and local relevance resulting in a "hybrid" knowledge base. The generation of "hybrid" knowledge reflects an effort to understand land management in the context of many forces interacting within a dynamic rural livelihood context as well as in the promotion and protection of multifunctional land use. Increased concern about soil management as a key determinant of sustainability in agricultural landscapes has promoted the need to identify indicators to monitor changes in soil quality, and their impact in the provision of ecosystem goods and services, as affected by land use change and agricultural intensification. This is part of a continuing effort to develop land quality monitoring systems that strengthen local environmental/agricultural institutions and communities with tools that support local decision-making in natural resource management and promote sustainable land use in agricultural landscapes. This experience is currently being adapted in the Formoso River watershed region, Mato Grosso do Sul – Brazil with financial support from CNPq and Embrapa and complementing activities in the existing GEF-funded project entitled ´Formoso River: Integrated watershed management and protection´and the IAI-funded project entitled ´Land Use Change in the Rio de la Plata Basin: Linking biophysical and human factors to understand trends, assess impacts, and support viable strategies for the future´. The Formoso river watershed is located in the municipality of Bonito, MS, that was selected by the SENSOR TTC team as a sensitive region in order to test SIAT model development. 1Visiting Researcher

Keywords: land quality indicators, monitoring systems, decision support, ecosystem services, sustainability impact assessment

Scenario developments for suburban area based on multiple landscape assessments

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From the point of view of the rural and suburban population, major functions for a healthy life in the landscape are described, functionalised and modelled by using GIS. For the examples of an agricultural landscape north of Leipzig in Saxony/Germany (60km²) three scenarios are demonstrated for possible future developments by basing on the status quo of the "mono-functional Landscape", the "multifunctional Landscape" and the "sustainable Landscape". All the scenario results are ranked against the indicator "biotic diversity". Different views on the landscape multi-functionality will be discussed on the basis of the functions 'accessibility of interesting biotopes' for recreation, 'landscape visibility' and 'landscape silence' at the local scale of 1:10.000. The assessment results show clearly the suitable areas for public housing and the areas for protection, developments and conflicting areas. The presentation is based on a short overview and on the discussion of the landscape functional approach for spatial explicit analyses and assessments. This approach presented includes ecological, economic and societal functions from the planning perspective. The presentation stresses out the integrative opportunities the assessment of landscape functions for monitoring, indicator development and scenario approaches. A comparison against of sector-orientated single parameters, as often sampled e.g. from agricultural, spatial, landscape or water planning authorities have been done. Analyses and assessment procedures of spatial parameters will be focused on as indicators.

Keywords: scenario, landscape function, landscape assessment, GIS, suburbanisation

Fixed or flexible land cover classification for the analysis of landscape functionality?

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In recent years a lot of effort has gone into harmonising and linking different land cover classification methods (CORINE, LCCS). The main driver of the harmonisation is to ensure that land cover maps can be compared across space and time, providing a basis for analysing changes in land cover and the impact of land use change on landscape functions. The popularity of land cover maps for monitoring is that the can be derived from easily accessible remote sensing data, either air-borne or satellite. In this paper we pose the question of whether a fixed land cover classification is the most suitable basis for the characterisation of multifunctional land use. The paper outlines an alternative approach to the mapping of land use, relying instead on a flexible classification system. The hypothesis put forward in this paper is that different functions in the landscape demand different types of classifications in order to improve analyses of their functionality and explicit spatial location. This could advance analysis and the spatial allocation of potential conflict areas between landscape functions and hence provide an important aid in landscape planning and analysis. The proposed system of flexible land classification uses a knowledge-based automated land classification method. The different types of land classification are identified through engagement with land use specialists such as planner and ecologists. The user-defined classifications are applied for the production of user-specific land cover maps with the remotely sensed data functioning as a common baseline. This paper will further outline some approaches for how to bring together information using different classifications.

Keywords: land cover classification, automated mapping, user-defined classification

Mining landscape multi-funcionality

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Cultural landscapes are multifunctional through their simultaneous support of habitat, productivity, regulatory, social, and economic functions (de Groot 1987; Bastian and Schreiber 1999). Many elements in cultural landscapes have a multifunctional character, and this has been thoroughly studied. Land use is the key activity which determines the performance of landscapes with respect to socio-economic functions such as land based production, infrastructure and housing. The degree of integration between these socio-economic functions and environmental functions including natural resources protection depends on the patterns and intensities of land use (Wiggering et al. 2003). The goal of this study is to identify and explain the new posibilities of multifuncional land use in region Banská Štiavnica.

Keywords: multifunctionality, transformation, functions, landscape

Sustainable land use management

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Landscape is a very dynamic system, comprised from two mutually interconnected subsystems (natural and social) which is impacted by constant changes in time and space. Land provides a variety of functions or goods and services, covering production, regulation, habitat, protection, stability and information. Multifunctionality therefore is a key feature for implementing sustainable land use. (Wiggering, Dalchow, Glemnitz, Helming, Muller, Schultz, Stachow, Zander, 2007) The consequence of the above means that sustainable landscape management is process aimed at the landscape-ecological optimum spatial organization, utilization and protection of landscape which results to the proposal of most suitable localization of demanded human activities within the given territory (where? – e.g. the most suitable locality for arable land) and successively to the proposal of necessary measurements ensuring proper environmental functioning of those activities on the given locality (how? – how to apply the most suitable way of soil-management – and ways to reduce natural risks and hazards). It is a method for to answer the question where and how to provide human activities in the territory that would be in least contradiction to natural conditions (Miklós, 1986). The sustainable landscape management is based on an integrated landscape research in its three basic dimensions, environmental, social and economic, analysing the connections and dependencies between the dimensions with the target to define such landscape management, which would regulate social landscape development with its natural, human, cultural and historical potential. Is based on matching the offer, which is represented by the resources in the region, and demand which is represented by the community needs of growth and development. References: Miklós, L., 1986: Spatial arrangement of landscape in landscape ecological planning LANDEP. Ekológia/Ecology (Bratislava), 5, p. 49-70 Wiggering, Dalchow, Glemnitz, Helming, Muller, Schultz, Stachow, Zander, 2007: Indicators for multifunctionality impacts in landscape. . In: Bunce, Jongman, Hojas, Weiil,: 25 Years of Landscaoe Ecology: Scientific principles in practice. Proceeding from the 7th IALE World Congress – 2. part. p. 817 – 818

Keywords: multifunstional land-use, spatial planning, sustainable landscape management

Changes in the functional-spatial landscape structure at the example of the Zemplínska sírava dam in the Eastern part of Slovakia

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The paper analyses the changes in the functional-spatial landscape structure at the example of a contrast region, a paradynamic system in the hinterland of the Zemplínska sírava dam. For this purpose a set of aerial photographs and topographical maps were used. The changes of the landscape structure stem from the land cover analysis assessed by the methods of GIS and mathematical statistics. Different economical, social and political development in certain decades might be visible also in utilization of land, what has been eventually reflected by changes in functional-spatial landscape structure. While by the first half of the 20th century the communities had primarily agricultural and service-housing functions, after building the dam the recreational and natural-protective functions started to prevail.

Keywords: landscape structure, land cover, land use, GIS, function changes

Assessing Ecosystem Services at the Catchment Scale

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The Parrett Catchment (PC) in SW England is a large, well-defined natural resource unit. It covers 50% of Somerset. It takes in Areas of Outstanding Natural Beauty and a coastline which attracts millions of tourists per year. It is also, however, exposed to a series of pressures and problems, including: diffuse pollution from farming; soil erosion, poor infiltration and exacerbated run-off; development pressures for new housing and light industrial expansion; demand for new road infrastructure; increasing demand for water; and, river and coastal flooding. The decision making processes affecting the catchment are diffuse and extend across a number of local authority, government agency local team boundaries and local area partnerships. This case study concerns a Central Government funded project to examine alternative assessments and approaches which could support existing decision making process in the light of securing natural recourses under an open developing catchment within the limits of sustainability assessment. The poster will introduce some of the results from the Catchment Futures project (www.catchmentfutures.org.uk) which applied the Ecosystem Approach to issues facing the catchment in the short and long term future. The poster concludes that by making a spatial assessment of ecosystem services within the catchment some of the existing problems and conflicts could more easily be solved. The Ecosystem Approach can help to address the resource questions arising out of the multifunctional use of resources within the catchment area, and to develop a "Leitbild" for the future management of the area.

Keywords: Multifunctional land use, Ecosystem Services, trade-offs, England

Channelling complexity - three approaches to assess the sustainability of human-ecosystem-interactions

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There is no doubt about the enormous impacts human activities have on our planet. Human induced transformation rates of the earth system are even increasing. On the other hand human society as well as economy, depend on land use and a functioning ecosystem (MA, 2003). Regarding these complex interactions it becomes clear that isolated investigations of single components are not sufficient to improve the understanding of the earth system (Berkes et al., 2003). The integration of the three dimensions environment, society and economy forms the core of mainstream sustainability thinking (Adams, 2006). This concept first gained noticeable, political interest through the release of the Brundtland Report in 1987. Thereafter, world wide efforts enforced to approach sustainable development (OECD, 2001a; EC, 2001). The agenda 21, resulting from the Rio summit in 1992, led to a concretisation and pushed institutional sustainability engagement forward (UNCED, 1992). The latest public sensitisation to negative human-ecosystem-interactions in the case of global change still increased the significance of the sustainability discussion. To steer developments through political activities towards sustainability a temporarily and spatially explicit assessment framework must be adopted. Various scientific concepts to analyse human-ecosystem-interactions have evolved which could serve for this purpose. Three different approaches will be compared presenting this paper. The concept of ecosystem services, as adopted by the Millennium Ecosystem Assessment (MA, 2003), is rooted in the field of ecology and was designed for the assessment of (semi-)natural ecosystems (Costanza et al., 1997). Contrariwise, the idea of landscape functions evolved from landscape ecology and was tailored for the characteristics of European cultural landscapes (DeGroot and Hein, 2007; Bastian and Lutz, 2006). Finally, the land use functions‘ approach (Petit et al., 2007) picked up the idea of multifunctional agriculture (OECD, 2001b; Wiggering et al., 2003) and transferred it to the cross-sectoral context of rural land use.

Keywords: ecosystem services, landscape functions, land use functions, sustainability, assessment framework

Scenarios of land-use change and its impact on green and blue water fluxes in Africa

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Rainfed agriculture plays a core role in Africa. While globally, 83% of total cropland is rainfed, this number increases to 89% for North Africa (excluding Egypt's ~100%) and to 96.5% for sub-Saharan Africa. Almost all of the current scenarios of future development underline the continuing trend of population growth in Africa, with rainfed agriculture remaining the dominating source of food in the foreseeable future, and possibly entailing further expansions of agricultural areas. Land cover and land use changes profoundly affect the regional flow pattern of water. In this study we will therefore assess the impact of land use change on current green and blue water fluxes on agricultural land in Africa and evaluate 2 of the GEO4 scenarios, Policy First and Security First for 2050. Green water, the fraction of rainfall that infiltrates the soil and is available to plants, is an indicator for biomass production and is compared to blue water, defined here as water used for irrigation. The study is carried out by linking two state of the art models, one global land use change model (LandSHIFT) with a resolution of 5' to model the effects of an increasing demand for food on the spatial extent and intensity of agriculture, and one global hydrology (WaterGAP) model with a resolution of 0.5°(geographical latitude and longitude) to simulate vertical and horizontal flow patterns of water.

Keywords: green water, evapotranspiration, land-use change

Integrating research to support land-use policy

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The design and implementation of policy programs for land use depends on judgments about political, administrative, economic, social, and environmental issues. Research of various kinds ought to feed in and influence such judgments, but often the gap between policy and research is frustratingly wide. Reasons can include that research and policy: suffer from a cultural divide, operate on different time scales, value different outcomes, face different reward structures, speak different languages, or simply ignore each other. This paper is from the perspective of a university researcher who has gone to considerable efforts to engage with and influence land-use policy in Australia, with some success. Lessons from earlier attempts to integrate research to support land-use policy design and implementation are outlined. Key lessons include that: any policy tool or framework must be transparent and simple to understand and apply; research from a range of relevant fields needs to be integrated; knowledge should be distinguished from values; the integrative researchers must work closely with intended users throughout the process; the researchers must understand the policy environment and the perspectives of policy makers; the researchers must be patient and adaptive; the researchers need excellent communication, free of technical jargon; and that successful application of research at the grass-roots level of policy implementation creates interest from policy makers and enhances researcher credibility. These lessons informed the development of a decision framework for public investment in land-use change to prevent degradation of land, water and biodiversity, caused by salinisation. Pilots of the framework with regional environmental managers were very successful, leading to demands for similar frameworks for other land-use issues. The work has highlighted the need for some substantial changes in the design on national policy. It has influenced policy thinking across Australia and is expected to affect the design of future policies.

Keywords: Policy, Integrated research, Decision framework, Land degradation, Communication

The interface between land use system research and policy: multiple arrangements and leverages

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In recent years, pressure has being applied to agricultural research organisations from funding bodies to become more pro-active in engaging with policy-makers; assuming that this engagement leads to more impact. It has been argued from within the science domain that the management of land, whether at the field, farm or regional scale, can benefit from computer-based system analysis. This paper analyses 12 cases of policy-oriented modelling research to to provide a basis for assessing appropriate approaches towards policy-oriented modelling work on agricultural production and other environmental services of land. First, we defined the 'boundary arrangement' for our field of interest. Five ideotypical boundary arrangements were proposed: 'Civil mandate'; 'Trickle out'; 'Janus face'; 'Critical participant'; and 'Knowledge broker'. In a second step, a number of critical leverage points were identified in policy-oriented modelling research and these were addressed in relation to the five boundary arrangements. The leverage points were: reputation of research institute and/or scientists; raising and balancing expectations; communication about and investment in the scientific basis of the modelling work; participation in model development; heterogeneous and extensive social network in policy domain; institute mandate that secures availability of stepping stones, such as persons that invest in a heterogeneous and extensive network in the policy domain and see opportunity to use modelling work developed in a more science domain oriented context. We conceive of two applications of our research for modellers who are interested in the use of their work in the policy sphere. First, the boundary arrangement classification helps to interpret the experiences of others and to assess the relevance of lessons and suggestions for their own context. Secondly, the combination of the boundary arrangement perspective and critical leverage points presents a basis to design an institutional pathway for enhancing impact of modelling research. For instance, some of the authors of this paper work in a rather science-domain oriented environment. The analysis in this paper suggests that there are more options than the frequently proposed 'more participation' for increasing the likelihood that their policy-oriented work is used, such as establishing contacts with research groups or institutes that are in a position to function as 'stepping stones', or engaging with others to develop a social network in the policy sphere.

Keywords: policy-oriented research, land use, model use, model development, boundary arrangements

Evaluating Integrated Impact Assessment (EVIA) – Results from the officer survey

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This paper presents the results from a survey among desk officers from Germany, the Netherlands and the United Kingdom, which was carried out as part of the research project EVIA (Evaluating Integrated Impact Assessment) early summer 2007. EVIA was funded by the European Commission within the sixth Framework Programme and aimed to advance the knowledge about overall practice of integrated Impact Assessment (IA) across Europe and about its actual effects, quality standards and institutional standards substantially. In particular, this survey offered the opportunity to compare to which degree IAs vary across the three covered countries regarding degree of transparency and disclosure, degree of involvement of external expertise, stakeholder participation, role of quantification and scope of IA. Moreover, determinants of sophistication of IAs (i.e. Is the IA elaborated and scientifically grounded?) are identified. The data have been analysed descriptively and statistically.

Keywords: Impact Assessment, policy making, survey

Institutionalising integrated impact assessment? The challenges of modelling-tool use

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Modelling tools are used to evaluate the potential outcomes of different policy options to provide information to policy makers. This instrumental perspective on the role of modelling tools ignores the communicative side of the policy making process. The aim of the paper is to analyse the rationales of policy developers in the European Union in their use of models to evaluate policy options with an institutional approach. Within the highly dynamic environment of impact assessment and greater importance paid to participation and transparency in the European Union, the current use of existing modelling tools can provide knowledge for the development of a new profiles for modelling tools. The focus on the ex-ante evaluation of policies on sustainability in a cross-sectoral manner poses questions of the institutional arrangements. To understand the institutional setting for model end users in the European Commission, qualitative interviews were conducted in different Director General, building on a previous round of expert interviews. The literature review, document and interview analysis is framed by the Institutional Analysis and Design Framework by Ostrom (2005). The contribution is structured as follows: 1) An introduction to the current dynamics in impact assessment in the European Commission is given. 2) The literature review concentrates on the recent findings on evidence-based policy support tools. 3) The findings of the institutional analysis focus on the dimensions of multifunctional agriculture, land use as an cross-sectoral concept, the normative policy goal of sustainability, the increasing demands of stakeholder participation in the policy making process, the challenges of visualising policy outcomes, the credibility of the data pool on which results rest and finally the targeting of model end-users. 4) Conclusions are drawn for the future design and implementation of the Sustainablity Impact Assessment Tool developed by SENSOR and for the institutionalising of policy evaluation instruments.

Keywords: institutions, impact assessment, modelling tools, end-user, rationale

Doing politics by help of Impact Assement

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To perform impact assessments (IA) of policy proposals is gradually becoming an important instrument in European policy making. The aim is wider than to merely provide a knowledge base for decision making. IA is introduced as a rational way to better regulation, but also as a tool to improve internal communication in the EU and to restore an anticipated lack of confidence in European governance. Great aspirations are placed on the IA system as a way to promote mutual learning and increased unity in European politics. The EU system is not a voting democracy but on a bargaining system in combination with deliberative democratic principles. To ensure that assessment work performed also serves its bargaining and deliberative purpose; consultations are made an integral part of the IA procedures. An IA process that meets the ideal requirement is one that involves stakeholders through out the process, so that the suggestions put forward in the final proposal are anchored on all levels in the community, which might provoke bargaining strategies rather than knowledge deliberation. Therefore assessment tools shall not be regarded simply as technical/scientific applications but as tools for communication between science and policy. In order to create integrated systems for modelling not only the modelling components have to be in place but the science/policy interfaces in the assessment procedures have to be identified and their social dynamic understood. The paper draws on the experiences made in the SEAMLESS-IF project and demonstrate the need for scientists to be conscious of the political process in which they participate. Not only the participation in assessment work but also the way work in EU funded projects is organised is part of a political progression to spread the idea of impact assessment as a political tool. The paper seeks to identify policy/science interfaces and discuss the dynamic of conflicting interests evoked in them.

Keywords: IA, bargaing democracy, deliberation, EU

Identifying options and objectives for future landscape development in Switzerland

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This project provides the basis for integrating the aspect of landscape development into the new national spatial concept of Switzerland, which is currently being outlined. This concept will provide strategic guidelines and objectives for the future spatial development of the country, which will subsequently be implemented through the revision of the national planning principles and the national spatial planning law. The current project thus (a) identifies possible options for landscape development in Switzerland within the next 25 years, (b) describes and visualises these options, and (c) creates a basis for discussion and deliberation among stakeholders and administration representatives. Based on a survey (n = 21) and small group discussions among scientists from the field of landscape research, possible options for the development of six types of landscapes in Switzerland were collected. The options were subsequently discussed in a workshop with administrative experts (n = 20), supported by visualisations of the landscape types and possible development options conducted by art students. The resulting final selection of 36 landscape development options for the six landscape types were again completed, described and put into context by the landscape scientists. Finally the development options served as input for a web-based survey among all the stakeholders involved in the participatory process conducted for outlining the spatial concept, n = 343). The stakeholders were asked to rate the options with regard to desirability and necessity for strategic guidelines in the spatial concept. The results of this survey will in turn serve as input for the events conducted in the course of the participatory development of the spatial concept. The poster will report experiences from the whole process of integrating knowledge of scientists, administrative experts as well as stakeholders, and discuss the visualization tools used.

Keywords: landscape, spatial development, participation, scenarios

Landscape of the Czech Republic in strategic political documents

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Sustainable development is a present European trend going along many political documents. Sustainable development covers not only environmentally sound economic development which preserves present resources for use by future generations, but also include a balanced spatial development, what means reconciling the social and economic claims for spatial development with area's ecological and cultural functions (ESDP). From this point of view the landscape has a very important role. It is a background for ecological, environmental and social processes as well as for economic activities. The purpose of our study was to examine the relevance of spatial landscape problems in national strategic and tactical planning. In our work we distinguish six spatial problems: Landscape fragmentation, Landscape sealing, Landscape abandonment, Brownfields, Marginalisation of agricultural land and rural areas, Non-recultivated landscapes. Although all these problems were mentioned in studied documents, most of them did not deal with these problems sufficiently. The study presented could offer a new method for political documents evaluation. The results of this study could be useful to planners and politics when improving national strategic and tactical plans that deal with landscape and establishing such landscape policy that would form a framework for other sector strategies and tactical plans. The study was part of the project no. 1P05OC059 sponsored by the Ministry of Education, youth and sports, and of the project no. 32-KJB601110701 sponsored by the Grant Agency of Academy of Sciences.

Keywords: Landscape problems, policy, strategic planning, tactical planning

A system dynamics approach applied to urban-rural linkages

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This paper presents a concept for analysing the multitude of driving forces, pressures, states, impacts and responses influencing and emerging from urban, peri-urban and rural land use relationships. The evaluation approach is based upon conceptual and quantitative causal-loop diagrams. These diagrams set up causalities between socio-demographic, economic and ecological demands and supplies using the theoretical concepts of ecosystem services and quality of life. Furthermore, decisions on land use change by the respective actors (individuals, companies and institutions) as well as bio-physical, socio-economic components and policy-related contextual constraints are taken into account in the model. Using example loops from a complex "general" model we will demonstrate how such causal-loop diagrams can be quantified using data from specific case studies with spatio-temporal representation. Finally, conclusions will be drawn regarding problems and potentials of the application of the system dynamics approach to urban-rural linkages. The approach we present is being developed within an international team of scientists collaborating in the EU 6 FP Integrated Project PLUREL (www.plurel.net). It focuses on generating deeper insights about the functional relationships between drivers, pressures, current state, impacts and (policy, ecosystem) responses in urban, peri-urban and rural land use systems. The work aims at insights on the pan-European level (EU27) and takes six European case studies as well as a Chinese reference case into account.

Keywords: urban-rural linkages, system dynamics, causalities, urban region, model

New pathways of urban sprawl and reurbanisation in European cities. Impacts of demographic change and population decrease on current urban change

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During the last decades, European cities have faced two predominating trends of development: On the one hand, suburbanisation and urban sprawl have been for a long time at the top of the agenda. On the other hand, the process of suburbanisation became intertwined by another development from the late 1980s and – reinforced – from the mid 1990s: the 'resurgence' of the inner city after decades of decline. In this vein, reurbanisation is discussed as one concept to analyse the potential of the inner city to hold inhabitants and to attract new households. Nowadays, the new framework of non-growth in many urban regions in Europe urges to re-think the future development of cities and their regions. Set against this background, the purpose of this paper is to address the question how processes of urban sprawl and reurbanisation of the core city are related to each other in European urban regions with particular respect to the new framework conditions of non-growth and demographic change. By means of findings of several recently finished international research projects, the authors discuss how reurbanisation and urban sprawl shape non-growing cities and if there is evolving a new type of urban development beyond the paradigm of growth for European cities.

Keywords: urban sprawl, reurbanisation, European city, shrinking cities, decline

Population as driver of land use change: regional-statistical analyses in European rural-urban regions

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In this paper we will present first findings from our research within PLUREL, an Integrated Project funded within the 6th framework program of the EC. PLUREL deals with the relationships between urban, peri-urban and rural land use and aims to develop strategies for a sustainable development of these interlinked rural-urban regions (RURs). A key product will be the sustainability impact assessment tool for urban-rural linkages. PLUREL applies the DPSIR-concept (Driver-Pressure-State-Impact-Response) on different European scales: from NUTS0 to LAU2 in six European case study regions. The research presented in this paper focuses on population as driving force for land use change converting open space into building land. It explores in which way population and household structure affect land use patterns and land use change and whether characteristic relationships can be derived for certain region types (e.g. urban-monocentric, dispersed peri-urban, rural, urban-polycentric) across Europe. Central-European and Austrian case studies carried out by the authors already illustrated the close relationship between population and land use patterns. Increasing demand for living and recreational space, smaller households and flows of people between urban, periurban and rural regions could be identified as major driving forces for land consumption. In this project we will examine if these findings could be confirmed on European scale, so that European-wide rules can be derived differentiating between land use related pressures in urban, peri-urban and rural regions. We will apply statistical analysis methods and carry out analyses on European NUTS3- level as well as on local scale for six case study regions (among them e.g. Warsaw, Leipzig, Manchester). Research in this field will help to understand the relationship between population and land use change in Europe, and will allow developing and improving tools to assess the future social, environmental and economic impacts of these changes.

Keywords: population, land use change, PLUREL, DPSIR-concept, rural-urban regions

Residential demand in urban - rural relationships: modelling interaction between supply and demand

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In the increasing residential demand of peri-urbanisation context, this paper intends to present a conceptual framework to better understand the relations between residential demand, urban shape and demographic dynamics trends. It will give elements of an econometric model to be developed in Plurel, quantifying the relation between residential demand and demographic variables while controlling for the urban configuration and the economic dynamics of the urban region considered.

Keywords: peri-urban, residential demand, economic dynamics, urban region

Land use changes due to peri-urbanisation: a methodology to develop response functions quantifying impacts on biodiversity and recreation on European scale (NUTSX)

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Urbanisation and urban sprawl have shaped the surface of Europe for the last decades and are likely to do so increasingly in future. Some of the most urgent sustainability issues related to landscape functions like soil sealing, pollution and loss of biodiversity are linked to urban development. In the IP PLUREL the authors develop 'response functions' (RF) describing the relationships between urbanisation-related land use changes and their impacts on biodiversity, recreation, agriculture and abiotic resources (water, soil). The paper presents a rule-based approach to develop RF at the example of recreation and biodi-versity. Both landscape functions are correlated to the same landscape attributes: (a) composi-tion (diversity), (b) structure (fragmentation) and (c) function (actual land use). For developing appropriate RF for assessing the impacts of land use changes on European scale (NUTSX), indi-cators have to be chosen that both refer to this spatial level of aggregation and take into consid-eration the complexity of landscape interrelationships Trends of land use changes, providing the spatial key information for RF, are derived by the analysis of quantitative changes of green open space (non built-up land) from 1990 to 2000 us-ing CORINE Land Cover data. Underlying research questions are: What types of open space decline? Which land uses consume open space? Is it possible to identify a European pattern of open space consumption? In the next step generic RF relate the changes in land use to changes in different landscape indicator values for biodiversity or recreational potential. The third step is a literature and expert knowledge based impact assessment. The methodology distinguishes between RF projecting the change of tangible, measurable indicators (e.g. soil sealing) and RF for aggregated indices (e.g. index of anthropogenic influence (hemeroby), index of landscape fragmentation). The former is established by using multiple regression analysis, the latter requires a more deductive approach.

Keywords: Response Function, Land-use change, Biodiversity, Recreation

An Assessment of Effects of Urban Sprawl on Rural Settlements in Metropolitan Areas: A Detailed Look for Ankara Greater City Area / Turkey

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Unplanned and uncontrolled growth demands have caused patch worked urban sprawl for two decades in the metropolitan fringe area of Ankara city, the capital. As well as the central government, the local governments (Ankara Greater City Municipality and the lower level local bodies within the municipal boundaries of 50 kilometers) have difficulties in finding solution to the problems of urban sprawl. This is also common and unavoidable problem for other developing and less developed countries. Uncontrolled urban expansion generally affects the rural settlements negatively under development pressure. These settlements change according to the short and long term needs of metropolitan areas. Deterioration of rural characteristics goes parallel with the urban development process. In this paper, physical, social and economical dimensions of transformation process which have influenced by urban sprawl in Ankara Metropolitan area will be tried to present. The following variables will be taken into consideration in the analysis: 1. Population data and population growth rates between the years of 1980-2000. 2. Changes in real estate tax values 3. In-depth interviews with real estate agencies 4. Questionnaires on local people In addition to these, in-dept interviews with local authorities whose experiences are valuable in the analysis of transformation process from the view point of future expectations will be included in the analysis. The study will also make clearer unknown dynamics and factors that are naturally embedded in transformation process beforehand. Finally physical, social and economical solution proposals will be tried to develop for problems of transformation process.

Keywords: urbanization, urban sprawl, transformation, rural, uncontrolled growth

An activity based cellular automata model to simulate population dynamics

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In land use models based on constrained cellular automata (CA), land use demands are defined exogenously, while the model computes the allocation based on transition rules. The CA model proposed in this study is constrained by total activity, and computes land use as a function of activity distribution. Hence each cell has two values: a land use state and an activity. Land use change is now simulated as a two step process. First activity are redistributed over cells based on the CA transition rules, and then land use is assigned based on this activity. The CA transition rules comprise the effects of the activity in the neighborhood, the land use of a cell, a diseconomy of scale factor and a stochastic perturbation term. As a result land use and activity are mutually dependent. In this study, we introduce a simple application and synthetically generated data to test some properties of the model. Land use is defined as 'urban' or 'non-urban', while the activity represents the number of inhabitants in a numerical value. Results of this study show that the model is capable of reproducing realistic urban patterns and realistic population distributions. Consequently, the activity based CA model can now be tested on real world land use dynamics.

Keywords: cellular automata, urban growth, population dynamics, activity based modelling

Farmland sale and transfer: urban influences on a rural land use

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Generally speaking, in decades past, the future of rural areas was deemed to be dependent on the performance of the agricultural industry; reflected in a farmed landscape. More recent approaches however, acknowledge a declining shift in the significance of 'farming' families in the rural population as compared to the expansion of para- and non- agricultural activities, a consequence of the attractiveness of rural areas to other sectors of society. Within the context of an adjusting agricultural industry, patterns of land sale and transfer can provide us with an important insight into the dynamics of land use change. The changing character of the agricultural community has implications for the land owned and managed by this group. Understanding the nature and influence of the main drivers of change in terms of land ownership, land transfer and land use, is challenging in the absence of consistent, readily available data. With particular reference to the Scottish situation, this paper examines trends in the sale and transfer of farmland paying particular attention to urban and rural relationships as they are played out as important drivers of land tenure change (as evidenced by increasing numbers of lifestyle farmers, a growth in equestrian activity and the soaring amenity value of farm residences and buildings). Following a 'gaps' analysis of existing secondary data and the collection of primary data (re farmland tenure and management arrangements), this paper proposes the use of Bayesian Belief Networks as a useful tool to structure complex (quantitative and qualitative) data sets, through which to consider the spatial and land use implications of tenure change.

Keywords: land transfer, land use change, land tenure

Sustainable planning? First results in land uptakes in rural, natural and protected areas: the Lombardia (Italy) case study

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In Italy there is a general lack of up-to-date information on land use/land cover changes besides the scarcity of monitoring systems to be used for planning and environmental policies. No official national database on land use changes exists and the last national research on this topic dates ‘80 (ITA-URB ‘80 by G. Astengo). This condition places Italy in an unfavourable position among its international partners and, above all, shows a situation of insufficient attention to a theme so important for guiding planning to a more sustainable approach. Despite this anomalous situation, something new is moving on. New geographic data are slowly becoming available for limited areas and over short temporal intervals. This is the case of the recent raster land cover database, produced in 2005, by the Agenzia Regionale per la Protezione Ambientale (ARPA) of the Lombardia Region (Italy). The database was derived for the years 1999 and 2004, from Landsat-Thematic Mapper satellite images. In this study the above-mentioned database was used to assess land cover changes between 1999 and 2004. Transition matrices were generated to highlight changes and analyses were carried out in order to verify which land cover classes experienced major changes towards artificial surfaces. Moreover land cover change gradients were investigated within specified spatial frameworks: urban versus suburban areas, urban versus rural areas, areas adjacent to transport networks, protected versus non protected areas, fluvial areas versus open countryside areas. We consider the obtained results of outstanding importance, especially in Italy, since they might redirect planning strategies and environmental policies (from local to regional level) towards more sustainable approaches, such as those based on the precautionary ecological compensation principle. Additionally they might show weaknesses and success strategies and strengthen the role of land use/land cover monitoring for preliminary impact assessment.

Keywords: land uptake, land cover change indicators, strategic environmental assessment, natural and semi-natural areas, ecological compensation

Regionalisation of population and residential land use scenarios for the Elbe river basin

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The paper presents a method and results for the generation of future residential land use scenarios for the Elbe river basin. The challenge of this study is to develop scenarios that consider two processes, accelerated urban sprawl in growth centres and depopulation in peripheral regions. The results are required as an input for the subsequent analysis of effects of socio-economic change on water resource management in the Elbe basin, within the context of a project on "Global Change in the Hydrological Cycle" (GLOWA Elbe). The approach consists of 3 steps. First, a regional economic model is used to regionalise the scenarios of the IPCC-SRES to spatial planning regions. In a second step commonly used approaches for the calculation of residential land demand within spatial planning regions are reviewed. An approach was chosen that includes existing projections about population growth, households and economic development. The Land Use Scanner, a spatially explicit land use change model, is then used to allocate the demand on a 250 meter grid within the spatial planning units. Driving forces for spatial allocation of residential land use are identified using statistical analysis. Two possible trajectories of regional economic development in combination with two orientations of land use policy are analysed. On the level of regional economic development the scenario of higher growth rates translates into a continuation of urban sprawl and further increases in residential land. In the scenario of lower economic growth rates this translates into stagnating residential development in peripheral areas. In scenarios with strong environmental policy the demand for residential land reduces and results in relative increases in population density. The advantages and problems of generating spatially explicit patterns of future population density and settlement areas are discussed in relation to the requirements of water use modelling on the scale of river basin units.

Keywords: land use change, residential land, land use modelling, scenario analysis

Land Use Changes in Berlin after the fall of the Iron Curtain. Governance paradigms shaping an urban landscape

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Urban to suburban land use changes in Berlin are closely related to effects stemming from the fall of the Iron Curtain in 1989. Processes of urban shrinkage occurred in parallel with urban growth and densification, making Berlin an ideal test-bed for analyzing the influence of changing policies and institutions on urban-rural landscapes. However, exact figures comparing formerly Eastern and Western Berlin are difficult to obtain, as no reliable reference data was available from socialist Eastern Berlin. This research accordingly focussed on detecting and quantifying the structural change of Berlin based on remote sensing methods since socialist times. We used the fraction of photosynthetic active vegetation in remote sensing data as an indicator describing economic change. Image classification based on machine learning algorithms (here: support vector machines, SVMs) seems to outperform classical ways of urban image analysis. We therefore performed an SVM-based change detection on Landsat TM/ETM+ data to analyse changes between the socialist and post-socialist era. Post-socialist processes led to remarkably different patterns in formerly East- and West-Berlin, as well as Berlin's suburban hinterland. Most prominent are derelict industrial sites in East Berlin and the re-wilding or restoration of the former Berlin Wall. From a remote sensing perspective, the related increase in vegetation cover is evident, while Western Berlin exhibits rather stable vegetation patterns. Stratified analyses of different urban structural types prove that results from high resolution satellite based remote sensing can be linked to economically induced urban land use changes. Our results suggest that changing policies and urban governance along with an abrupt economic decline of formerly heavily subsidised industries re-shaped large areas of Eastern Berlin during the last 15 years.

Keywords: Berlin, Re-unification, remote sensing, urban vegetation, urban growth and shrinking

Private gardens: single small but multiple big at regional level and in environmental perspective

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In the "environmental equations", the survey and the monitoring of both components and processes of the environment at regional scale, private gardens tend to be missing. With urbanisation going on not only in the city fringes but also in the rural area, gardens are collectively becoming a major form of land use. They are not only to be considered as microlandscapes of different functionality (production, biodiversity, recycling, recreation etc.) but also as intimate media of the relation of society with nature and environment. We will present results of a regional-wide internet survey of garden components and activities in Flanders (northern Belgium), and of more detailed research in sample gardens in a pilot municipality. The objective is more precisely to be able to link easily measurable characteristics of the garden or of garden complexes (such as the total area of lawn) with input and output characteristics (such as the use of fertilizer). The results can then be upscaled to regional level, in order to be able to assess the overall importance of private gardens next to other major land use categories.

Keywords: private gardens, soil cover, urbanisation, inputs/outputs, Flanders

Blog, blogospreher, innovation diffusion and location processes in the rural and urban web environment - global and local models

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Abstract Weblog or blog has not in global genre of its own. Often it is characterised as new media and used in communication, companies and many institutions as a part of their interest group relations. The bloggers of the web community form a blogosphere or a blogostan. Today, there are near 100 million active information producers. It can be considered the largest global factor related to innovations and their diffusion for the web environment, the individual person, the community, society and the economy, as well as the largest social and cultural phenomenon since the birth and spread of the internet. Blog and blogosphere research in the web environment can be divided into the following tasks: 1) The research tries to identify a set of tools with which the scientific community can operate in the new web environment in a creative and innovative way. 2) The second task is related to communication that can cross cultural borders and is not hindered by hermeneutical thresholds or the cultural practices of producing or receiving information. 3) The third set of tasks studies the structures of blogs and the cultural differences between them as well as the global variance in producing and receiving the information of the web environment. The research material is from 2000-2007. The methods include multivariate methods designed for processing of large masses of data, factor and cluster analyses and structural or delphoi-type intuitive step-by-step processes. Web environment research naturally covers all diffuse processes of rural areas concerning diffusion models, communication models, interaction models and network and cluster models. The web environment is the most important rural development target in all key sectors of innovation policy: technology-based, science-based, cost-based, customer-oriented or generic innovations as well as innovations based on regulation. The blogosphere resembles the cluster in many ways. It is often problematic to observe this if one only acts as a producer of content for a blog. The blogosphere is a network of networks, in the same way as a grid has been visualised as the data network of future data networks. Together, these form a kind of a global meganetwork. In the blogosphere, persons participate in the activity as individuals and with their whole personality, not as reflections of a certain role or institution, culture or organisation. Traditional media even in its electronic form relays ”news” whereas the blogosphere creates them. Here, the blogosphere is ”rational”, multicultural and appreciative of its own, e.g. ”creative class” for the innovation process. In practice, the web environment changes all our traditional ideas concerning organisational research, but also our localisation theories in the rural areas. Four large homogeneous main groups and two relaying groups can be created. The first of these is the diverging telecity innovator group representing the creative class, the second one a processing and sub-innovative but converging group of postmodern ramblers or flaneurs, the third one a pragmatic

and harder group of intrepreneurs and the fourth one the group of gamblers that has the weakest morale. There are no big differences between rural and urban areas. Rotating the factors or engineering the variables causes less variance than the exclusion of major blog areas. The structure changes the most by excluding the European blogs from the model. Spatially, global variance is greater on the north-south axis than the east-west axis. In the processing and reception of information Asia is closer to Africa but in the production of innovation the United States and a few metropolis dominate. The processing and separation of information, its areas, interests and acquisition happen as a task breaking the invariance and are analogous to the protein synthesis. The process is extremely rapid, self correcting and easiest to understand with a social philosophy where the given laws are critically mystified, also in natural sciences. This is very importan when we speak of rural areas and ecological cluster in web environment. references www.mtt.fi/met/pdf/met70.pdf (english summary) www.mtt.fi/met/pdf/met102.pdf (english summary) see also www.mattiluostarinen.fi or www.clusterart.org

Keywords: blog, weblog, blogosphere, innovation policy, web environment, network, cluster, diffusion models

Issues on urban rural linkage through biomass utilization in Asia – A comparative study on Japan, China and Vietnam

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While world-wide demand for biomass such as biofuel made of corn and sugarcane is growing, it is predicted that unused agricultural residues and abandoned arable land may increase in developing countries due to changes in diet and rural farming systems. Production of agricultural crops and biomass energy often relies on demand in urban areas. Biomass use matters relationship between urban and rural areas not only through material and energy exchanges, but also through history, culture, tradition and social context of each region or country. This paper identifies and discusses issues on urban rural linkage through biomass utilization in Asia, comparing cases in Japan, China and Vietnam. The issues include some common aspects characterized by climatic, ecological and cultural background in Asian countries, and problems and challenges unique to respective country, such as the expansion of abandoned arable land and forest recovery in Japan; the water shortage, growing demand for food, rapid increase in food imports, and underuse of biomass wastes in China; and soil degradation and biodiversity loss due to intensive agricultural production, and the future change in the demand for rice due to diet change and population growth in Vietnam. The paper also examines the risks, potentials and trade-offs of urban rural linkage modification associated with the prospective expansion of biofuel production and consumption in these countries. Discussing these issues, the paper intends to provide the implications for developing more sustainable future scenario and natural resource management in Asia.

Keywords: urban rural linkage, biomass, biofuel, trade-offs, future scenario

Governing farmland conversion: Comparing China with the Netherlands and Germany

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Farmland conversion has become an increasing concern in China and other parts of the world, including Europe and the USA. Be it for environmental or food security reasons, questions arise concerning how urbanization should be governed, i.e. what rules and regulations could enhance the efficiency and sustainability of land use. Taking a first step toward answering such questions, this paper describes different governance structures for farmland conversion in the Netherlands, Germany, and China. Secondly, it compares five identified differences between these countries in the realms of land property, land use planning, the role of the market, the role of government, and the performance of governance structures. The purpose of this paper is to develop an approach for comparing governance structures for land conversion that a) offers some opportunities for exchange of experience between the three countries and b) provides a framework for further research on governance structures in farmland conversion.

Keywords: land conversion, land development, governance structures, Europe, China

Regional development policies towards "harmonious urban-rural relationship"

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Urbanization is a major theme in economic development. In most of the developing countries urbanization is accompanied by the continous rural to urban migration. Unbalanced development between the urban and rural areas and development problems caused by urban-rural dualism are the most important problems in less developed and developing countries' agenda. Because of the inharmonious relation between the urban and rural development, the urban-rural relationship is changing rapidly and the dualism increases. There is a tendency that the countryside is being neglected and the urban-rural gap in both income and living conditions is increasing. Instead, a balanced and a supportive development approach should be adopted for these closing the gap. Regional development models through urban-rural relationship have important place in European Union and Habitat agenda. For the economical, social and environmental integration and relations of the urban and rural areas a new structure, explain the urban rural integration development approach is now common for regional development. "Harmonious urban-rural relationship" development model will provide: - The integration between urban and rural areas, - Equality and dependency for the two side - Common responsibility and partnership The aim of the study is to analyze the "urban-rural relationship" development process which is essential for regional development policies. Changes in the policies are analyzed in an historical process and current agenda is also considered. Concept of region, the transformation of regional development and the importance of "urban-rural relationship" development models in the regional development policies in an historical process are the main parts of this study. The literature survey about the "urban-rural relationship" development models in the regional context and the review of these studies are the methodology that followed by this study.

Keywords: Regional development, integrated spatial development, urban-rural partnership, less developed areas, harmonious urban-rural relationship

The SENSOR approach to scenario design

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Scenarios may be constructed to forecast the future, to explore the consequences of a hypothetical event, or to examine the effects of a policy. These different objectives lead to different types of scenarios. The paper will attempt to classify the various approaches in use in policy-oriented research today, and explain how the SENSOR approach fits into this classification. As a decision-support system, SENSOR is more oriented towards policy evaluation than towards scenario analysis: the latter is the means, the former is the end. Therefore, a sharp distinction is made between policy scenarios showing what would happen if a certain policy were implemented and baseline scenarios sketching the counterfactual. For baseline scenarios, SENSOR built a reference scenario consisting of trends for five major drivers of change. These trends are either extrapolations of what happened in the recent past, or, where such extrapolation is considered unrealistic, based on the output of relevant models spiced with expert judgment. In order to allow the end user of the system the possibility to design and test his own policy scenarios, the latter are set up through the intermediate of policy cases: problem areas that affect multifunctional land use and that are likely to be relevant to EU policy-making over the next ten years or so. For each policy case, a narrative is made describing the problems to be addressed by the policy, the objectives to be achieved, and the instruments to be used. For modelling purposes, these instruments are translated into policy variables, several settings of which are calculated by the models. On the basis of these settings, response functions are constructed which are then entered into the interface software. With the response functions, users of the system can now build their own scenarios by interpolation.

Keywords: scenario, policy evaluation, multifunctional land use

Scenarios: a framework for policy support for EU Sustainability

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At the European level policy is driven by the Sustainable Development Strategy, which was renewed for an enlarged EU in June 2006. This Strategy actively seeks to promote the integration of economic, social and environmental considerations and sets out an approach to policy-making based on better regulation and on the principle that sustainable development is to be integrated into policy-making at all levels. One way to support this aim is through the development of robust and scientifically sound baseline and alternative scenarios, which can be important sustainability impact assessment tools. While scenario development is now an established tool, many focus only on one sector or one dimension of a problem, ignoring the inter-linkages or cross cutting issues that contribute to these problems. In addition, many do not have an EU focus and thus results have to be extrapolated or inferred from available data. This paper describes a back-casting approach to integrated scenario construction, derived from a Bayesian network driven by a series of cross-sectoral environmental, social and economic indicators. The investigations are based on a 6th Framework Project, FORESCENE (www.forescene.net). Bayesian networks were used for the synthesis of a range of information sources into a single model because they are flexible, transparent and relatively straightforward to use. They also have the capacity to efficiently capture the connections and interactions that characterise sustainable development. The resulting scenarios have an EU focus but also attempt to address the issue of trans-regional sustainable development or 'problem shifting'. These scenarios (describing the possible outcomes of policy options) will provide a useful sustainability impact assessment tool, to highlight the potential consequences of political decision-making for all dimensions of sustainable development.

Keywords: Scenarios, Sustainable development, Bayesian network, European Union, Sustainability impact assessment

Assessing impacts of EU agri-environmental policies and technical innovations on farming systems sustainability: how to translate policy questions into SEAMLESS-IF compatible scenarios?

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Scenario approaches in environmental and policy assessment studies are increasingly applied in Integrated Assessment and Modelling (IAM) frameworks. The SEAMLESS-Integrated Project aims at developing such an IAM framework to assess, ex-ante, impacts of agricultural, environmental and rural development policy options and agro-technical innovations on the sustainability of agricultural systems and on sustainable development at large. The main challenge of this project is to develop a generic framework, which translates a diversity of policy experts' questions into scenarios that can be implemented in the modelling chain of the framework. The definition of scenarios has to comply with the aim of the framework: to assess impact of different change factors across hierarchical levels (from field to global). Accordingly, a scenario definition and assessment procedure has been developed which is subject of this study. The procedure is composed of three main phases. In the pre-modelling phase integrative modellers, who set up the IA project in the SEAMLESS-Integrated Framework (S-IF), interact with policy experts to capture and rephrase their questions into a set of scenarios. These scenarios describe through three sets of parameter i) the exogenous driving forces (e.g. demographic and climatic evolutions) ii) the agricultural policy context (i.e. combination of policies and policy options) and iii) the agro-technical context (i.e. technical innovations). To complete this phase Policy experts have to select key indicators used to assess scenarios. The modelling phase corresponds to the implementation of scenario parameters into S-IF by the integrative modeller, who then runs a suitable model chain to calculate indicator values for each scenario. Finally the post-modelling phase allows reviewing and analysing assessed scenarios. The first phase of this procedure has been evaluated with policy experts at regional and national levels, while for the second and third phase two prototypes of the SEAMLESS-IF have been tested.

Keywords: scenario, impact assessment, agricultural systems

Assessing the environmental performance of spatial plans through land use scenarios

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This contribution discusses the role of land use scenarios in assessing the environmental impact of spatial plans, with specific reference to the EU mandatory procedure of Strategic Environmental Assessment (SEA). First of all, the provisions of a regional Plan were spatially resolved in quantitative, and in some cases qualitative terms. This allowed to simulate future land uses, by paying special attention to elements, such as urban growth, natural resource protection, tourism facility development and encroachment of agricultural areas. This analysis was performed by using „What if?“, a GIS-based system that supports the generation of alternate futures and the preparation of long-term projections. Several scenarios were built, by simulating different states for few key variables: expected economic and population growth, enforcement of environmental standards, and the actual degree of compliance with the provisions of the planning tool under analysis. Subsequently, the environmental impacts of the land use scenarios were spatially predicted and assessed by computing a set of indicators aimed at detecting: - Changes in urban quality (e.g., accessibility to recreation areas; availability of public transport; distribution of undesired land uses with respect to population density); - Disturbances to natural ecosystems and protected areas (e.g., interference with ecological networks; soil loss) - Evolution of urban sprawl and the rationale use of space. Impact maps were generated and combined so as to provide a representation of the environmental performance of the Plan. It was then possible to assess the Plan's consistency with environmental sustainability objectives, and consequently to suggest modifications and mitigation measures. The approach was tested in three municipalities in Trentino, an alpine region located in northern Italy. The Spatial Coordination Plan of Trentino was used to develop possible land use scenarios, which was then refined by taking into account also the provisions of planning tools at local level.

Keywords: Strategic Environmental Assessment, Spatial indicators, Urban quality, Sprawl, Ecological network

Do CAP policy scenarios meet future development scenarios of rural areas? Simulations on land use changes by typical farms and the impact on multifunctionality

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The latest reform of the European agricultural policy aims at stimulating more competitiveness on global markets, more environmental soundness, supporting rural viability and better meeting consumer demands. From 2013 further far-reaching policy changes are expected leading to on-going adaptation processes of European farms that will change the rural landscapes and their socio-economic conditions drastically. The EU-project MEA-Scope has developed alternative future scenarios of the Common Agricultural Policy (CAP) targeting towards specific rural development potentials. In this paper, we present the methodology to derive the scenarios, and selected results for seven MEA-Scope case study regions in Germany, Denmark, Italy, France, Poland, Slovakia and Hungary. To identify main drivers of the future development of the CAP, MEA-Scope applied a participatory approach that involved regional stakeholders, EU officials, scientific experts and computer modellers, eventually resulting in four alternative EU policy scenarios (status quo, competitiveness, environment, rural viability) with varying 1st and 2nd pillar policy settings of the CAP, 2002 as base year and a time horizon of 15 years to be covered. The scenarios were implemented in a complex modelling procedure, involving an agent-based model (AgriPoliS), a bio-economic farm model (MODAM) and a Nitrogen flow model (Farm-N) to simulate the dynamics of structural and management change and their impacts on multifunctionality indicators for all farms in our case study regions. Soil fertility, designation status and socio-economic variables were used as criteria to identify political priority areas (‘target areas’). It could be proven that farms located in target areas react differently with regard to the adaptation processes of the farms than the case study average. Despite of sometimes radical land use changes of single farms, a geo-referenced multifunctionality impact assessment eventually showed less distinct impacts from average than expected. On the other hand the analysis identified several farm types that provide unexpected positive synergies.

Keywords: scenarios, policy targeting, multifunctional agriculture, modeling, impact assessment

Evaluating today's landscape multifunctionality and providing an alternative future: a normative scenario approach

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Over large areas, European landscapes do not fulfil the requirements of the concept of multifunctionality. Intensive agriculture in particular has multiple negative effects on environmental and societal landscape attributes. On the other hand, less intensive agricultural production systems may be unsustainable from an economic perspective. In general, the degree of landscape multifunctionality is hard to be evaluated for a given landscape as long as 'multifunctional reference landscapes' are being missed. In this context, designing multifunctional landscapes by means of normative landscape scenarios - that 'portray futures that should be' [1] - may be helpful. Given the example of the Wetterau, an intensive agricultural landscape in Hesse (Germany), we present a normative scenario approach that aims at an interdisciplinary evaluation of today's landscape multifunctionality with the objective to inspire policy makers and land users by providing an alternative future. Our approach comprises the following steps: (1) documentation of today's land use at the scale of uniformly managed land units, (2) detection of functional deficits of today's land use considering environmental (biodiversity, groundwater production, water quality, soil contamination, soil erosion), social (landscape perception by its population) and economic (ground rent) attributes, (3) compilation of a catalogue of alternative land uses suitable to minimise the detected functional deficits, (4) determination of rules for the incorporation of alternative land uses in a normative scenario through interdisciplinary expert discussions, (5) rule-based modification of today's land use pattern in a normative scenario, and (6) comparison of today's landscape and the normative scenario with respect to multifunctionality by applying the spatially explicit and GIS-based SFB 299 model network ITE²M [cf., 2, 3]. In our presentation, we will briefly present and discuss results, advantages, and limitations of our approach.

Keywords: spatially explicit modelling, landscape attributes, sustainable agriculture, decision making, Germany

Participatory Scenario Processes for Supporting Transitions towards Sustainable Land Development

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Against the background of increasing anthropogenic influence on the life support systems of planet Earth, the need for transitions towards more sustainable land development is widely acknowledged. Spatial scenario-based studies arguably have great potential to contribute to such transition processes by informing decision making about the potential consequences of today's policy alternatives. While scenarios have therefore been applied in a growing number of studies, little work has addressed the question of how such studies could be designed and conducted to most effectively contribute towards the needed transition processes. This paper will draw on concepts for intentionally influencing transitions towards sustainability and recent findings on the effectiveness of environmental assessments on decisions in general to develop a set of requirements for scenario based studies to be influential. Against this background, recent case studies of spatially explicit scenario-based assessments from Europe and North-America will be reviewed and evaluated. Methods for participatory scenario development will be introduced and their potential for increasing saliency and legitimacy discussed. The paper contributes to the current debate on both approaches for better integrating qualitative and quantitative information in scenario building and participatory scenario development as a tool in the emergent sustainability science toolbox in general.

Keywords: scenarios, participation

Local actors involvement to develop scenarios of a sustainable future for landscape and society in an Alpine region - the Montafon experience

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Global change has many faces affecting different regions by different impacts, each requiring certain strategies to cope. Within the project future.scapes three regions, representative for Austria, have been selected: an industrial city, a remote cropland farming region and an Alpine landscape shaped by cattle breeding, forestry and winter tourism. During the development of local future scenarios, impacts are explored and strategies are derived to achieve sustainable future development of landscape and society suitable for certain regions. The presentation concentrates on scenario development for the Montafon valley in Western Austria, an Alpine region affected by climate change, social and landscape transition. Landscape attractiveness and winter climate play a key role for the future development of the region as tourism is a key sector of the local economy and therefore for societal wealth. Here, drivers of past and future transition have been explored through qualitative and quantitative scenario analysis. Qualitative future scenarios were developed by local actors, exploring local systems dynamics during the development process. For the participatory discourse, impacts on the landscape through these scenarios were simulated using an agent based land use change model which reflects the main decision-patterns of the local population. The local population actively alters the landscape by constructing roads and houses, and passively through agricultural extensification. Further, a rise of timber line due to global warming is included which might also heavily influence landscape attractiveness. To model future changes, transition probabilities considering various spatial characteristics have been derived from observations of earlier settlement growth and forest expansion. The model delivers spatially explicit land use maps of scenario runs which serve as decision support for the local actors. In the final workshop planned in January 2008, the local actors will be confronted with results of several scenario runs to valuate them, and discuss, define and adapt strategies to achieve a favourite sustainable future scenario.

Keywords: Alpine tourist region, global change, sustainable future development, participatory scenario development, agent-based land use change model

Does participatory scenario development keep its promises? A reality check for land use change assessment on a European scale

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Land use change cuts across a wide range of policies, ranging from agriculture to rural development and from transport to tourism and housing policies. Accordingly, there is not one single community of policy-makers, but a rather diverse setting of actors with divergent interests and information needs. If land use scenario analysis should fulfil its prime functions effectively, i.e. raising awareness and contributing to supporting decision-making, finding a format that is broad enough to accommodate the divergence of these interests and information needs, but focused enough to maintain scientific manageability poses a challenge for research. The PRELUDE project (PRospective Environmental analysis of Land Use Development in Europe) of the European Environment Agency (EEA) combined a qualitative and quantitative analysis of long-term land use change with an extended participatory approach, following widespread suggestion in the literature that participatory approaches can help to increase the originality, credibility and legitimacy of scenarios. However, little to less work has been conducted that analyses whether the benefits proposed in theory materialise in reality, or not. Does it pay off to go down the – challenging – road of developing long-term contrasting scenarios in a participatory manner? This paper addresses this question on the basis of an extended analysis of the outreach process for the PRELUDE project, where the EEA engaged a wide difference of policy communities in strategic discussions about long term land use change. The paper, after presenting the general approach to and key findings of the PRELUDE project, highlights the experiences and lessons learnt and draws conclusions for the further design of scenario development. Based on a typology of outreach action following the type of audience and type of discussion it discusses the respective suitability of participatory approaches to land use scenario development. In general, the paper suggests a positive answer to the question raised above. If scenarios want to trigger strategic conversations among key stakeholders that are normally out of reach due to undisputed processes of day-to-day politics and want to open up discussions across policy areas and networks which can help to foster integrative policy approaches, they need a broader, more integrated framework of analysis.

Keywords: Participatory scenario development, typology of outreach action, European land use change scenarios

Scenario techniques as a tool to monitor urban land use perforation. Experiences from Eastern Germany

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Demographic change and economic decline produce new pattern, densities and dynamics of urban land use. Compared to the beginning of the 90s after the German reunification, nowadays massive vacancies in the housing and commercial sector come to pass in eastern Germany. In consequence of large-scale demolition procedures, a considerable surplus of urban brownfields and an increasingly perforated land use structure have been created. Furthermore, the decline of the urban fabric affects local livelihoods, social infrastructures and urban green systems. In order to quantify such land use perforation in terms of its socio-environmental impact on urban greenery and the residents, a multi-criteria assessment scheme (MCA) was developed and applied to two different neighbourhoods of the city of Leipzig, eastern Germany. There we have Leipzig-Grünau a prefabricated socialist housing estate on the one site and Leipzig-East – a Wilhelminian old built up housing estate. In a second step demolition scenarios for the coming 20 years were applied in order to give an idea for a long-term monitoring approach at the local district level. In doing so, for each indicator value of the MCA a range of states had been created following the land use development along the scenarios. In our study different scenario techniques have bee applied to provide the user with data on the variability and 'typical' change rates for the respective urban structure type. Whereas for previous states historic data on key land use elements can be used to compile a 'historic land use status' (Haase et al., 2007b) field mapping and the survey of current arial data has been executed to monitor the current land use of a status quo scenario. For the future scenarios (up to 2020) another methodology was applied: based on existing planning documents and expert interviews, reference scenarios were created that represent a likely future for all relevant aspects for both test areas Leipzig-Grünau and East Leipzig. The study shows that the development of different forecasting scenarios improves an impact assessment of both demolition and perforation processes to enhance the quality of the urban green system on the one site and to preserve the quality of life of urban residents on the other.

Keywords: scenario, urban land use, impact assessment, shrinkage, green quality

Food Security in Sub-Saharan Africa and Biofuels: A Quantitative Analysis

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The recent expansion of biofuel production has raised commodity prices; e.g. the price of maize has increased about 60 percent in the last two years (World Bank, 2007). The aim of this paper is to analyse the impact of further biofuels development on food prices and food security in Sub-Saharan Africa, where the proportion of undernourished people currently amounts to about 32 percent of the total population (FAO, 2006). Our analysis focuses on two opposite effects of a price increase – the increased expenditure effect on ordinary consumers and the agricultural revenue effect, which increases the purchasing power of some farmers' households. The Global Forest and Agricultural Sector Optimization Model is applied. Global FASOM is a partial equilibrium model, based on maximization of the market welfare, operating globally with the country resolution. Yield parameters were estimated by the G4M model for the forest module and by the EPIC for the agricultural commodities. The model contains several biofuel production technologies. The prevalence of undernourishment is estimated by two different methods: 1) the FAO method (FAO, 2003), and 2) the calorie-income curve method (Timmer, 2000), used to assess the amount of the income effect. We compare the impacts of substitution of 10 percent of the 2020 projected transport fuel consumption by, on the one hand, biofuels based on conventional feedstocks (sugar cane, maize,…), biofuels of the first generation, and on the other hand, biofuels based on woody feedstock, representing the second generation technologies. The major conclusions are: 1) Using the FAO indicator, the second generation biofuels development would be neutral to the nutritional situation of the region. 2) If only first generation biofuel technology were available, the prevalence of undernourishment would increase by 4 percentage points. 3) If we adjust the undernourishment assessment by taking into account the income effect, the first generation biofuels still lead to a negative impact, but the second generation biofuels development reduces the undernourishment to 15 percent of the total population. Nevertheless, this result assumes the capacity of Sub-Saharan Africa to export the final product – methanol.

Keywords: biofuels, food security, partial equilibrium models, Sub-Saharan Africa

Integrating land use implications of biomass trade in national policies: Towards a sustainable biomass strategy

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The topic of biomass has become one of the most discussed options for the development of sustainable energy and resource systems. The heated debate on energy security and fossil fuel prices has triggered an intensive search for alternative energy carriers and biomaterials. The pressing need for effective greenhouse gas abatement measures provides another argument for bioenergy based on the wide-spread assumption of its "carbon neutrality". But will biomass hold the promise as base for sustainable energy and production systems? What about sustainability impacts from offensive expansion of non-food biomass uses? The paper reviews current knowledge on the use of biomass for non-food purposes, critically discusses its environmental sustainability implications, and highlights further research needs, thus enabling a more balanced policy approach. Based on the analysis of biomass markets the current global land requirements of Europe and Germany will be presented. Scenarios will highlight the future perspectives of the land requirements as result of relevant current national and international biomass policies. However, due to limited global land resources, non-food biomass may only substitute for a certain share of non-renewables. The current aspirations and incentives inevitably lead to an expansion of global arable land at the expense of natural ecosystems such as savannas and tropical rain forests and are thus bound to a high risk of problem shifting. They may even lead to a global deterioration of the environment. Although the "balanced approach" of the EU biomass strategy may be deemed a good principle, the concrete targets and implementation measures in the EU and countries like Germany should be revisited. Likewise, countries like Brazil and Indonesia may revisit their strategies on natural resource use. The paper reflects results from ongoing research projects for the Federal Environmental Agency, the German Ministry for the Environment and the Ministry for Economics and Technology.

Keywords: biomass strategy, global land use, policy assessment, sustainability impacts, greenhouse gas emissions

The impact of CAP reform and EU climate policies to world's economy and ecology

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In 2008 the European Commission will release its climate and energy policy package to take the lead in the globe's combat against climate change. Simultaneously, the European Union would like to take further steps in global trade negotiations under the flag of the WTO, including its own reform of Common Agricultural Policies (CAP). However, these policies cannot be seen separately from developments outside the EU. Production of bioenergy products is more profitable outside Europe, which will lead to consequences on agricultural income in biomass exporting regions like Brazil and Indonesia, but will also impact the biodiversity in those same regions. And trade liberalization will also lead to shifts in current agricultural production with opportunities, but also threats to communities outside the EU. In the EUruralis project, the global context is one of the crucial aspects that is included in the modelling approach of this European land-use study. We conclude that the CAP reform is shifting agricultural production to large food exporting regions like Brazil because of cost minimization. However, cost minimization of production is not necessarily equal to the lowest environmental pressure on land. In EUruralis it is shown that trade liberalization leads to a global increase of agricultural land, resulting in biodiversity loss in regions like Latin America. Moreover, the introduction of the Biofuel Directive will also have global consequences. In a liberalized world, more than 60% of the biofuels are imported from outside Europe, of which around 40% comes from Brazil. The coinciding land-use impact will further deteriorate global biodiversity outcomes, worsening the chances to meet the global biodiversity target. These external impacts of EU policies need to be taken into account in future CAP and biofuel discussions.

Keywords: Land-use, Agricultural income, Biodiversity, Biofuels, CAP reform

CompasSus – Compass of Sustainability A contribution from the University of Brasília to the search for a sustainability model

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Aiming at the current need for assessing sustainable development processes, the objective of this article is to propose a new assessment model. The idea is based on both an original conceptual framework and existing methodologies, such as the Human Development Index (HDI), SENSOR, Ecological Footprint and Barometer of Sustainability, evaluated under the perspective of their different operational concepts of sustainable development. Among econometric models, the Index of Sustainable Economic Welfare (ISEW) and NEMESIS are considered. The ecological-economic literature on weak and strong sustainability has explored some important values and interpretations affecting a desired operational concept of sustainability. The question is: how to define the sub-set of natural capital for which man-made substitutes are not achievable? According to a less extreme version of strong sustainability, a limited stock of natural capital should remain preserved, among which a stable climate, stratospheric ozone, or life-support systems in general. As for addressing trade-offs between economic growth and environmental conservation, the Compass of Sustainability (CompasSus) introduces a Hemispheric Assessment of Sustainability: whereas the western hemisphere represents a weak sustainability approach with a focus on local/regional impacts; the eastern hemisphere mirrors a strong sustainability focused on global impacts and its implications, by considering critical natural capital an important component of sustainability. Looking at the Brazilian case within the LUPIS EU-Project, conservation strategies are needed to protect the world's largest tropical rainforest against a predatory business-as-usual frontier expansion. On the other hand socio-economic development is a legitimate demand of the Amazonian residents (12% of Brazil´s population) living in a region that occupies 58% of the Brazilian territory and produces just 7% of the country´s GDP. Preliminary results using the CompasSus model indicate its potential to combine strengths of both weak and strong sustainability approaches so that a more comprehensive notion of sustainability is achieved.

Keywords: sustainability, modelling, trade-offs, global x local, strong x weak sustainability

Trade, tradition and environmental conservation; corn and jalapeño pepper cultivation in a national protected area in Mexico

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This article is based on a research project carried out in the municipality of Calakmul, in the southeastern portion of Campeche, in Mexico. Calakmul is particular because it is the first ecological municipality in the country, having three natural protected areas which cover approximately 85% of its municipal territory. In addition, its inhabitants come from 24 different states and belong to a variety of ethnic groups. Building on the case of this municipality we explored which factors have determined the current trade-production dynamic for traditional-commercial crop production in Mexico. Corn and Jalapeño pepper are taken as examples because we think that both are affected by a national and international competition dynamic produced by the free trade process. This can be observed in the growing corn imports coming from the United States and those of peppers coming from China. In spite of this, the production of both products is still important in the area, although there are other crops which appear to be more profitable –such as vegetables-, which are also better suited to contribute to the protection of Calakmul's natural resources. Therefore, we think that in addition to market dynamics there are other factors which affect production, commercialization, land use changes and environmental protection, which should be taken into account. For this reason this work analyzes the interactions between the trade-production process, considering the influence of traditional practices of different ethnic groups and the dynamics posed, on the one hand, by the national and international market competition and, on the other, by conservation demands required by the natural protected areas.

Keywords: Land use changes, Environmental protection, Traditional practices, Free trade, Natural protected areas

The Land Use Policies System of China

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This report pay emphasis on the land policies of China,not only introduce the central government land policies, but also talk about the local government land policies, and contrast with Europe land policies.

Keywords: land policy, land use policy, China policy

Regional policy impacts – scenario-wise analysis of land use dynamics and environmental effects in four case-study regions of the MEA-Scope project

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The EU-STREP MEA-Scope (2004-2007) has developed a tool for the ex-ante assessment of policy impacts on the multifunctional role of agriculture. This paper compares economic and environmental trends in the four case study regions Ostprignitz-Ruppin (Germany), River Gudenå (Denmark), Mugello (Italy) and Piešťany district (Slovakia) which are very heterogeneous in terms of geo-physical and socio-economic conditions. Using the MEA-Scope modelling approach, the impacts of four alternative policy scenarios of EU's Common Agricultural Policy (CAP) are analysed (Agenda 2000, decoupling, liberalisation with and without 2nd pillar programs). The modelling approach is based on three farm-level models (AgriPoliS, MODAM, FASSET) and makes it possible to analyse dynamically both the structural change of the farming sector and agricultural-management-related environmental impacts. The chosen indicators for this analysis involve several abiotic and biotic environmental indicators and also economic and structural indicators such as farm income, farm size, livestock densities, participation in 2nd pillar programs of the CAP etc. The modelling results show that the same scenarios applied to different regions can lead to sometimes opposite or conflicting results with regard to the environmental and economic performance of the farms in the regions. Although the decoupling of direct payments, for example, led to a clear intensification on arable land in all regions, this overall intensification was not necessarily accompanied by an increasing mean farm income. In the liberalisation scenario, for example, 2nd pillar programs were of particular relevance for the analysed biotic indicators in all regions, but participation in these programs could only partly compensate occurring income losses from the 1st pillar of the CAP. The modelling results therefore demonstrate how much the diversity of European regions matters for practical policy implementation and that farm-level modelling tools are a valuable add-on for more aggregated tools to provide effective decision support at all scales.

Keywords: MEA-Scope, economic-ecological trade-offs, CAP, land use dynamics, regional policy impacts

Transferability Constrains: implication of the use of an European-developed Impact Assessment Tool to MERCOSUR

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SENSOR project aims to develop, validate and implement sustainability impact assessment tools (SIATs) to support decision making on policies related to land use. SENSOR has an extension branch that aims to adapt the European approach to extra European conditions in Targeted Third Countries (TTC). To apply the impact assessment methodology used by SENSOR to develop a SIAT in TTC, the feasibility of transferability of the SENSOR approach has to be tested. Here we will discuss some of the transferability issues that were found when applying SENSOR's methodology in MERCOSUR. These issues include: geographical constrains, differences between the research institutions, availability of data (indicators lists, bibliographic background, guidelines for impact assessment, policy proposals), differences observed in the institutional analysis (e.g. differences between MERCOSUR and EU), adaptation of the methods for stakeholder analysis and participatory approaches, and possible constrains in the identification of our indicators. All these issues must be considered and solved to develop a SIAT in MERCOSUR. The knowledge acquired transferring SENSOR's approach to TTC will be integrated to SENSOR's methodology, contributing to development of a sustainability impact assessment tool that can be applied world-widely.

Keywords: impact assessment tool, transferability, SENSOR, Targeted Third Countries, MERCOSUR

Sensor TTC – The La Plata River Basin Application: Policy cases, main land use change drivers and Case Studies

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Sensor TTC Mercosur activities were launched in workshops held in Rio de Janeiro and Florianópolis in August 2007. The La Plata River basin (LPB) is the analysed region in the realm of Mercosur. This area was selected because the majority of Mercosur countries are part of it, is has been subjected to significant processes of land use change, and the Mercosur TTC partners have been actively involved in research activities related to these processes. Two major policy cases will be used in the development of the SIAT prototype, to be constructed by SENSOR TTC: biofuel crop expansions (mainly sugarcane) and the forestry sector development. The former is more relevant to the Brazilian territory, due to environmental restrictions for the expansion of this crop in other parts of the LPB. The latter involves Uruguai, Argentina and the South of Brazil, which will enable a sound testing of the feasibility of adoption of the SENSOR framework by Mercosur countries. Major land use change drivers for each of these cases were identified as: a) climate change; b) transport, infrastructure, and energy availability; c) Oil/gas price; d) world demand; and e) R&D. The policy cases will very likely consist of the following policy variables: a) investments in technological development (R&D); b) incentives for production of the respective goods (waiving of taxes); c) international policy (export situation depend on WTO measures; a quantitative measure could be the commercial barriers/taxes established at the EU and the USA, in the case of ethanol); d) restrictive environmental measures for production (quantitative measure could be the thresholds for allowing sugarcane production, for eg.); e) investments on infrastructure and logistics; f) energy policy (% of renewable energy, for eg.).

Keywords: Ethanol, Sugarcane, Forestry, Mercosur

Using landscape decision support systems to evaluate long-term management options for a National Nature Reserve in Scotland

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Glen Affric, a recently designated National Nature Reserve in the north-west highlands of Scotland is the largest area (224,000ha) of Caledonian forest owned by the Forestry Commission. However, in the period between 1945 and 1980's large areas of non-native tree species were planted in the forest. The aims of management are to promote natural processes and foster the return to more natural woodland. The challenge is to convey a long-term vision of the desired forest structure for the next 150 – 200 years and to identify silvicultural options that achieve these aims while maintaining biodiversity and landscape values. This requires an evaluation of options and the creation of a plan for the next 20 - 30 years, informed by predictions of changes in key indicators of sustainability. This paper will show how a suite of GIS supported models has been applied and integrated into the standard forest planning process to assess the impacts of alternative management interventions on this forest of high conservation and landscape value. These tools provide forest managers with the ability to implement a landscape scale approach to habitat management, select ecologically suited species to sites and estimate the probability of wind damage. The use of these DSS has helped the spatial delivery of the management objectives at the landscape scale but also improved the objectivity and transparency of the decision making process. They also enable exploration of the impact of different approaches over a period of several decades. The lessons from this case study are now being used within the EFORWOOD project to develop a landscape approach to sustainability impact analysis of management alternatives in other forest types in Scotland.

Keywords: decision support systems, landscape approach, GIS supported models, sustainability impact analysis, management alternatives

Sustainability Spatial Planning Tool for Peri-urbanization: a Case Study of Estonia

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The fast economic growth (8−11% GDP) of recent years has brought along rapid sub- and peri-urbanization in Estonia, as a result of which environmental and social impacts have also become more severe. Urban sprawl has deserved special attention of researchers due to its nature of loose planning schemes and waste of natural resources. The planning coherence and policies are weak, too fragmented to consolidate city-regions and avoid outward stretching urban development in Estonia. The benchmarking could serve as an efficient analytical tool of planning support systems. The treatment of environmental issues at the urban fringe should be complex, whereas study area should be defined, first as a city-region, and second treated as a full life cycle. Lifestyles in the threefold pattern home-work-leisure and in the means of communication of the modern times increase the mobility of people, which accelerates structural changes in urban-rural spaces and requires obviously a more dynamic assessment and planning process with a real-time monitoring, maps and data. The environmental assessment and planning tool is developed as the bases for sustainable planning. The tool takes into account land use and indicators of urban environment, it monitors the energy and environment indicators, mobility of dwellers, and synthesises the compounding effects. To integrate features of the built environment and rural landscapes the comprehensive indicator set and GIS analysis methods have been employed for the analysis of impacts and changes to fill methodology and data gaps in urban fringe. In addition to sustainability indicator set the total growth of environmental impact of suburban dwellers is expressed in the increase of ecological footprint, specific resource and energy consumption. The increase of built land and infrastructure happens as a rule at the expense of arable land, natural or semi-natural areas. Change of lands use from (semi)-natural to built-up area degrades the ability of natural systems to provide services and goods to the surrounding environment in the previous way and volume, and cannot buffer human pressure in many cases in the Tallinn metropolitan area and Tartu city-region. Green networks advocate the integration of cities with their immediate physical surroundings, keeping natural areas and making the health of such environmental amenities goals of the planning and design process. The tool for sustainable land use policy, environmental assessment and spatial planning assists controlling low-density urban sprawl and de-concentration of built environment.

Keywords: spatial planning tool, sustainability, urbanization, impact assessment, land use

Landscape metrics as a tool to assess changes in land-use: case study in Otepää region

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Numerically expressed character of landscape as expressed by landscape metrics has been used to describe various aspects of land-use. Exercises relating changes in human landscape consumption pattern to landscape metrics are provided in the paper/presentation. Developing socio-economic structure causes drift in the weights of land-use functions, the role of land based production decreases while those of transport, residential and recreational functions increase. Otepää (South Estonia) is known for several aspects of identity. The location on endmorainic upland has led to formation of hilly and diverse landscape with many lakes favoring recreational use and nature conservation. Recreation area started in the 1920s has grown into a target of mass tourism. The winter sport area since the 1950s is by now an international cross-country skiing center. Most of the area is protected as a Nature Park belonging to the NATURA 2000 network. The region has changed into a highly rated target area for real estate development clearly different from other rural areas of Estonia with higher cash flow and elevated construction activities. Traditional agricultural land use is diminishing. Different indicators of landscape metrics calculated from maps (like Estonian Basic Map, CORINE Land Cover) by 22 settlement units of the Otepää parish were compared to the intensity of housing construction and changes in population between 2000 and 2005. The results show higher construction pressure with increasing diversity and more complex pattern of landscape whereas the permanent population rather decreases with increased construction. Also, the construction activities is higher closer to the main tourism attractions and center of the parish. Impact from tourism development and increasing recreational use of landscape can be concluded from the results. Conflict with nature conservation interests is increasing. Landscape metrics proved to be a promising tool for predictive mapping and impact assessment of land use changes.

Keywords: landscape metrics, land use change, recreation pressure, Otepää

Evaluating catchment management strategies for diffuse pollution under climate-induced landuse change. A case study of the River Tamar, UK

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As part of the Euro-limpacs project a Decision Support System (DSS) has been developed to evaluate catchment management strategies in the context of climate change. The DSS provides a GIS-based framework for integrating social, environmental and economic data through Multi-criteria Analysis (MCA). The DSS is being applied in the Tamar catchment (UK) to evaluate management strategies intended to address diffuse nitrate pollution from agriculture. Using the Climate Landuse Allocation Model (CLUAM), the land use distribution in the Tamar catchment was predicted for two future climate scenarios. Fertiliser application rates and stocking densities for each type of land use are also calculated as part of the modelling process. Alternative strategies for catchment management were then defined by assuming realistic changes to the attributes of landuse management (landuse types, fertiliser application and stocking density) as a result of interventions to improve the catchment status with respect to diffuse pollution. The land cover type, stocking density, fertiliser application rate and climate variables for each scenario then act as inputs to the INCA-N model to derive values for nitrate and hydrological variables for each scenario. The costs of implementing the management measures are estimated using the gross margin figures for different land uses (e.g. gross margin per hectare of wheat or per head of dairy cow), which are predicted by the CLUAM model. Using MCA, the data on the costs and the environmental variables under each scenario are combined to derive a single score for each scenario in each sub-catchment that reflects the relative ranking of the climate scenario and management measure combinations, which are displayed on a map of the catchment. This form of output could be used to support a catchment decision maker in determining the most appropriate type and level of management intervention in different parts of the catchment.

Keywords: Decision Support System, climate change, catchment management

Strategy Maps for Sustainable Regional Development

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This contribution presents the elaboration and implementation of a Strategy Map for developing and controlling strategies of sustainable regional development. Strategy Maps are derived from Balanced Scorecards in business administration and connect – in a hierarchical order – the four levels of (1) strategic objectives, (2) external reputation/measurable effects, (3) local processes and (4) local stakeholders and potentials. Strategy Maps show complex systems of intended direct and indirect effects. The maps are combined with proposed measures to achieve the overall goals and related to the necessary contributions of the involved parties. We present the principles of the Strategy Map in a case study of a peri-urban region near Zurich (CH), where a new motorway is constructed and will improve the accessibility of the region to the central city. The region seeks for economic profit from an increasing number of residents and companies, but without losing the ecological and recreational benefits of the current quantity of open green-space. In addition, local image promoters want to enhance the regional identity of the population to increase the region's reputation in the surroundings. The trigger of our cooperation with the regional stakeholders was the opportunity to make use of the scientific knowledge generated in the WSL-research programme 'land resources management in peri-urban environments' (www.wsl.ch/forschung/forschungsprogramme/ballungsraum), which is now in the phase of synthesis. In this research programme, we investigated the societal demands on every-day landscapes, the ecological consequences of land use change and landscape fragmentation, as well as economic and planning approaches for steering land use development. The single projects delivered a variety of quantitative and qualitative information, which is presented in heterogeneous ways according to the customs of their disciplines. Hence, we chose the Strategy Map as a comprehensive and flexible approach for the synthesis. In addition, it enables communication between science and policy.

Keywords: Strategy Maps, Regional development, Science-policy interface

Exploring the methodological gap between models and case studies

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As models are criticised for being data-oriented, providing what is possible to model instead of what is useful to society, links to more contextualised types of research are worth considering. But the differences in methods and objectives look daunting. We explore how models and cases could join forces.

Keywords: contextualised research, case study, rich information

Stream of acidification and base cation losses with grassland afforestation

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Afforestation of natural grasslands with fast-growing pine and eucalyptus species is increasing globally, including large areas of southern South America, but little is known about its effect on ecosystems and watersheds in this region. To investigate the biogeochemical and hydrological consequences of this land-use change, we sampled streamwater in paired watersheds in Uruguay and Argentina. In watersheds planted with pine, we found no change following afforestation, while in watersheds planted with eucalyptus pH was 0.6 units lower than streams draining grasslands. To further investigate the mechanism behind the decrease in pH, we sampled soils and streams of eucalypt catchments in Uruguay and analyzed base cation concentrations, alkalinity, and dissolved inorganic carbon (DIC). In these sites Ca, Mg, and Na concentrations were >30% lower in afforested soils than in grassland soils, and pH was significantly lower below 10 cm depth. Measurements taken over three years illustrate that these changes were also reflected in streamwater chemistry. In the eucalypt watersheds, base cation concentrations were more than 40% lower and alkalinity and DIC were halved in stream water. Data from additional sites where both pines and eucalypts were planted nearby suggest that eucalyptus has a stronger acidifying effect than pine. Research on the role of different plantation species would therefore be beneficial in this and other systems to minimize potential problems. Overall, our data suggest that repeated harvesting cycles could negatively impact the soil store of base cations at these sites and contribute to an impairment of downstream water quality.

Keywords: afforestation, acidification, streams, Argentina, uruguay

Estimating the impact of reorganising political economy on landscapes using a ground rent model after von Thünen

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Today the kind, scales, rates, and combinations of land use and land cover changes (LULC) are fundamentally different from those at any given time before. While this process is continuing, the only certain aspect of the future is that it will be different to the presence! Moreover, the complexity of social, economic and political interaction becomes increasingly overwhelming causing the world to change faster and faster. We face the problem that we do not yet understand the synergistic consequences resulting from the numerous environmental risks to which we contribute to - especially when changing economic-political organisations. Hence, this article hypothesis', that there is a relation between (inter-national) socio-economic reorganisation and LULC. Unfortunately, these alterations become only apparent after a longer time period and are hardly manageable to recover and therefore cause immediate action. The mentioned issue is examined by reference to the land rent model of von Thünen (1826) which has been adapted to the present socio-political and economic circumstances and allows to model the difference between the income (production and (inter-)national subsidies) and the expenditures (fertilizers, pesticides, fuel, etc.). The main objective of this paper is to improve spatially explicit information sharing technologies and dissemination of knowledge and experiences at parcel and farm level. The information is derived from the broad context of environmental, socio-economic and political research, supporting synergies between subsidies and agricultural maintenance. Having modelled scenarios of possible intervention strategies, we argue that the decline of financial resources, as foreseen in the period from 2007-2013, might put substantial pressure on the farmers financial net balance in the Mondsee catchment in Salzburg, Austria. Especially remote areas might be at risk of being released from agricultural practice. This abandonment of land causes bush encroachment leading further to a forest climax stadium. This puts in turn pressure on the maintenance of the open landscape and hence biodiversity as well as on the tourist industry due to changes in the landscape scenery. As a result, this work contributes to achieve economic and socio-spatial explicit measurements with the aim to detect financial disparities among local farmers. Clustering local farming systems with the equal average income will help to display regional imbalances. Furthermore, the developed tool has the possibility to analyse likely effects of decisions made by stakeholders and politicians by certain intervention strategies. Subsequent scenario results display the immediate effects of interventions which might have implications on the farmers budget and hence on the landscape.

Keywords: land rent, GIS, policy, landscape, von Thünen

Relationhips between socioeconomic or biophysical conditions and land use change trends in rural and post-industrial regions of Poland

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Silesia and Podlaskie regions (NUTS-2) of Poland were chosen to investigate land use change dynamic within the last decade which was driven by factors other than CAP as these instruments were introduced in 2004. Test regions in Poland provide an opportunity to study autonomous drivers of recent land use changes in new member states independly of CAP. Podlaskie and Silesia represent totally different economic structure. Silesia has a long history of mining and smelting industry, leading to environmental pollution. The population density is extremely high and it faces structural social problems, resulting from a collapse of the heavy industry. In general the region attracts investors due to its infrastructure, strong technical background and low labour cost. Podlaskie is a typical rural region in north-east Poland with a low population density and a large share of the population involved in agriculture. Accessibility of Podlaskie is limited - it is remotely located and the density of road network is rather low. Rural character of the region makes the region relatively less attractive for investment. The social, economic and environmental data characterizing Podlaskie and Silesia test areas was collected at resolution of gmina (LAU-2) from GUS regional database. Land use change analysis was based on CORINE layer of changes characterizing land use conversions between 1990 and 2000. An analysis of land use changes between 1990-2000 for Silesia and Podlaskie, derived from CORINE, shows small conversion of agricultural areas into artificial or forest areas. In order to verify uncertainty related to CORINE resolution we produced 30 m resolution classifications for the test areas and used them to conduct more detail analysis. A comparision was made between trends and rates of land use changes in post-industrial and rural test areas. Multiple regression equations were produced to explain land use changes drivers depending on region character.

Keywords: land use change, rural, post-industrial

Environmental and socio-economic sustainability indicators for sensitivity assessment of European coastal zone

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During the integrated SENSOR project of the European Union's (EU) 6th Framework Programme, we have assessed the sensitivity of the EU's coastal zones using data on 191 coastal cells at The Nomenclature of Territorial Units for Statistics (NUTS) level, based on information from the Statistical Office of the European Community (EUROSTAT) and other Europe-level sources. To determine sensitive coastal areas, multidimensional clustering was provided. The NUTSx level (a combination of NUTS2 and NUTS3 level cells in order to achieve better spatial coverage) clustering resulted in 7 clusters which were not, however, well distinguished in terms of the SENSOR sensitivity areas concept. Therefore clustering on the NUTS2 level was provided using fifteen parameters characterizing economic, social and environmental aspects, yielding six clusters that were logically distinguishable from each other. The cluster characterized by a rapidly growing economy combined with relatively high but decreasing unemployment, low but increasing income, a low rate of investment in research and development (R&D), a low share of arable land but a high rural population, moderate length of coastline with the highest share of coast exposed to coastal erosion and a highly variable level of environmental protection, including 23 coastal NUTS2 areas plus 5 islands, has to be considered sensitive and needs further attention from the European Commission.

Keywords: coastal zone, GDP, sensitivity, SENSOR, sustainability

Analysis of rural landscape responses to EU agricultural policy scenarios in selected EU27 countries (Poland, Estonia, Bulgaria)

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What is the future of the diverse landscapes in the rural areas of Eastern Europe, given the fact that EU policies and regulations will have a dominant influence on the landscape development? To answer this question, this paper analyses the potential effects of EU agricultural policy scenarios on landscape in selected EU27 countries. Focus of the paper is on Eastern European countries, recently accessed to the EU (Poland, Estonia, Bulgaria). The landscape developments in these countries are compared with those in 'older' EU member states where conspicuous transformations of the agrolandscapes as a consequence of EU policies can be observed (Portugal, Ireland, Italy). The selected Eastern European countries represent various biogeographical zones in Europe. Evidence of recent agrolandscape change is already available in these countries. They are especially interesting with regard to landscape change because they have traditionally a strong agricultural sector, and are rich in areas of outstanding natural beauty. The paper first presents the results of a basic study of landscape change with the help of literature review and interviews of key experts. Based on this study a scenario analysis is then presented, using the EURURALIS model, both in a retrospective and in a prospective way. The comparative analysis between the 'old' and 'new' EU countries uses regional clusters – comparable, well-delineated agrolandscape plots from different countries. To describe landscape developments in space and time, both quantitative and qualitative measures are used, among which sophisticated landscape indicators. The paper concludes that there are still considerable degrees of freedom in defining the direction of landscape change in the Eastern European countries. The model can well be used as a tool to support policy makers in discussions about the future of rural areas in the EU27, preventing ecological and social degradation of the vast rural areas still present in Eastern Europe.

Keywords: scenario, rural landscape, agricultural policy, landuse change, Eastern Europe

RP-RainNet: The Rio de la Plata Atmospheric Deposition Network. Set up and Preliminary Results

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Atmospheric deposition is a key flux for understanding nutrient cycling in ecosystems. Several well-known networks exist in developed countries of Europe and North America. The lack of networks in other parts of the developing world challenges both global and local biogeochemical studies. Southern South America almost completely lacks atmospheric deposition data. We began rain collections at three (9/2005) and then seven (9/2006) sites in Argentina and Uruguay across a west (dry) to east (wet) transect at latitude 34°, conducting event-based and monthly collections. Collectors were manually operated and had a 100 micron meshed funnel to maintain water clean and avoid evaporation. Results from these two types of collectors were compared across the year to define a regular protocol to be applied in additional sites. Preliminary data showed a low and uniform NO3 deposition across the region in the first three study sites. Nitrate deposition was similar in populated (Buenos Aires, 13 million people) and unpopulated regions (Flores, less than 5 persons per km2), in spite of the relative high industrial activity of Buenos Aires, suggesting relative well mixed conditions. Ammonia deposition (6.0 kg/ha.year) doubled that of NO3 (3.2 kg/ha.year) with a high correlation between them across rain events (r=0.91), supporting a similar origin of both N forms, likely found in agricultural fields and rangelands. Chloride, Mg and Na concentrations were highly correlated suggesting a marine origin. Ca and K had lower correlations with other ions, but correlated better with land derived ions (NH4 and NO3). Correlations between ions were stronger in Montevideo (seaside site), weaker in Buenos Aires (estuary site) and medium in Flores (inland site). All ions concentrations in rain events decreased exponentially with precipitation amount. A Principal Component Analysis (PCA) showed a high variability in ions concentrations of rain events within each site but separated well rain events from different sites with the first component being driven by Cl concentration vs. other ions and the second by marine (Cl, Mg and Na) vs. land ions (NH4, NO3, Ca and K). Ongoing collections will expand or results in space and time including more continental situations.

Keywords: Atmospheric depositon, argentina, uruguay, ions, rain

Land use changes as a reflection of the natural conditions and socio-economic development of the Rosice-Oslavany region landscape

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This paper analyses land use changes that occurred at the area of Rosice-Oslavany region in the period 1840 – 2006 and how these changes were influenced by natural and socio-economic driving forces. The Rosice-Oslavany region is a unique example of interactions between natural conditions (especially the Oslava R. valley which is a part of supraregional ecological network) and socio-economic factors (coal mining, power station, hinterland of Brno city). Land use changes in the Rosice-Oslavany region were monitored within the framework of the long-term research programme MSM 6293359101 – Research into sources and indicators of biodiversity in cultural landscape in the context of its fragmentation dynamics, Part 1 Quantitative analysis into the dynamics of landscape development in the Czech Republic in the last 250 years (landscape fragmentation dynamics). The researched period is represented by maps from 2nd Austrian military survey in the scale 1:28 800, 3rd Austrian military survey in the scale 1:25 000, military topographic maps from 1950s and 1990s in the scale 1:25 000 and topographic base maps from 2006 in the scale 1:10 000. The main socio-economic driving forces that influenced land use changes were mining (the first black coal mine was founded here), political changes (especially after the 1989) and very strong influence of Brno city. Analyses of the maps show stable and unstable areas of land use and a range of the changes of studied categories.

Keywords: land use changes, socio-economic forces, old maps

The Effect of Climate Change on Future Land Use - A Case Study from Northern Jutland

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The European nature and agricultural areas - particularly in the coastal zone - are under increasing pressure from urbanisation, and the global warming will further enhance this pressure. Accordingly spatial and environmental planners have urgent needs for scenario tools analysing the impact of possible land use changes. As part of the INTERREG IIIB project Forum Skagerrak we developed a modelling framework for Land Use Change Impact Analysis (LUCIA). The aim of the Forum Skagerrak project was to develop policies and measures supporting a sustainable development around the Skagerrak Sea. Basically, LUCIA estimates future (urban) land use on rather detailed spatial resolution (e.g. 100 meter grid cells) from prescribed driving forces like population change and economic development through a set of response functions. The effects of various spatial policies are entered into the model through various zoning regulations. Due to the rather comprising data requirements, LUCIA is mainly suitable for modelling and analysis at the regional level - for example in case studies. The purpose of the current project has been to analyse the effects on land use of climate change and its derived effects like sea level rise as well as increased storminess and precipitation. The case area is the Region of Northern Jutland where particularly the low land around Limfjorden is most sensitive to the effects of climate change. Built-up areas represent huge societal investments and accordingly a rather long life expectancy - for example 100 years. Therefore, new buildings must be raised outside what we call a 100 years flood risk zone. The identification of areas with flooding risk along the coast of Northern Jutland is carried out using a new very detailed digital elevation model from the Ministry of Environment as well as expected predominantly future wind directions. Before modelling the future land use we calibrated the model. Secondly, we calculated a scenario-0 by running the model without regarding climate change. The simulation period was from 2005 to 2035 for all scenarios. Beyond this time span, the driving forces would be too uncertain. Thirdly, we made two simulations taking into account that some areas will be in the flood risk zone before the end of this century. Scenario-1 was based on the most optimistic of the so-called SRES emission scenarios, whereas Scenario-2 used the most pessimistic of the emission scenarios with comparatively big areas with future flood risk. As expected there were only minor difference between Scenario-0 and Scenario-1, but Scenario-2 exhibited a more comprehensive redistribution of future urban land use, although population development is rather weak in the Region of Northern Jutland. The current abstract describes our first attempt to introduce future climate changes in land use modelling and the approach focus on adaptation. Our on-going research tries to analyse the societal structures giving rise to the various SRES scenarios and use this information to improve the modelling of future land use under the pressure of climate change. The aim of this research is to develop spatial planning strategies for mitigating climate change.

A window of opportunities; The contributions of land use modelling to societal learning

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It has been argued that the management of land, whether at the field, farm or regional scale, can benefit from computer-based land use system analysis. The reported study investigates the contributions of land use models to learning for societal problem solving, i.e., learning of farm managers and/or land use planners at local, regional, national or international level, to solve a land use related problem. Learning through modelling took the form of a new perspective on a land use system, frequently in combination with a better understanding of the position of other stakeholders, resulting in adapted problem definitions, a changed solution space and/or the formation of new coalitions to tackle a particular land use related problem. Models were found to contribute not only to improving understanding (heuristic role) but also to agenda-setting (symbolic role) and the creation of communities (relational role). Instead of rather static and distinct factors, such as a user interface, the study suggests that we need to anticipate the relatively fluid and fuzzy features of social contexts and problem solving processes to harness land use modelling for societal learning. What do the findings imply for those who wish to pursue the use of science-based land use models to contribute to societal problem solving? First of all, the study demonstrates that the contributions of land use models to societal problem solving represent 'a window of opportunities'. The contributions are not limited to learning about a land use system but are more diverse and extend to learning about the views, norms and values of other actors, mediation of conflicts between stakeholders and community-building when the organization of stakeholders is desirable for coping with a problem. Furthermore, our research suggests that in designing a modelling strategy, equal attention needs to be paid to the requirements for model development, and the embedding of the work in a given/intended societal context.

Keywords: societal learning, land use modelling, change processes, model use

Environmental aspects of land use change trends in post-industrial areas – Silesia case study

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It is well established that the dynamics and evolution of land use change processes are strongly dependent on socio-economic and environmental characteristics of regions. One of the fundamental objectives for testing sustainability impact assessment tools (SIAT) is to verify their validity for sensitive regions which represent a particular pattern of features concerning environmental, social and economic setting. Post-industrial areas are of particular concern as these regions are usually densely populated, affected by strong historical soil and water pollution which exposes population to a considerable health risk. It is of vital interest to assess how different scenarios of land use change, responding to different settings of policy, will be related to spatial characteristics of land contamination. This particularly concerns spatial trends in expansion of energy crops which will likely reduce the food chain risk as food crops acreage will decline. Whereas urban sprawl on contaminated land can increase human exposure to soil dust containing various pollutants. Changes in distribution of land use functions under different policy scenarios will be assessed in the context of soil contamination. Similarly, projections of trends in population density will be also analyzed in relation to contamination pressure. A detailed spatial analysis of land use change and demographic trends for different policy cases and scenarios is thought to demonstrate an added value of SIAT testing in special case study areas. Sustainability requires that regional planning strategies are minimizing health risk in postindustrial areas. Therefore the sustainability choice space for different scenarios will be assessed by stakeholders in relation to different risk aspects.

Keywords: postindustrial, land use, contamination, environment

A Swedish regional level simulator for forest projections and analyses

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The demand on different goods and services from the forest ecosystem has increased as well as the demand on decision support tools that can assess impacts of policy changes and on the use of the forest resource. In Sweden, a new simulator – Heureka – is developed for regional and long-term projections of the forest state and the output of forest goods and services. Heureka is developed to meet the needs for an up-to-date decision support tool from a number of stakeholders, such as national and regional authorities, forest companies and forest owners associations. It will enable analyses of the impact of different forest management regimes, intensities, etc. on the sustainability of the forest resource. This includes the future forest state and outputs of goods and services, including timber production, bio fuel, biodiversity, changes in carbon stocks, and recreation services. Most forest goods and services are closely related to the state and development of the tree-layer making it possible to derive indicators not only related to timber from the tree-layer development. Thereby, projections of the tree-layer make up a core part of the Heureka system and are enabled by detailed, individual tree growth and yield models. To enable reliable projections, detailed and high-quality data are needed. Heureka uses National Forest Inventory data, remote sensing data, and other data sources in combination. Within the EU integrated project EFORWOOD sustainability impact analyses of Forest-Wood Chains are performed. As a part of such analyses, the Heureka system will be used to predict wood supply for year 2015 and 2025 for a region in northern Sweden given different assumptions concerning forest policy, forest management and changing climate conditions.

Keywords: Forest projections, forest management, forest policy, decision support tool

Estimating future forest sustainability indicators at national/regional level using NFI data: the impact of data aggregation

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EFORWOOD aims to develop a quantitative decision support tool for Sustainability Impact Assessment of the European Forestry-Wood Chain (FWC) covering forestry, industrial manufacturing, consumption and recycling. Supplying the tool with real aggregated data is one of the objectives. EFORWOOD Module 2 (M2) focuses on key forest types and tree species for wood production in Europe and on several different scales (from local to European). Even though NFI provides information for the current status of the forest there is the need to predict future forest characteristics under alternative forest management and land use changes scenarios. M2 is responsible for developing new models, or improving existing ones, to estimate forest resources sustainability indicators for current and possible alternative forest management strategies (FMS). The models will include multi-functional aspects of forestry and will be calibrated to work at different spatial scales, ranging from the individual stand to the European level. Therefore, problems such as data aggregation, choice of appropriate growth models, among others, are important points to be considered for the development of national/regional simulators. The objective of the present presentation is to compare different ways of aggregating NFI data, from individual plots to data aggregated by age classes, to be used as input for a forest regional simulator – sIMfLOR – that is being developed under EFORWOOD. Intensive plantations of Eucalyptus (Eucalyptus globulus). are used here as a case study. At present sIMfLOR simulates long term forest development and the associated sustainability indicators using wood harvest, annual area burnt, new planted areas per year and land changing for other uses as drivers but in the near future it will include changes to other management alternatives such as biomass for energy or multifunctional forestry. Finally, preliminary estimations for the period 1995-2005, obtained with each of the proposed methodologies, will be presented. As NFI occurred in 1995 and 2005 it will be possible to assess the quality of the predictions for 2005 by comparison with the results of the NFI carried on in 2005.

Keywords: Forest simulator, Sustainability indicators, Eucalyptus, Portugal, Forest growth and yield models

EFISCEN-Space: high resolution modeling of forest resources at a pan-European scale

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Forest resource analyses have been conducted at the pan European scale with the EFISCEN model successfully for a range of applications. However, scenario projections are most reliable for intensively managed even aged, monospecific forests as were traditionally dominant in large parts of Europe. With European forestry shifting away from a timber production system towards more nature oriented management or short rotation biomass plantations, there is a need to adopt a more flexible approach. As the goals of forest management are becoming more diversified and the calculation of scenario projections has grown towards extensive sustainability impact assessments integrated over a whole sector, the robust but simple approach of EFISCEN does not fulfill the current requirements anymore. Therefore a new high resolution (1 km x 1 km) forest simulator EFISCEN-Space is presented as an improved tool to analyze the development of forest resources on a regional to European scale under scenarios of management, societal demand and environmental circumstances. The model is based on a large set of National Forest Inventory plot level data integrated in a GIS framework including earlier pan-European forest maps and related information. Algorithms have been developed to translate the original georeferenced plot data into maps with the data needed to initialise a dynamic forest development model. Without the complexity of a physiological model, the latter has been developed to deal with anticipated trends in forest management. Indicator values calculated from the output provide information about both timber and non-timber services for different forest types, allowing the evaluation of ecosystems functions by forests in the simulated region. We present the first results for two pilot regions.

Keywords: forest resource modeling, European scale, scenario, NFI plot level data, GIS framework

OakChain – Research and development along the forest-wood chain in the Northeastern German lowlands

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In the subcontinental Northeastern German lowlands (Brandenburg, Saxony), the prevailing monocultures of Scots pine (Pinus sylvestris) are subject to an impaired stability (e.g. insect outbreaks, fire, soil fertility), which causes substantial economic losses for forestry. These problems will increase due to the predicted climatic changes in this region, i.e. rising temperatures and changing precipitation regime. Due to comparatively low amounts of precipitation and sandy soils, which are poor in nutrients, little effort has been made to transform these monocultures into mixed stands before 1990. Sessile oak (Quercus petraea) is the predominant species of the natural forest landscape and suitable for forestry in this region. Hence, the regional forestry programme was put into action about 15 years ago to increase the participation of mixed oak-pine forests. However, there is both little scientific knowledge as well as little experience in forest management on the transformation of pine monocultures into mixed stands with oak. Moreover, the increased supply of small dimensioned oak wood in the next decades requires innovative solutions within the forest-based industry. Finally, new methods need to be developed for the improvement of transport logistics from the forest to the production site of the forest-based industry. Therefore, research and application are carried out along the forest-wood chain of pine monoculture transformation into mixed stands with oak in the subcontinental Northeastern German lowland. Joint research is based upon a set of common study sites, including a chronosequence as well as a gradient of increasing continentality from Saxony-Anhalt to East Poland. Overall goal is the development of a decision support system for the management of mixed oak-pine forests in the subcontinental Northeastern German lowland. Preliminary results will be presented as well as an outlook on the effect of this policy change on the sustainability of the forest-based sector in this region.

Keywords: forest-wood chain, decision support system, Northeastern German lowland, Sessile oak, Scots pine

How to assign sustainability impacts to products and side-products of a Forest-Wood Chain?

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A forest wood chain (FWC) can be represented as a set of production processes by which resources from forests are converted into products. Sustainability of the FWC can be evaluated using environmental, economic and social indicators that are linked to the production processes. These indicators can be aggregated along the FWC to calculate the overall effect of a particular FWC for example on employment, regional economy, or greenhouse gas emissions. On the other hand, consumers are increasingly interested in the sustainability of a specific product. Therefore, in order to compare sustainability of alternative technologies it is important to link indicators directly to specific products. In this paper we are analysing different options how sustainability performance can be related to the different products of the forest value chain. A production process at any step of the FWC can produce more than one product, for example sawn timber and saw dust. The material flowing into a process will be divided into multiple output flows and these flows are split on a mass basis. However, economic activities are often measured in terms of the value produced. The ratio between the main product and side-products could in these two cases be very different. So how should the sustainability performance of a given production process be assigned to the output products of the processes? Using an example from the EFORWOOD project, sustainability performance of a Scots pine FWC from Northern Sweden is analysed by comparing different allocation principles for assigning the sustainability performance to the different products of the studied value chains. The allocation principles were: (i) proportional to the mass of the products, (ii) proportional to the monetary value of the products, and (iii) proportional to mass and value (mass*value). The effects of the application of the alternative allocation rules are quantified, evaluated and discussed.

Keywords: forest wood chain, sustainability assessment, allocation of impacts to products

Assessing impacts of policy changes on sustainability of forest land use in Europe

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Sustainability is a concept that has been applied in forestry for about 200 years, but it has changed considerably over time. Initially focussing on the economic dimension, it nowadays entails a social and environmental dimension as well. Indicators have become important tools to measure sustainability. Combined with forest scenario models indicators allow ex-ante impact assessments of e.g. policy proposals. The European Forest Information SCEnario model (EFISCEN) is such a model and projects possible future forest resource developments. The aim of this study was to extend EFISCEN to include all three dimensions of sustainability to assess sustainability impacts of European policies related to forest land use. Based on a review of available indicator sets, a number of indicators for each dimension were selected. The main selection criteria were their relevance and sensitivity to policies and time-frame, data availability and its quality and compatibility to the EFISCEN framework. For the economical dimension harvesting costs and harvest revenues were selected; for the social dimension forest sector workforce was selected; and for the environmental dimension the ratio between annual fellings and net annual increment, the forest carbon budget and deadwood were selected. Data for these indicators were collected from various international databases and related to key output variables of the EFISCEN core model. The use of the indicators are demonstrated by analysing impacts of different policy scenarios: 1) business as usual; 2) bio-energy production (increase removals and harvest residue extraction for bio-energy production); and 3) biodiversity protection (increase share of protected forests, with strong limitations on harvests in these protected forests). The simulations were carried out for 24 EU countries until the year 2025. The impacts of the policy alternatives are analysed for each sustainability dimension separately. Conclusions are drawn on how bio-energy production and biodiversity protection affect sustainable use of European forest resources.

Keywords: EFISCEN, forests, indicators, SIA

Integrated Sustainability Impact Assessment of Multifunctional Land Use: Agricultural and Silvicultural Systems and their value chains

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An integration of Value-Chain Analysis (VCA) and Life Cycle Assessment (LCA) was performed by modelling the environmental, economic and social aspects of land use for food, forestry and bioenergy. Organic and conventional farming systems have been assessed. The different ligno-cellulosic bioenergy chains (dedicated energy crops, forest residues, sawmill co-prducts, arboricultural arisings, and recovered wood) in the UK were also assessed. Oilseed rape, wheat and grassland were used to represent land use for food in the UK. This integrated assessment was performed so as to capture all sustainability aspects of the systems/chains. Preliminary results suggest that organic farming systems generally perform better environmentally, but not necessarily better economically or socially; and that they generated more value and that is distributed more equitably that their conventional counterparts. Key methodological issues that were addressed include the allocation between co-products for all three sustainability aspects. It was found that there is significant potential to supply bioenergy from existing biomass waste with little disruption to the rest of the chain. Dedicated crops, conversely, may have a negative social impact depending upon the scale in which they are adopted, due to increased food-prices arising from competition for land, despite their overall beneficial environmental impact. A consequential assessment is needed as increased land use for energy will certainly result in increased importations of food items, with potentially significant impacts on all three sustainability pillars. The inherent trade-offs intra and inter the different pillars of sustainability require an appropriate tool, such as Multi-Criteria Decision Analysis, to aid decision-making.

Keywords: Life Cycle Assessment (LCA), Value Chain Assessment (VCA), Multi-Criteria Decision Analysis (MCDA), Land use, bioenergy

Application of ToSIA (Tool for Sustainability Impact Assessment of Forest-Wood-Chains) to assess sustainability of two bio-energy value chains

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As an effect of the increasing demand for renewable energy from biomass, more harvest residues and small diameter trees are extracted from forests. This trend is particularly strong in Sweden and Finland, where biomass utilization for energy purposes has a strong tradition. Changing forest management practices towards more intensive biomass utilization will affect sustainability of the resource management. The newly developed Tool for Sustainability Impact Assessment of Forest-Wood-Chains (ToSIA) will be applied to evaluate the environmental, social, and economic sustainability of two typical Scandinavian bio-energy value chains: (i) using wood residues from a saw mill to produce pellets for household use and (ii) extracting biomass from early thinnings, which are chipped and burned in a power plant for use in district heating. Forest value chains are modelled in ToSIA as chains of production processes (e.g. stand development – harvesting – transport – industrial processing – transport – consumption) which are producing a number of products (e.g. timber – sawn dust – pellets). Every production process is measured in terms of its environmental, social and economic performance by using a holistic sustainability indicator set. The sustainability of the entire bio-energy chain is then summarized as overall effects of all its production processes and evaluated using multi-criteria-analysis technique. The presentation will demonstrate the application of ToSIA with specific focus on the following questions: • If we take an already existing pellet production chain as a starting point for the analysis, what are the effects of an additional extraction of forest biomass for energy purposes on sustainability? • If we compare the alternative bio-energy value chains per unit of energy produced, what chain has the better greenhouse gas balance? Which chain has more positive effects on social and economic aspects and what are the potential environmental trade-offs?

Keywords: bioenergy, forest value chain, sustainability, pellets, district heating

Forest and wood utilisation in the Alpine region of Grisons, Switzerland: Economic impact and CO2 effects

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The Kyoto Protocol aims for a stabilization of greenhouse gas concentrations in the atmosphere. Carbon storage through forest management can already be included in the calculations of involved countries, and it is discussed whether and how wood utilisation can also be accounted for in the following, post-Kyoto phase. This leads to new options in forest management and the utilisation of wood, particularly, if we assume financial compensation for storage and substitution effects through CO2 certificates. In this case study from the region of Grisons, Switzerland, we focus on the CO2 effects of forest and wood utilisation, and estimate the economic effect including both the value chains and a hypothetical value for CO2 certificates. For that, we adapt models of material/wood fluxes, of substitution effects and an input-output table for the wood industry that have been used in two earlier, nationwide studies. In a first step, the recent situation is assessed to highlight how forest management and wood utilisation already now contribute to climate protection and what monetary difference it would make, if these effects would be remunerated through CO2 certificates. In a following study also alternative scenarios of forest management and wood utilisation are to be considered in order to indicate how further optimisation could improve climate protection as well as the economic and social welfare within an Alpine region like Grisons.

Keywords: forest management and wood utilisation,, carbon storage and substitution effect,, material flux analysis and input output analysis,, climate protection

Afforestation and groundwater use in South American grasslands: impacts on productivity and salinity across a rainfall gradient

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Terrestrial vegetation is a main control of the hydrological cycle and has the capacity to modify the direction and intensity of water fluxes and salt exchange between ecosystems and groundwater. Afforestation in the native grasslands of temperate South America often triggers an intense groundwater consumption that can have cascading consequences on net primary productivity (NPP), through increased carbon and water exchange with the atmosphere, and on salt distribution in soils and groundwater, through a switch in the hydrological regime from net recharge to net discharge. We explored the role of climate and tree species shaping these effects across 50 pairs of contiguous grassland–plantation stands along a broad precipitation gradient in Argentina and Uruguay. Satellite EVI data was used to estimate NPP and geoelectric surveying and groundwater sampling to assess salinization. Tree plantations displayed higher NPP than grasslands (p

Keywords: eco-hydrology, groundwater, water balance, vegetation change, MODIS

Soil carbon stock and origin in tropical soil under sugar cane management afther deforestation

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Sugar-cane is the most important source of bio-fuel in Brazil and large efforts have been done to increases its productivity. To understand the impact of sugar cane harvest system (green and burned cane) on soil organic dynamic we compared area under native forest vegetation (Atlantic Forest) with an area which approximately 10 years of pasture had been converted to sugar cane in Conceição da Barra municipality, Espírito Santo State, Brazil. Since 1998 the sugar cane have been submitted to these harvest systems and at 2005, we conduced the sampling. Under each treatment a trench was opened and three samples from each different soil layer (0-10; 10-20 and 20-40 cm) were taken for bulk density and analysis of total C and 13C isotopic abundance. The C stocks (for 0-40 cm) and contribution of C derived from forest and pasture/sugar cane areas were calculated. The C stock was equivalent to 3.45 kg m-2 under forest and to 3.19 and 3.08 kg m-2 under sugar cane harvested without fire and using this practice, respectively. After 15 years of sugar cane (plus 10 years pasture) and considering all profile, approximately 33 and 40% of the C derived from graminaceous C4 crops (under management without and with fire). The highest proportion of sugar cane-pasture-derived C were found in a superficial layers (0-20cm): 40% for green cane and 44% to burned cane. We concluded that the introduction of sugar cane after pasture in a Typic Paleudult soil (sandy, kaolinitic, isohyperthermic) decreased soil C stocks, besides evolves green house gas emission when the cane burned.

Keywords: 13C, soil organic matter, carbon dynamic, land use change

The Impact of Climate Change Adaptation on the Sustainable Development of Forest Landscapes in Northeastern Germany

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A region-specific example of sustainable forest development in a European model region within North-Eastern Germany is assessed in terms of its natural, economic and social potentials. Site-specific scenarios of measures and strategies of forest utilization in their complex effects on the regional landscape system (ecosystem network plus forest users) under variable environmental and site conditions as well as economic, social and political boundary conditions are measured and evaluated. As a result optimized, site-specific options for action are derived. These contain elements of the adjustment to variable climate, site, as well as social conditions by increase of self-adaptiveness, site plasticity and functional diversity of the forests. This diversity also shall lead to a greater variety of timber and wood assortments in the future. The practical implementation of the development concepts will be prepared by a broad participation of local actors during a continuous transfer process. A so-called 'landscape workshop', an action-oriented dialogue between science and the actors' ensemble (e.g. land owners, forest users, researchers) is part of the transfer strategy. Furthermore, modules for an education for sustainable development are being developed together with teachers and students.

Keywords: Adaptation to Climate Change, Forest Management, Ecosystem Plasticity, Stakeholder Participation, Education for Sustainable Development

Contribution of forestry management to biodiversity conservation. A study case in Mesopotamia, NE Argentina

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Natural protected areas (i.e. National and Provincial Parks) are not enough to biodiversity conservation worldwide. They are becoming strongly isolated sites within a matrix of multiple uses for human needs. Therefore, productive zones are playing a key role in nature preservation. Although they do not replace public areas, private lands can be an integral component of a conservation strategy. In Mesopotamia, for example, recent studies have determined that 15% of plantation zones (170.656 ha) occur in areas with highest conservation values. The region also harbors several biodiversity hotspots for both national and international agencies. In this context, precise knowledge of conservation status of species and ecosystems is required to develop management recommendations, particularly to determine specific priority sites for protection or special practices in the forestry industry. This study case was conducted at a representative area of 1.400.000 ha in the core of Mesopotamia. This region includes 94.000 ha of pine and eucalyptus plantations managed by "Bosques del Plata" (BDP) company. We employed GIS to examine landscape composition and conservation values. Biodiversity baseline was obtained from literature review and on-going field monitoring. BDP area is a patchy landscape composed by plantations (77%) and natural habitats (23%). The later ones include wetlands (15.000 ha), grasslands (4.500), highland forests (2.900) and riparian forests (1.200). These environments harbor more than 90% of the biodiversity with highest conservation values estimated through the whole study area (136 species: 27 mammals, 22 birds, 22 herps, and 66 plants). Monitoring program is also contributing to increase community commitment and reinforce positive attitudes towards biodiversity conservation. Total area of natural patches in BDP provide critical habitat for threatened species and is over the 10% recommended for extensive exotic plantations. These results will allow the company to establish ecological reserves and reflect an example of forest-based sector policies that contribute to environmental sustainability.

Keywords: conservation value, wildlife monitoring, sustainable management

Land use strategy for natural forest management of China

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Land Use Strategy is a research model with the project of China-EU Natural Forest Management (2003-2008). Overall objective of the research is to solve land use conflicts between forest management and maintenance of forest ecosystem functions. The specific objectives are to improve environmental stability, conserve and restore quality, biodiversity and ecosystem functions of natural forest, and promote sustainable development of local community through participation of stakeholders involved, and on-site test and demonstration of land use strategy at commune (town) level. Altogether 12 communes (towns) at 6 sampled counties of 3 provinces (Hunan, Sichuan, Hainan) have been chosen as pilot areas for land use strategy research and exploration of sustainable land use patterns for each of the study areas, and surrounding regions with similar environments. The main land use types include those for forest production (timber and fuelwood), pasture area (pastures and shrubs), non-timber products (mushroom, herb plants, nuts and vegetables), and forests suitable for eco-tourism and conservation purposes. The major achievements of the research include decision-tree models for local planning, atlas for local land use strategic planning (e.g., as protected zones, restoration zones and development zones), and a set of management regulations developed using participation approach and accepted by the stakeholders. It is evidenced that the land use strategy and atlas are very important guidance for forest land use planning, and also for project development and implementation at the community level.

Literature review of afforestation trends and forest management practices in the La Plata river basin, South America

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In this study, we review effects of national afforestation programs, international association agreements (eg. EU-Mercosur), carbon sequestration and other clean development mechanism projects on current and future expansions of forest plantations on the La Plata River Basin (LPRB) , mainly Brazil and Argentina which together have about 75% of the 3.1 million km2 of this basin surface area. In addition, regional and national forest legislations, engagement in forest certification programs, state of the riparian protective forests and forest management practices in the region will be examined from the literature to draw conclusions about the action plans and instruments to promote sustainable forestry and to halt biodiversity loss in the LPRB. As a preliminary finding, at least for the Brazilian portion of the LPRB (45.6% of its surface area), several authors foresee a significant intensification of the forest-wood chains, and an increase in land allocated to forest plantations, mostly pine and eucalyptus monoculture. Hence, sustainability impact assessment tools (SIAT) centered on multifunctional land use are important for regional and national forest policy-making support in LPRB/Mercosur. This is one reason why Mercosur partners set out to adapt the SENSOR-EU's SIAT forest strategy policy case to the Mercosur conditions as well. This review will contribute with data and information for this purpose.

Keywords: afforestation, La Plata river basin, sustainable forestry, biodiversity loss, forest management

Sustainability indicator development - natural science or political negotiation?

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The development of indicators for sustainability assessment has gained popularity since the beginning of the 1990ies. Indicator development processes in all kind of sectoral policies (land-related) started all over the world. In Europe currently four integrated projects (SENSOR, SEAMLESS, EFORWOOD and PLUREL) among others financed within the framework of the European Union research programme are dedicated to the design of tools for sustainability assessments. In that regard indicator development lies in the heart of their research designs. They are all confronted with land-related questions of sustainability, but currently no common approach to sustainability indicator development is available. Indicators may be viewed as technical devices that depict real world factors, as well as politically developed factors that are to be seen as social constructs. Different planning ideas may inform their development. In addition in the context of land-related research indicator development processes need to mediate between expectations of natural and social scientists as well as policy-makers. The aim of the paper is to compare the underlying concepts of the indicator development processes, indicator selection, methods and criteria of selection of the four land-related projects.

Keywords: sustainability indicator, indicator development, governance, land use

Indicator selection in SENSOR and SEAMLESS: issues with regards to the policy-science interaction

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SENSOR and SEAMLESS projects have as common objective setting up ex-ante impact assessment tools for European policies based on model chains and on the participation of experts and stakeholders. In these projects, policy impact assessment is viewed both as a scientific process to provide policy-makers with strategic knowledge and as a social process, including but not restricted to formal products (models and indicators). Indicator selection is central from these two perspectives. It is a way for policy-makers to get context-sensitive explanatory knowledge about the tested policies and action-guiding knowledge with regard to strategic decisions. Besides, it acts as a science-policy interface, where values and facts mutually confronted are a means for learning. This deliberative process involving scientists and policy-makers aims at discovering values and will learn about respective interests. However, the indicator selection doesn't play the same role in these projects. With a limited set of indicators that measure the regional impacts of multifunctional land use policies and that are familiar to the EU policy-makers, SENSOR contributes to the institutionalisation of the model based impact assessment method, which opts for the primacy of science. It leads to the gradual penetration of scientific knowledge in the political realm, but with delay and never totally. In SEAMLESS, indicators are user specific combinations of outputs of models, which provide policy-makers with strategic knowledge on the effects of agri-environmental policy options. However, the scientific process is in no way isolated from the socio-political context: the assessment involves value judgements or decisions both from policy experts about what will be considered, and from integrative modellers about who will be involved and how. In addressing problems and designing potential solutions that pertain to both the scientific and the political processes, SEAMLESS assumes that policy-makers are involved in learning process through social debate, and in doing so, contributes to the institutionalization of 'deliberation' processes.

Keywords: indicator, impact assessment, scientific knowledge, learning process

Indicator sets in environmental assessment: composition, structuring, and prioritization

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The paper will address a problem of indicator choice in environmental assessment (EA) with particular focus on urban development. It is estimated that in the next twenty-five years almost two billion more people will move into cities. This makes urbanization one of the key factors that govern global environmental change. There has been an increasing understanding of the importance to consider cities as an instrument to address global environmental challenges. Cities and megacities are probably the only answer to the need for accommodating growing population of the world and minimizing adverse environmental impact of the population growth. It is a challenge to scientists, urban developers, industry and policy-makers to provide sustainable solutions for urban development, and EA plays an important role in the decision-making process. Urban environmental indicator sets has been developed by many international organizations: World Bank, UNDP, UNEP, OECD, Eurostat, Metropolis, others. One of the commonly recognized problems of indicators use is difficulty in data compatibility collected by different authorities. The other major issue is structuring of indicator sets, that integral conclusion on an assessment problem can be reached. The paper will review some of existing approaches (e.g. pressure-state-response model) and will explore in depth opportunities for using of analytic hierarchy process (AHP) to composition of an indicator set. AHP can be successfully used for structuring and prioritizing of indicators, as well as their aggregation. Two approaches have been developed for a hierarchy structure arrangement: bottom-up and top-down. Finally an example of using indicators to analyze urban development will be given. This example combines urban environmental and infrastructure indicators and explores their interdependency.

Keywords: environmental assessment, environmental indicators, multiple criteria decision analysis, urban development

The Indicator System LUCCA: an Instrument to Implement the Adaptation of Regional Land Use to Global Climate Change into Strategic Environmental Assessment

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The paper deals with the methodological application of strategic environmental assessment (SEA) in German regional land use planning (SEA-REP) with emphasis on quantitative indicators and assessment thresholds for impact assessment and the comparison of alternatives. A future key role and responsibility of regional planning in cooperation with sector planning to soon adapt to climate change is determined. It is investigated, how SEA-REP as decision-aiding instrument can contribute to an adaptation of the European regions to climate change with the objective to mitigate negative impacts of climate change on the environment and mitigate cumulations with physical degradation caused by regional plan designations. A core problem during the selection of indicators for land uses for the adaptation to climate change (here called LUCCA) as part of SEA-REP and the derivation of assessment thresholds is a lack of region-wide objectives for the protection of land and resources. At the same time climate change is so far not sufficiently considered in regional land use planning. It is investigated how regional planning could integrate site-specific designations and objectives for an adaptation to impacts caused by climate change. The proposed LUCCA indicator system integrates mitigation and adaptation measures for environmental impacts of climate change, which are evaluated by indicators and assessment thresholds. These involve for instance designations of priority areas of land uses with future potential for climate protection and human recreation, ecological biotope connection, floodplains, freshwater resources for water storage. The overall objective of the research focuses on a proposal of regional environmental orientation objectives for adaptation of land use to climate change, quantitative indicators and the derivation of assessment thresholds for an adaptation of European regional land uses to climate change.

Keywords: Quantitative Indicators, Assessment thresholds, Regional land use planning, Strategic environmental assessment, Adaptation of land use to climate change

Adapted Indicator Guidelines for SENSOR TTC in China

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The aim of this report and the activities behind it is to facilitate SENSOR test in China by establishing an adapted indicator framework in model-based sustainability impact assessment. Based on both SENSOR Guideline and China's circumstances, a draft indicator framework specifying indicators in three dimensions including environmental, social and economic aspects has been drawn. The principles of the indicator framework are as follows: Firstly, to take full consideration on the common issues faced by the international community, and to choose those indicators with which the comparative analysis can be made at international level. Secondly, to avoid those indicators which are not in China's priorities. Thirdly, to throw out those indicators which require too many efforts to get the exact data. This indicator set is of significance in its potential policy implications. This indicator set is of great significance in terms of policy and practice implications. At present, China has entered into the accelerating urbanization and industrialization period. To maintain a sustainable China, it has to face many severe challenges, one of which is how to coordinate regional arable land, residential land, industrial land and other types of lands and get the scientific land resources structure and layout. This indicator set can be effectively used to guide the regional land resource use and planning, and to monitor, evaluate and promote the process of sustainable development. Like SENSOR Guideline, however, this report also does not deal with the important issue of how to aggregate and weigh indicators over impact issues, sectors, regions or otherwise.

The indicator set for the SENSOR TTC is used to reflect the state and progress of the social, economic and environmental development, which should have the following functions:

Description: The indicator should reflect the status quo and the trend of the social, economic and ecological environment development.

Interpretation: The indicator should make scientific and rational explanations for land use and land use changes.

Evaluation: Based the indicators and their criterions, the comprehensive evaluation can be made on one region‘s social, economic and environmental development and the sustainability of the targeted region can be measured.

Monitoring: With the data and information, the regular monitoring can be conducted on the social, economic and environmental development of the targeted region.

Early Warning: The indicator set can be used for searching factors against sustainable development in order to find and address them timely and to provide a scientific basis for policy –making.

Keywords: indicator, China, SENSOR TTC

Modelling soil quality changes in Europe

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Soil is one of the most important and most complex natural resources. However, current developments (urbanisation, erosion and climate change) tend to increasingly imperil this valuable resource in Europe. The aim of this paper is to introduce how changes in soil quality were modelled in the SENSOR project in response to different policy scenarios and to evaluate the accuracy of these model calculations through comparing GIS data with empirical findings in a case study in Hungary (Sárvízvölgy). In the SENSOR project changes of soil quality are modelled through three indicators: soil carbon content, soil water erosion and soil sealing. Soil organic carbon content is a widely accepted indicator of soil quality, since decrease in soil organic carbon content brings about fertility loss and degradation of the resource. Soil water erosion specifies physical loss of fertile soils causing sedimentation elsewhere. Since in general erosion is a natural process, the focus of this indicator is accelerated erosion induced by human activities. Soil sealing indicates soil loss from a land use point, since covering the soil surface with an impervious material makes this resource no longer available for other purposes. The calculation of these indicators is done through state variables and model variables that are mainly model outputs from CAPRI, CLUE and EFISCEN models. These model outputs are responsible for indicating changes due to different policy scenarios that again induce changes in indicator values. In the Hungarian case study area we compare model calculations with previous empirical data in order to assess data loss and accuracy of modelling. One source of inaccuracies emanates from the fact that homogeneous physical units often do not coincide with administrative units which might produce considerable data loss when moving from high to low resolution. With our scrutiny also the question of model sensitivity to changes in important determinants can be answered.

Keywords: Soil quality modelling, modelling accuracy, problem of fit

Impacts assessments of human uses on ecological integrity and the provision of ecosystem services

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To meet its demands and needs, humankind has been very effective and inventive within living memory. One main result of respective activities is the emergence of scale-specific use patterns of natural resources, which can be found everywhere on earth. These patterns are resulting out of characteristic combinations of drivers of human action and can be classified according to their spatial extension and intensity. Following the Driver-Pressure-State-Impact-Response (DPSIR) model, cause and effect chains of human-environmental relations become obvious. Thus, a combination of drivers of human action leads to pressures (in form of nature use) that will alter the capacity of ecosystems to provide goods and services to the society. The base for the supply of provisioning, regulating and cultural ecosystem services are supporting services like maintaining biodiversity, primary production or soil formation. Supporting services depend strongly on ecosystem state, which denotes essential ecosystem structures and functions. They characterize the integrity of ecosystems which can be assessed using corresponding indicators. As could be indicated by numerous studies and observations, the intensity of human use of natural resources correlates in general negatively with ecological integrity and thus, with the capacity of ecosystems to provide goods and services, due to sudden or long term shifts of ecosystem dynamics. These shifts can be connected with severe changes in the capacity of ecosystems to sustain ecosystem goods and services and in turn impact human well-being. Therefore, a responsible and sustainable environmental management has to look for appropriate options of response in order to avoid undesired developments and system shifts. Hence, an assessment of impacts of different forms of human uses on ecological integrity offers important information with regard to resource and spatial management. Different case studies, methodological frameworks and assessment tools, linking theoretical concepts with practical applications, are presented to test the hypotheses mentioned above.

Keywords: Ecosystem Services, Human-environmental systems, DPSIR, indicators, ecological integrity

A simple indicator of soil-erosion risk: is it successful?

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Both farmers and policy makers need simple indicators of erosion risk in order to plan for land uses that will protect the soil and decrease off-site impacts. In England and Wales, Defra (Department for Environment, Food and Rural Affairs), uses field gradient, soil texture and crop type as indicators of risk of erosion. Subsidies under the EU Single Payment Scheme are reliant on farmers meeting Cross Compliance rules. These include completing and implementing a Soil Protection Review based on Defra's soil erosion risk assessment. For two sample areas in England, farmers' compliance with recommendations is assessed. In the Midhurst area of West Sussex, field maps of erosion can be compared with the risk rating and farmers' compliance. We suggest modifications to the Defra erosion-risk indicator approach to take into account off-site risk to watercourses and roads due to muddy floods.

Keywords: soil erosion, risk assessment, off-site impacts, farmers, muddy floods

Modelling changes in habitat eutrophication from atmospheric nitrogen deposition across Europe in response to policy scenarios

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Eutrophication of terrestrial habitats is a major policy concern globally. It results in loss of biodiversity and changes in ecosystem processes in semi-natural habitats. Complex models (e.g. IIASA Rains model) predict changes in nitrogen emissions across Europe in response to specific scenarios. However, a more generally applicable model framework is needed which can be adapted to fit outputs from different models and predict eutrophication under a range of policy options. This paper describes the development of such a model framework. The model adjusts existing data on emissions and deposition of nitrogen in proportion to predicted changes in emissions (derived from the macro-models CAPRI and NEMESIS), and calculates critical load exceedance for sensitive habitats, working primarily at a spatial scale corresponding to NUTS2 administrative units. EMEP data were used to establish relationships between emission and subsequent deposition of nitrogen, separately for oxidised (NOx) and reduced (NHy) compounds, on a regional basis, incorporating EMEP blame matrices. These relationships differ spatially due to influences of climate and long-range pollutant transport. Habitats sensitive to eutrophication were assigned to response classes depending on their critical load ranges. The area of sensitive habitat in each class was calculated in a GIS using Natura 2000 and Corine Biotope databases, matched to the EUNIS classification. Average accumulated critical load exceedance was calculated by comparing total N deposition with the mid-point of the critical load range, multiplying the exceedance by the area of habitat exceeded, and dividing by the total sensitive area in that region, as per the EEA indicator. Testing of the model suggests that an EU-wide 20% decrease in nitrogen emissions reduces critical load exceedance by 35%. Regional differences in nitrogen emissions as a result of the modelled policy scenarios create regional variation in critical load exceedance, with implications for interpretation of the sustainability of policies.

Keywords: sustainability, eutrophication, indicator, nitrogen, regional

Assessing policy impacts on deadwood in European forests

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Deadwood is an indicator that captures many elements of naturalness of forests. Its quantity and quality is crucial to the ecosystem biodiversity and the survival of many endangered specialist species. Deadwood has been accepted as one of the main indicators for forest biodiversity at the scientific and at the political level and is therefore a key indicator to assess ex-ante impacts of policies on forest land use. This paper describes the approach employed to include this indicator in the large-scale European Forest Information SCENario model (EFISCEN) and illustrates its use through the analysis of policy scenarios on deadwood. Deadwood is the result of tree mortality and including deadwood in EFISCEN required developing mortality functions and re-estimation of forest increment. Mortality functions were estimated through application of data from national forest inventories, European-wide databases and calibration. Deadwood was modelled to remain standing before falling down or being removed during management. Decomposition of fallen trees was modelled through the soil model YASSO. The use of the indicator is demonstrated by analysing impacts of different policy scenarios: 1) business as usual; 2) bio-energy production (increase removals and harvest residue extraction for bio-energy production); and 3) biodiversity protection (assign biodiversity protection status with strong limitations on harvests to a share of production forests). The simulations were carried out for 24 EU countries until the year 2025. The impacts of the policy alternatives are analysed for different deadwood fractions. Further, the behaviour of the indicators towards the scenarios is analysed and the use and impact of different data sources are discussed. Suggestions are forwarded to improve deadwood projections in European-wide modelling and conclusions are drawn on how bio-energy production and biodiversity protection affect biodiversity.

Keywords: Deadwood, EFISCEN, Environmental indicator, SIA

Modelling the European Farmland Birds Indicator in response to forecast land-use change in Europe

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The farmland birds indicator for Europe is an aggregated index integrating the population abundance and the evenness of 33 common bird species associated with specific farmland habitats during the nesting season and for feeding during most of the year. We describe a modelling method to predict this indicator from land-use characteristics. Using yearly historical land use data of crop areas for the period 1970-1990 derived from the FAO databases and published population data of farmland birds at the national level for the same period, we developed a series of multiple regression models to predict the trend of the combined populations of 33 individual farmland species that are used to calculate the Farmland Bird indicator. These models incorporated up to 4 parameters and were selected based upon the significance (p

Keywords: farmland birds, land-use change, modelling

Spatial cohesion, an indicator to assess the impact of land use change on the connectivity of ecological networks

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Human-induced land use change causes habitat fragmentation of natural habitats and is therefore an important driver of biodiversity. Spatial cohesion is a sustainability indicator to determine whether the size and connectivity of ecosystem networks is sufficient for sustainable biodiversity protection. The turnover of natural habitats and the intensification of land use in the matrix between natural habitats both have impact on spatial cohesion. We present the model LARCH-SCAN that calculates spatial cohesion of forest ecosystems for species that function on different spatial scales. Changes in spatial cohesion of different land use change scenario's are compared. Species differ in area requirements, dispersal capacity and whether they are sensitive to barriers in the landscape such as roads, urban areas and intensification of agricultural use. Thus species require different levels of spatial cohesion for their long term protection (sustainability thresholds). In addition the same landscape might be sustainable for one species but is not for species with different requirements. Methods of up scaling and down scaling of model results are discussed. Possibilities for improving the approach by using remote sensing data to estimate landscape permeability are discussed.

Keywords: Habitat fragmentation, Impact assessment, Connectivity, Landscape permeability, Ecological networks

Mapping environmental and economic effects of bioenergy production in Europe

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The aim of this study is to present a method to model and map indicators for the environmental and economic effects of scenarios for increased bioenergy consumption and production in Europe. The method is developed within the www.SENSOR-IP.eu European research project. Here, a number of environmental (ENV), economic (ECO) and social (SOC) indicators are developed. In this paper we present procedures to model and map selected indicators for all regions in The EU-27, where results, for the bio-energy production case defined, are presented. An increased bioenergy production will significantly change the land use in Europe and consequently lead to environmental and economic effects. In this paper, we especially focus on climate (ENV4) and water pollution effects (ENV2), compared to effects on business operating cost (ECO3), value added (ECO8), and employment (SOC1). The values of these indicators are mapped for the SENSOR (medium) baseline scenario in the year 2025. The 2025 situation is compared to the 2005 situation. Moreover, two policy scenarios with different support options for bio-energy are used to analyze differences in the regional effects of increased bio-energy production. The sensitivity and uncertainty of the indicator derivation are discussed, and compared to similar studies from literature, and from ongoing national and international research projects.

Keywords: bioenergy, mapping, Europe, environment, economy

Evaluating of land-use sustainability using birds as indicators

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Intensification of land management is a major factor driving the change of biodiversity in agricultural landscapes. Different agri-environmental schemes aim at counteracting this process by enhancing faunal richness and therefore achieving a sustainable farming system. To evaluate the sustainability of land-uses and effects of the environmental schemes we used the German Sustainability Indicator for Species Diversity (SISD) which is one out of 21 head indicators of the German National Sustainability Strategy. The SISD builds on monitoring data for 51 selected indicator bird species, with trends in the population size of these species being assumed to reflect changes in overall species diversity. A target value for the population size in 2015 for each bird species was determined by a national expert panel. We modeled the effect of landscape changes on the distribution and population numbers of selected indicator species. Changes of landscape structure involved in the model concerned e.g. landscape diversity or hedge density in order to increase the SISD value and to achieve a more sustainable land-use. The study focused on the Nidda catchment which is located in Hesse (Central Germany). This region contains comparatively uniform areas of intensive agricultural use as well as less intensively used areas with a high proportion of semi-natural habitats. The use of high resolution maps allowed for assessing the impact of small-scaled habitats on the population size and distribution of birds by means of the GEPARD tool (Geographically Explicit Prediction of Animal Richness Distributions). Our modeling exercise revealed contrasting habitat relationships for different species, with some species preferring areas of high (e.g. Yellowhammer, Red Kite, Little Owl) and others of low (Skylark) habitat diversity. Yet, our results show that it may not be possible to optimize agricultural regions in a way to meet the target value of all SISD species. Our data rather suggest that priorities need to be set concerning the development of certain landscapes.

Keywords: Sustainability Indicator for Species Diversity, land-use change, species distribution modelling, GEPARD tool

Definition of spatial scales and their transitions by assessment of structural heterogeneity

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There exists a lack of knowledge regarding the identification of spatial scales as precondition for investigation of processes. For identification of spatial scales a mathematical approach was developed, which is based on the assessment of structural heterogeneity by using moving window-technology and raster based data input at high resolution. The procedure includes the stepwise aggregation of pixels to larger areal elements (arithmetic mean), the so-called moving window, which are characterized by a maximum overlapping. The moving distance corresponds to the pixel edge length. After that for each discretization stage (level of resolution) the relative variances (variance divided by standard deviation at pixel resolution) were calculated and plotted versus the logarithmic edge lengths of the corresponding moving window. The resulting curve of relative variance is characterized by a sigmoid shape. The inflection point (maximum rate in increase of relative variance) of any sigmoid variance curve characterizes the edge length of the dominant spatial subunit (pattern) within the corresponding scale. Transition from one scale to an other is characterized by a second inflection point (minimum rate in increase of relative variance) between two neighbouring sigmoid variance curves. The derivative curves of variance curves, described above, characterize the dominant spatial subunits as local maximum and the transition zone between two scales as local minimum. The developed approach was applied for artificial number fields, structural images of CT-scanned soil columns, field measurements of relief, electrical conductivity and leaf area index as well as remote sensing images of landscape subunits. The results correspond with the visual inspection of structural heterogeneity.

Keywords: spatial scales, structural heterogeneity, moving window-technology, variance curves, derivative curves

Development of a Data Integration and Management Tool for the Strategic Environmental Assessment as a Contribution for Sustainable City Planning in Berlin

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Urban developments, such as large infrastructure projects, have usually not only local environmental effects, but consequences to larger parts of a municipality. Although with the existing planning instruments direct impact on the environment can be efficiently reduced or avoided, there is no suitable tool for the preventive management of these spacious effects. Therefore, the Senate Department for Urban Development Berlin intends to develop a spatial data integration and management tool, which is designed as a part of the Strategic Environmental Assessment (SEA). The challenge in developing this instrument is the necessity to integrate heterogeneous data sources in terms of different scales and environmental aspects. The presented study shows the transferability and interoperability of different environmental data-sets (e.g. selective faunal mapping results and biotope maps). These geodata have different semantic and geometric accuracy. A rule-based approach is used for the combination of large scale data, such as the land use plan and small scale data of parts of the city (e.g. development plan). The combination of large scale and small scale information of several environmental indicators results in aggregated information, which can support a comprehensive generation of different planning alternatives for sustainable urban developments.

Keywords: Strategic Environmental Assessment, Data Interoperability, sustainable city planning

Weighing procedure in spatial upscaling of farm data: limitations of data sources or concepts?

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Data are often (dis)aggregated along the spatial dimension. Farm performance is characterized by different data (economic, social, environmental) for which the (dis)aggregation procedure needs to account for. The existing EU farm typology used in Farm Accountancy Data Network (FADN) is based on regional proxies for the farm income coming from different production sources. Each farm type has a weight corresponding to the number of agricultural holdings it represents in a FADN region. Transfer of data from the original FADN regions to e.g. Nitrate Vulnerable Zones, environmental zones will require information about spatial farm allocation. It is unclear whether the number of representative farms in a FADN region is the best weight to aggregate data to the different regional typologies and whether the considered farm types sufficiently represent the agricultural area in a region. The paper introduces a farm typology based on size, intensity and specialization/land use and the spatial allocation procedure developed in SEAMLESS project. It attempts to clarify the pros and cons of using FADN data and the considered farm types in terms of farm representativeness. Alternative weighing factors to aggregate socio-economic data are explored. Calculations based on FADN and SEAMLESS farm types (year 2003) in selected regions illustrate the sensitivity of the upscaled values to the choice of weights. Several approaches are discussed to ensure sufficient agreement between the agricultural area in a region and the area of the main farm types and of the remaining group of farms. The paper concludes by stressing the need for modeling the structural changes of farming systems to enable aggregation of results from ex-ante assessments. It also clarifies the consequences of methodological choices on the results of aggregation of the observed data.

Keywords: FADN, representative farms, aggregation, regional typology

European wide assessment of the nitrogen cycle at 1x1 km grid cells based on the DNDC/CAPRI metamodel

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In the context of the EU co-funded research project CAPRI-DynaSpat, data bases and methodologies were developed to consistently downscale crop shares, yields, animal stocking densities and mineral and organic fertilizer applications from the agricultural sector model CAPRI for larger administrative regions at EU27 level to clusters of 1x1 km grid cells. Those processing units are assumed to be homogenous regarding environmental and agronomic conditions and are interfaced to the process-based model DNDC-EUROPE for the mechanistic simulation of nitrogen cycling in arable soils. However, it is not feasible to perform decadal runs with DNDC for all major crop-site combinations at European scale for every policy scenario. Therefore we derived statistical meta-models which can seamlessly be linked into the economic model for agriculture CAPRI. Ordinary least squares regressions were performed on DNDC-EUROPE results on about 11000 representative crop-site combinations with different application rates of mineral and organic nitrogen. We used soil and climate parameters and N-application rates as explanatory variables. An optimal fit was obtained by offering these parameters to the estimator in linear, logarithmic, square and square root transformations, both individually and as combined terms. Insignificant variables were removed by stepwise backwards elimination. The final models explained in most cases >95% of the variance of the DNDC results. As the meta-model can be integrated also in the down-scaling procedure that derives input parameter for DNDC simulations, it helps to create maximum consistency between the 'economic' and the 'bio-physical' modelling worlds, including the simulated yield by estimating individual potential yields as input for each crop-site combination. We present applications of the CAPRI/DNDC-EUROPE for the assessment of reactive nitrogen fluxes from present (2002) and future (2013) European agriculture according to official projections, and analyse selected policy scenarios.

Keywords: Spatial disaggregation, Nitrogen fluxes, Statistical meta modelling, Large-scale integrated modelling

Aggregation and weighting of indicators in a sustainability impact assessment frame

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SENSOR's Sustainability Impact Assessment Tool will give the user the possibility to analyse the impact of policies through an appropriate framework. The basic elements in this framework are selected indicators and Land Use Functions (LUFs) . LUFs represent the goods and services that each land use provides. The methodological challenge in the development of the LUF framework is how to aggregate the indicators to LUFs in a way that the aggregation and weighting procedures can present the impact of different policy scenarios on land use sustainability in a sound and clear way to the end user. The paper presents a screening of available methods for aggregation and weighting of indicators verified against SENSOR and Impact Assessment requirements and a proposal for building the aggregation scheme in SENSOR. In order to select the most appropriate method, all the different dimensions implicitly considered in the SENSOR framework have been taken into consideration: the relations between the indicators and the land use functions (LUFs), and between the LUFs and the model for sustainability; the relations between the indicators and the corresponding critical thresholds and limits; the difference of the scale of analysis (test area, regional, European); the use of qualitative and quantitative indicators; the weights assigned to the indicators at each spatial scale; the different actors involved; the need for benchmarking and/or ranking the possible alternatives; the need to maintain a transparent process.

Keywords: indicators aggregation, indicators weighting, sustainability assessment

How to manage models outputs aggregation for indicator quantification within SEAMLESS Integrated Framework

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SEAMLESS-Integrated Framework (S-IF) aims at assessing, ex-ante, impacts of policy options and agro-technical innovations on the sustainability of agricultural systems and on sustainable development at large. To reach this objective the modelling chain of S-IF, which simulates the behaviour of the key hierarchical agricultural systems, calculates a set of environmental, economical and social indicators at different scales (from field to EU). Despite the large range of scales at which S-IF can provide model outputs it is not always possible to calculate the indicators required by policy experts without a scale change procedure. Accordingly several aggregation procedures for upscaling model outputs have been developed. This paper presents the aggregation methods and concepts that underpin the scaling capacities of S-IF as well as some examples. The necessity to manage temporal and spatial aggregation of model outputs led SEAMLESS researchers to define generic indicator attributes and aggregation procedures which are described in an ontology of indicators. In the ontology each indicator is defined in a generic way. This involves first a combination of an assessment criterion (tagged to a model output) its units and its spatial and temporal resolutions (model output scales) and extents (policy expert's target scales). The second element of the definition contains complementary information necessary for transforming model outputs and for aggregating from the indicator resolution to the indicator extent for example algorithms and parameters for transforming or aggregating model outputs). To manage indicators within S-IF a flexible Indicator Manager which provides and links indicator selection, classification (i.e. indicator framework), edition and calculation functionalities of the framework is in development.

Keywords: upscaling, indicators, aggregation procedure, sustainibility, agricultural systems

Accounting for externalities from land-use policies

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SENSOR uses a number of environmental, social and economic indicators that are defined to characterise the state of the environment and the economy. Impact assessment in SENSOR is based on observed policy-induced changes in those indicators. However, the information about potential changes in the several indicators may not be enough for a complete evaluation of the policies if externalities are not accounted for. Externalities arise when the action of an economic agent affects the welfare of another economic agent who does not receive a compensation for the cost he or she is suffering (if the welfare change is negative) or does not pay for the benefit he or she is enjoying (if the welfare change is positive). From an economic perspective, externalities induce inefficient allocation of resources since the economic agents do not face the correct prices for their actions. The accounting framework for the assessment of externalities in SENSOR is based on the Impact Pathway Approach (IPA) used in the project series EC ExternE (Externalities of Energy). It benefits from previous accounting frameworks developed in Europe and other recent similar European projects. We assessed the range of possible impacts associated with each indicator and the available estimates of the external costs and benefits associated with each sustainability indicator, which were generated using sound valuation exercises in Europe or elsewhere. In addition, since the results of the proposed accounting framework are to be introduced into the SIAT tool, it suggests procedures to transfer national or regional monetary values to NUTSx regions according to the sustainability indicator type. Finally, we present the results obtained with applying our accounting framework to selected policy cases studied within the SENSOR project.

Keywords: Green accounting, Valuation, Externalities, Land-use changes

Combining stated preferences and multi-criteria analysis for valuation of environmental goods

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Valuation of environmental goods is a growing area of research where consensus regarding the validity and reliability of obtained estimates is far from being achieved. We propose two alternatives combining stated preferences (contingent valuation) and multicriteria analysis (AHP and Goal programming) for obtaining information on preference structure. These alternatives allow for clearer budget constraint implementation (alternative 1) and testing of non-additive preference structures (alternative 2) in order to gain additional insight on consumer preferences for environmental goods. Alternatives have been applied to multifunctional agriculture in dry-land agriculture and a protected natural area and results show that both aspects need to be considered when valuing environmental goods. The first option shows that mainstream applications of choice-experiments might be overlooking the issue of budget constraint for attribute bundles while the second shows that inter-actions among attributes play an important role in utility functions and that these are far from being homogenous for the general population.

Keywords: stated preferences, multi-criteria analysis, multifunctionality, protected natural areas

An integrated methodology for rural landscape economic valuation to support land use policies

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Incentives and subsidies have been commonly implemented in the European agriculture policy to pursue sustainability principles. For them to be effective, these mechanisms should manage to make sustainable choices in resources use economically convenient to agents. Estimate of incentive values for rural landscape should consider not only biophysical and environmental but also social and cultural components, related to individuals' perception, in a "holistic" approach that integrates both "objective" and "subjective" valuation criteria. In this light, the aim of the this research project is to define a transdisciplinary valuation methodology for rural landscape, where landscape ecology and resource economics principles integrate to support respectively objective and subjective landscape components analysis. Such methodology is organized in two main phases: - in the first, the analysis with Geographical Information Systems and FRAGSTATS describes the study case area landscape settlements in homogeneous units and quantifies their spatial structure by landscape ecology metrics; - in the second, the economic analysis with choice models integrates these metrics in the econometric models and elicits individuals' preferences, estimating the value they attach to different landscape settlements. Some important methodological issues are tackled: - the use of landscape metrics allows for a more quantitatively rigorous representation of different landscape attributes in econometric models; - consideration of spatial relationships among observations, as recently highlighted by several authors, improves econometric models performance in interpreting data with respect to non-spatial specifications; - econometric analysis will be conducted combining revealed and stated preferences data, according with recent developments in non-marketed goods valuation methodologies. Results in current literature, in fact, show that this approach provides major improvements in terms of more robust estimates and better identified attributes. The methodology analytical phases will be presented in conjunction with first results from GIS and FRAGSTATS-based analysis of rural landscape settlements in the case study area.

Keywords: rural landscape, economic valuation, landscape metrics, Geographical Information Systems, holistic approach

Non-market benefits of enhancing biodiversity through forest conversion in Lower Saxony

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Forests are multi-functional and provide, in addition to timber, a broad array of goods and services. These non-timber forest products include, for example, watershed protection, recreation, and biodiversity. As markets fail to reveal the economic value of many of these goods, supplementary measurement instruments are needed in order to inform decision makers about the values of these public goods. Therefore, one objective of the FOREST project (Forest conversion: Ecological and socio-economic assessment of biodiversity) was to determine the benefits people would derive from changed levels of forest biodiversity in two regions of Lower Saxony, Germany. The changes in forest biodiversity will result from a conversion of coniferous forests into mixed and broadleaved forests. In order to determine the benefits both the contingent valuation method and choice experiments were used. Both methods are interview based and belong therefore to the class of stated preference methods. While the former presents respondents generally with a single environmental change, the latter asks respondents to make comparisons among alternatives characterized by a variety of attributes and the levels these are taking. Each method was used in both study regions resulting in four independent samples of approximately 300 face-to-face interviews. In the presentation we will compare the results of both valuation methods with respect to the long-term ecological forest development programme (LÖWE) launched by the government of Lower Saxony for the state-owned forests in 1991. In addition to a discussion of the pros and cons of both valuation methods concerning the economic valuation of biodiversity we will also present results from cost-benefit-analyses investigating whether the determined benefits of enhanced forest biodiversity outweigh the costs of forest conversion arising at private forest companies.

Keywords: cost-benefit analysis, forest biodiversity, contingent valuation method, choice experiment, forest conversion

Economic value of landscape aesthetic impacts of windpower

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Renewable energy options like windpower could greatly reduce the emissions of greenhouse gases and regional air pollutants, compared to the fossil fuels like coal and natural gas. However, on-shore windpower comes at a cost to the landscape. We use Contingent Valuation (CV) to estimate the economic value of the negative aesthetic impacts of planned windpower projects in Norway, and compare the external costs of windpower with other options for covering the annual, national electricity production deficit of 5 - 10 TWh. The results from the national survey of 480 households show that the economic value of landscape aestethic impacts pr. kWh produced electricity are much higher than expected, but still less than the external costs from the current solution which is importing electricity from coalfired power plants in Denmark. We also report results that indicate that Norwegians prefer few, big wind farms rather than many, small ones. More studies are needed in order to test the benefit and costs of different designs and measures to reduce the negative landscape aesthic inmpacts of wind power.

Keywords: contingent valuation, wind farms, aesthetic impact, external costs

Socio-economic valuation of land use changes: a procedure for cost-benefit analysis in the rural-urban region

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This study develops a cost-benefit analysis procedure that can be used to assess socio-economic impacts of urban, peri-urban and rural development strategies in the rural-urban region (RUR). Starting from the concept of Functional Urban Region, the RUR includes an urban core and its peri-urban belt that can extend to include peri-urban and rural regions.The functional relationships between land use changes and changes in the rural, peri-urban and urban service supply on which the model is constructed are identified based on a survey of more than a thousand existing socio-economic valuation studies. The role of land use diversity in shaping the production of goods and services and its impacts on the stock of manufactured capital (such as urban infrastructure) and non-manufactured capital (such as forests, fisheries, wetlands, biodiversity and mineral deposits) is taken into consideration. The possibility of replacing the traditional cost-benefit decision criteria with a decision criteria based on the real options approach is also investigated and discounting issues are discussed.

Keywords: Rural Urban Region, Cost-Benefit Analysis, Real Options, land use diversity, socio-economic valuation

The redevelopment of brownfields in England

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Urban sprawl and the development of greenfield sites that most developed countries are currently facing, has recently pushed government in both the EU and the US to reuse previously developed land. Observers believe that, among other things, compact cities contribute to biodiversity conservation and decrease energy consumption. At the same time, the regeneration of brownfield sites addresses problems of contamination, improves the balances between urban, peri-urban and rural relationships, identifies sustainable future opportunities, may increase the supply of affordable housing close to local amenities and open space, reduce inequalities, and make our inner cities less congested and safer places to live. This paper uses econometric techniques, supported by GIS data, to address key questions that brownfield stakeholders and policy-makers are facing in the UK and elsewhere: what site characteristics, what ownership type, what geographical characteristics, make brownfield sites more likely to be regenerated? What are the drivers of specific regeneration projects? Are there any regional variations? To address these questions we analyse a dataset of more than 20,000 observations of brownfield sites in England. The results show that more resources and specific policies are needed if the government wants to redevelop 'difficult sites', such as sites that have previously been used for commercial and industrial activities, large sites, and sites that are located in the poorer and bleakest areas of cities and regions of England.

Keywords: brownfields, sprawl, regeneration, previously developed land, panel data econometrics

Reurbanisation processes in a shrinking city

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Recent research evidence across Europe underscores that reurbanisation processes become more and more important in European cities. Particularly in shrinking cities they are supposed be an opportunity to counteract urban sprawl and suburbanisation. To get a broader picture of its evidence, progress and local specifics, reurbanisation needs to be observed in a long-term way. In this paper, we analyse whether reurbanisation is a long-term process of stabilisation of inner-city areas by both a readiness of present residents to stay and an influx of new residents. We further ask whether reurbanisation needs certain settings of socio-economic and residential environment factors to become a stable component of urban development. In order to reach these objectives and using the example of the city of Leipzig, eastern Germany, we test the appropriateness of an indicator set developed by science and practitioners for the observation of inner-city reurbanisation processes. We bring in findings of a small-scale municipal time series from 1992-2005 for Leipzig's 63 urban districts. Among others, the paper argues that reurbanisation has been occurred in most of all inner-city districts and has undergone considerable progress since 1992. We found young, mobile and small households to be the "reurbanisers" in Leipzig since 1990. This influx of households is supported by the availability of socio-economic infrastructure such as shopping, medical and educational facilities. Further we identified a ring of reurbanisation-sensitive municipal districts using a cluster analysis. Among those we found some districts that carry reurbanisation potential and processes since 1993. However, the spatial distribution of relevant indicators shows that reurbanisation is far from being a homogeneous process and that it has the potential to leads to a stronger fragmentation of both the city as a whole and its inner districts in terms of socio-demographic structure, built environment, economic competitiveness and liveability. Probable reasons are given and discussed.

Keywords: reurbanisation, shrinking city, indicators, cluster analysis, demographic change

Urban Development and Quality of Place in Europe

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Various recent policy initiatives at the European level focus on urban areas: e.g. the Thematic Strategy of the Urban Environment, the Territorial Agenda, and the Leipzig Charter. These initiatives strive in general at an improved environmental quality and liveability, and a more sustainable urban form. In the EURBANIS project the characteristics of urban development in Europe in most member states in terms of urban land use and urban densities during the period 1990-2000 have been researched using data on land use, demography, economy, and accessibility. According to these characteristics, a typology has been drafted that distinguishes seven categories of urban development in Europe. For each category, an extensive case study has been carried out using qualitative as well as quantitative methods. At this local level, the process of urbanisation has been linked to various aspects of quality of life and quality of place using data from the Urban Audit. The study shows that many city regions have comparable problems with liveability and quality of place. Often these can be ascribed to urban transport, the effects of demographic changes, segregation and polarisation, and life-style changes. Despite these resemblances, an explanation of the observed urban change and quality of place proved to be very difficult. This was mainly a result of the heterogeneity of underlying demographic and economic changes with a similar manifestation in urban land use and densities.

Keywords: urbanisation, quality of life, land use, densities, EU policy

Mapping Out the Social Impacts of Land Use: Soft-GIS and Choice-Based Conjoint Analysis as Integrative Methods

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People's experiences of place are affected by planning strategies as much as community-based behaviours and emotions can in turn affect planning and development. Residents' experiences of their environment are geographically located, since people can attach their experiences, memories, and feelings to specific locations. By allowing participants to locate these experiences, researchers can not only identify their specific affordances but also analyse and visualize the information for research and planning practices. This paper aims to: a) Examine how soft-GIS and choice-based conjoint methods can help accurately to measure the perceived importance of quality of life indicators and to incorporate them into the impact assessment process by allowing researchers to map out the quality of the living environment resulting from forecasted land-use scenarios; b) Explore ways of analysing "soft knowledge" together with other geo-demographic data to understand land use in peri-urban areas and other places undergoing land use change. For example, to examine how people's preferences and perceived affordances relating to land use are affected by membership of different groups and segments in the population, such as older people and groups of immigrants; c) Discuss how these participatory methods can help build a bridge for more effective collaboration between researchers, stakeholders and planners and to provide a more holistic picture of the quality of the environment. This paper will conclude by providing specific examples of the use of these methods in examining land use impact and by stressing their strengths and limitations.

Keywords: quality of life indicators, land use change, impact assessment, Soft-GIS, conjoint analysis approach

Socio-economic indicators, well-being, and land-use change

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The social and economic dimensions of 'sustainable land use' are not easy to pin down. They reflect, implicitly, constructs such as quality of life, welfare, social and economic cohesion, social capital, social inclusion and social exclusion: well-being is a notion that may capture some, or all, of these constructs. We reflect on some of these ideas and consider them against moral philosophical conceptions of 'Good' (as distinct from the economic concept of 'goods'). We modify these in a way that helps our debate, and recognise different orders of Good, whereby Good itself ('the Good Life') might be regarded as the first order Good, and 'happiness' as a second order Good (one means of obtaining, or perhaps one aspect of, 'the good life'). Well-being can be conceptualised as a third order Good by means of which happiness is operationalised, and which can be seen as a package of fourth order economic and social goods. In turn we can see a fifth order – the means of achieving the package, and thus of achieving happiness, etc, which includes for example education, employment, clean water, pure food, wildlife or biodiversity: freedom from pollution, persecution, and other 'bads' could also be figured into this hierarchy.. In turn, these moral Goods, and social and economic goods, may – in part at least – be 'products' of, or related to, land use or land use change, and the processes by which this change occurs (a reciprocal relationship might also be possible). Land use change results from a variety of policies, market processes and individual or group decisions, but we can argue that these are all ultimately governed by the desire to increase well-being, or perhaps 'happiness'. We discuss the potential for getting as close as we can in social and economic terms (rather than in psychological or spiritual terms, for example) to the notion of 'happiness' by considering 'well-being', as a moral/philosophical Good which it is possible to assess through indicators of some kind. Then we bring the discussion into a practical and empirical context by considering which indicators might be used to tell us about socio-economic well-being associated with land use change. We conclude with reflections on the potentials and limitations of socio-economic indicators in the context of well-being.

Keywords: Social indicators, Economic Indicators, Well-being, Land-use change, Philosophical Good

Recreational use as an indicator to assess the impacts of forest management on quality of life in Europe

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Efforts to incorporate social and cultural values into impact assessment procedures in the forestry sector have presented major challenges to researchers and policymakers. Part of the problem lies in the intangible nature of the public benefits forests can provide such as improvements to quality of life, spiritual and emotional attachment to wilderness, cultural heritage values, and opportunities for education and learning. Typically, selection of indicators is restricted to tangible measures such as levels of employment for which there is good data and a clear causal link to policy drivers.

This paper describes initial findings of research carried out for the EU-funded project EFORWOOD, which seeks to go beyond this narrow coverage of the 'social pillar' within policy appraisal, by developing 'recreational use of forests' as a sustainability indicator in European member states and regions. Assessment of recreational use can act as a proxy for many of the direct use values that people attach to forests, including less tangible values associated with 'quality of life'. Its inclusion in impact assessment procedures would greatly enhance the range of social values being considered within sustainability assessments in Europe.

The research assesses how a range of forest management scenarios may impact on levels and quality of recreational use for different kinds of people in different forest types. Firstly, a literature review is examining public preferences and willingness to pay for silvicultural factors (age, species, density, etc) and non-silvicultural factors (e.g. recreational infrastructure). Secondly, case study research is revealing stakeholder perspectives on factors influencing public preferences and levels of recreational use, both at the stand level and landscape level. Finally, expert consultations will be used to integrate and refine the conclusions from the review and case studies, and incorporate them into the 'ToSIA' impact assessment tool being developed by EFORWOOD.

Key words: forest, recreation, impact assessment, social values, EFORWOOD

Migration-environment relations: an ecological model and methodology for elaborating response functions

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The objectives of this paper are threefold: (1) to emphasize the need for empirical evidence to shape the understanding of the relationship between migration and land use in European rural-urban regions; (2) to propose a theoretical ecological framework which stresses push and pull factors involved in migration and focuses attention on the multiple levels of influence on migration on behaviour, i.e., individual, social-environmental and physical environmental. This framework will lead to the generation of hypotheses and make it possible to quantify the relative contribution of people- and place-related correlates on behaviour; (3) to present specific research methods, such as multilevel modelling, which are suitable for data characterized by a hierarchical or clustered structure, as is the case with data generated when examining migration-environment relations. The multi-level structure of the data is based on the fact that the migration phenomenon—which refers to different types of migration (i.e., return, permanent and temporary)—is nested within different compartments: geographical (e.g., rural/urban areas), aging (e.g., older adults/younger adults), ethnic (e.g., EU/international migrants), and location (e.g., inner-city/coastal areas). Multi-level modelling is helpful to identify groups with varying demographic, behavioural and psychosocial characteristics in terms of their effect on the use of land or other natural resources. This information is essential to help researchers and policy-makers to know where to target their research and intervention resources. This paper will conclude by emphasizing that a future agenda targeting migration and its effects on land use should include theoretical understanding, empirical evidence, and forms of measurement based on modelling approaches. The integration of these aspects may help design comprehensive interventions—targeting both people and environment—and therefore foster the planning of supportive social and physical environments.

Keywords: Migration, Land use, Rural-urban regions, Ecological theoretical framework, Multi-level modelling

Landscape Character as an assessment framework – the experience from an England Case Study

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The Countryside Quality Counts (CQC, www.cqc.org.uk) study provides evidence about the ways the character of the English landscape is changing and what implications this might have for achieving sustainable development. Evidence and information was needed to understand and manage change in the landscape and to plan strategies to ensure that long term development is sustainable. We need to know where change is occurring and whether those change matters to people in terms of the way change affects the things about landscape that they value. The CQC study has made an assessment of countryside change for two periods, 1990-1998 and 1999-2003. The presentation will cover the most recent assessment which has shown that between 1999-2003 existing landscape character is being maintained in 51% of England's landscapes, while in a further 10% existing character is being enhanced. However 20% of our landscapes are showing signs of neglect, in the sense that past loss of character has not been reversed, while in a further 19% new characteristics are emerging. Compared to the earlier assessment, these results suggest that the erosion of valued landscape character has been arrested in some places and has slowed in others. There is also evidence that in many key localities, the existing landscape character has been sustained or strengthened. The study has also shown how landscape information of the type used by CQC can inform strategies for targeting and monitoring agri-environmental schemes as well as other initiatives which affect the landscape, and that CQC can be an important in the development of regional spatial strategies. It may also provide a framework in which an integrated assessment of ecosystem goods and services can be developed and enable a better understanding of sustainability limits in rural England.

Keywords: Landscape Character Assessment, SIA, Sustainability Choice Space, England

Ecoaesthetic landscape character assessment as a tool for sustainable spatial structure of landscape

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Landscape is an important part of the quality of life in urban areas and in the countryside, in degraded areas as well as in the areas of high quality, in areas recognised as being of outstanding beauty as well as everyday areas (European Landscape Convention, 2000). Aesthetically valuable landscape is a product of nature and human activity, which should be enriched and protected by a cultural society in the third millennium (Eringis, 2002). In Lithuania, scenic areas cover about 7.6 % of the country's territory. Scenic landscape is one of the essential advantages of Lithuania, which is integrating into European tourism market. In different countries, Lithuania included, ecoaesthetic landscape character assessments are made by using the principles of landscape ecology, landscape architecture, landscape geography, aiming to integrate them into landscape protection, maintenance, management and planning policy. It enables to form sustainable spatial structure of landscape, restore its resources and vulnerable territorial units, ensure ecological stability, preserve and increase biological diversity. According to the Landscape Policy Directions of the Republic of Lithuania, certified in 2004, to ensure sustainable spatial structure of landscape, it is necessary: to maintain and increase spatial expressiveness of landscape; to sustain and regulate informative diversity of landscape; to individualize spatial structures of the formed landscape; to develop landscape standards based on harmony of nature and architecture. To create sustainable spatial structure of landscape, it is important to consider the possibilities of preservation and increase of biological diversity, restoration of violated landscape complexes (excavated quarries, degrading bogs, etc.), preservation of cultural heritage, ecoaesthetic features of landscape.

Keywords: landscape, ecoaesthetic, assessment, sustainable, scenic areas

The PICA procedure: insights from an empirical application

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The Procedure for Institutional Compatibility Assessment (PICA) has been developed within the SEAMLESS project as a formalised methodology to assess ex-ante the compatibility between a policy option and different institutional contexts. As a first empirical test of the tool, PICA was applied to the implementation of the Nitrate Directive in two study areas in Auvergne, France: the „départements“ of Allier and Puy-de-Dôme. In Allier, the Nitrate Directive has been implemented from 1994 while in Puy-de-Dôme, the directive is not yet implemented. Three different empirical analyses were conducted to test the procedure. In Allier, a simulation of the running of PICA before the start of the implementation of the Nitrate Directive was realized as well as an ex-post evaluation of the effective process of implementation of the policy. The comparison between the outputs of the simulation of the „ex-ante“ assessment and the ex-post evaluation was used to validate the „predictive power“ of PICA. The procedure was also applied to the future implementation of the Nitrate Directive in Puy-de-Dôme, that is, in a „real“ ex-ante situation. The comparison of the outputs of the „ex-ante“ analyses allowed for an assessment of the tool ability to account for the common and distinct features of different institutional contexts. Methodologically, the empirical test of PICA was based on a literature review and 18 interviews with experts and stakeholders involved or likely to be involved in the local implementation process of the Nitrate Directive. The paper presents the main conclusions that can be drawn from the empirical test in Auvergne regarding the practicability and quality of results of the procedure. In spite of methodological constraints of the test, the capacity of PICA to „predict“ institutional factors affecting the implementation of a policy and its ability to account for the similarities and differences between two distinct institutional contexts are highlighted.

Keywords: Institutional policy assessment, Nitrate Directive

Bridging the gaps of the planning system - a Hungarian example

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In Hungary a new landscape planning methodology has outlined in the recent years. A survey of the actual environmental planning system of the country identified several gaps in the web of compulsory plans. There is no sufficient coherence amongst the several environmental and spatial plans: structure plans, environmental programs, rural development strategies, management plans for designated areas and landscape restoration plans. In addition there is a lack of the systematic, thematic distribution and spatial coverage of the issues related to the preservation and rehabilitation of the natural and cultural heritage. Therefore a new type of landscape plan has been proposed aiming to complete the actual planning system. The new plan called preliminarily "landscape protection plan" has two main pillars: one is the protection and restoration of the landscape character and the other is the conservation and rehabilitation of the ecological network at landscape level. Both are based on a holistic assessment, but the character approach give a high emphasis to the perception of the landscape and the ecological network approach to the landscape structure and the land-use intensity. An accurate landscape character assessment would serve several other plans and programs as well feeding them with the information about the unique values and special problems of an area. In addition the systematic analysis and evaluation of the ecological network in correlation with the landscape character would give a larger context for the habitat restoration and thus more efficiency to the nature conservation at landscape level. Achieving the proposed planning targets, the gaps between the several environmental and spatial plans and programs could be bridged. The presentation will give an overview on this new planning methodology and show an example of the LCA as part of a model plan prepared recently for the Fertő-Hanság basin, situated on the north-western border of the county. Parts of this diverse area are everyday landscapes, but parts are rather particular, designated as national park, word heritage cultural landscape, Ramsar area and biosphere reserve.

Keywords: landscape character, landscape restoration, ecological network, landscape planning

The Icelandic Landscape Project

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The tectonic rift-zone position of Iceland, its active volcanism, geothermal fields, extensive uninhabited highlands and the ruggedness reflecting its high-latitude location, all combine to produce diverse and highly unusual landscapes. Only one quarter of Iceland carries continuous vegetation and its agriculture is almost exclusively extensive. Most methods of landscape analysis and classification rely heavily on vegetation and land use but these are of limited use in Iceland where they are poor predictors of landscape forms, colours and textures. In 2006, work started on the Icelandic Landscape Project (ILP) whose aims are to develop methods to describe, classify and evaluate Icelandic landscapes and to carry out a comprehensive description, classification and evaluation. This will i.a. allow identification of landscape types or regions of conservation value because of visual diversity, rarity, or high preference ratings. Here we describe the approach and methods of the classification part of the project. Data are systematically collected within a nationwide 10*10 km grid system and sites located as their central GPS point. At present 105 sites have been sampled. The classification is based on the visual qualities of the physical characteristics of the land through a quantitiative assessment of 23 variables on a 5-point scale. Variables include landscape depth, basic landscape shape, elevational range, and forms, patterns, textures and colours. At each site a checklist is completed, and photographs and video recordings taken following set procedures. Cluster analysis is used to derive a multivariate classification of landscape types. Ordination methods will be used to explore the underlying major variables. The ILP is governmentally funded and initiated within a Framework Plan for the use of hydropower and geothermal energy. We believe the approach and outcome have a wide potential relevance, e.g. in environmental governance in Iceland, where landscapes have so far received little systematic attention.

Keywords: landscape description, landscape classification, visual landscape characteristics, multivariate analysis

The impact of institutional changes on land amelioration and land use in Odra River Valley, Poland

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The Odra River Valley, SW Poland has undergone significant changes in land use, water regime and social structure since the end of Second World War including: the introduction of socialist economy controlled by state after 1945, the beginning of the transformation towards free market economy in 1989, and finally the EU accession along with consequent policies such as the Common Agricultural Policy in 2004. During the socialist period people, including farmers were used to depend on top-down decisions and care of the state. This type of passive behaviour could not change as quickly as both institutional and legal rules adapted by different organisations and authorities in the new political situation. The example from Odra case study relates to the land amelioration system (LAS), which was maintained by state before 1989 and currently, according to the new law is supposed to be maintained by landowners themselves. LAS maintenance must be considered as a collective effort that requires social mobilisation of the farmers whose land parcels are located along a ditch or a communicating ditch system. The obligation of LAS maintenance can also be met by a Water Partnership (WP), organisation which associates natural or legal persons in order to satisfy their needs regarding water management. Water Partnerships existed before 1989 and farmers are accustomed to their responsibility for LAS. However, although the name of these institutions did not change, there is a big difference between the way they functioned before and after 1989. At the moment the LAS is not maintained neither by farmers nor by the WP, which is suspended. According to our research this situation results from personal attitudes of farmers, disinformation regarding water law, and WP's ineffectiveness. Additionally LULCC analysis proved that despite neglected LAS farmers turned grasslands to arable fields, even more dependant on LAS than meadows.

Keywords: land amelioration, collective action, political transformation, institutional change, Odra River valley

New Frontiers in Institutional Policy Assessment

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Policy assessment from an institutional perspective follows the concept of institutions for sustainability, which is defined as the necessary institutional structure capable of delivering economic, social, and environmental sustainability objectives. Thus, the effectiveness of a policy and the cost-effectiveness of its implementation depend to a large extent on the degree of compatibility between this policy option and the respective institutional context. However, not least because institutions usually relate to a great diversity of situations, the state-of-the-art in institutional economics offers hardly any standardised procedures for institutional analysis that can easily be combined with environmental and agricultural models widely used for policy impact assessment. To assess the compatibility between policy options and various institutional contexts a formalised methodology has been developed that provides for an institutional dimension in modelling: the 'Procedure for Institutional Compatibility Assessment' (PICA). PICA comprises four distinct steps: first, policy options are clustered according to the type of intervention (regulatory, economic, and advisory), the area of intervention (hierarchy/bureaucracy, market, and self-organised network), possibly induced property rights changes, and the attributes of the natural resource(s) addressed. This classification allows identifying the generic structure of a policy option. Second, each policy cluster is linked to specific sets of crucial institutional aspects (CIA) that may constrain or foster policy implementation. In the third step, institutional indicators are used to evaluate the potential of a respective CIA. Forth, combination of the identified CIA and assessment of their relative importance leads to statements about the probable effectiveness of a policy option. The mainly qualitative PICA outputs are arranged in thematic categories of institutional compatibility. Following an overview about the state-of-the-art in approaches for policy assessment, this contribution will focus on the PICA methodology. In particular, the four distinct steps are elaborated on using the EU Nitrate Directive as a concrete policy example to illustrate the procedure. Finally, some ideas will be presented how PICA serves as a tool for pre- and post-model analysis of environmental and agricultural models for policy impact assessment in a complementary way.

Keywords: Ex-ante Policy Assessment, Institutional Economics, Institutional Policy Assessment

Integrating socially constructed scale into theories of institutional change: the role of re-scaling in land use change in Southern Iberian coastal zones

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Iberian coastal zones have undergone drastic land use change and intensification throughout the last few decades (e.g. Spanish provinces of Almeria, Malaga, Granada or the Portuguese Algarve). Wherever morphological and resource conditions allowed for it either tourism facilities or intense irrigation agriculture located itself. Together with ongoing Europeanization of policies shaping land use three claims can be singled out as dominating land use change, which are sometimes conflicting: nature conservation, coastal tourism, and highly productive intense irrigation agriculture. Geographers suggest that one of the most crucial processes in the context of Europeanization is re-scaling, i.e. the contestation and re-constitution of „social control levels“ of material flows (resources and finance) and regulation. They suggest that it has important effects on the „production of nature“. The proposed paper tries to integrate this understanding into explaining the role of institutional change in the context of Europeanization and the way it shapes land use change in Southern Iberian coastal zones. First, the paper will describe the notion of scale and its role for the „production of nature“ in human geography. Second, it will briefly characterize theories of institutional change proposed by Institutional Economists. Third, it will try to identify the role that scale, space and physical nature have in approaches adopted by institutional economists. It will identify existing overlaps and incompatibilities and propose ways to integrate the two strands of explanation. Fourth, the paper will provide a cursory account of the drivers of land use change in a Southern Iberian coastal zone (Algarve or Almeria) focusing on coastal tourism development, in order to evaluate the role of re-scaling and institutional change in explaining land use change.

Keywords: land use, institutional economics, re-scaling, coastal development, tourism

Applying Transaction Cost Economics to Farmland Conversion for Urban Development: A Conceptual Framework

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Farmland being converted from the rural to the urban sector provides needed space for urbanization and industrialization. Since farmland resources have faced a high pressure of urbanization in recent decades, economists pay increasing attention to the efficiency of farmland conversion or land development. Neoclassic economists have analyzed and compared the efficiency of the land allocation in rural and urban sectors. Besides them, institutional economists and planning theorists influenced by New Institutional Economics (NIE) have also entered the debate since the 1970s, but it is just recently that this approach has been more frequently employed. NIE scholars emphasize that the appropriate governance of farmland conversion is important for the sustainable use of land both in the urban sector and the rural sector. Within the NIE perspective, the most discussed alternative governance structures of farmland conversion include the land use planning, the market, and the coordination mechanisms between them. Actually all the three structures mentioned above are the very objectives that are examined by Transaction Cost Economics (TCE), which accesses the efficiency of each structure by comparing their positions on the continuum from markets to hierarchies according to TCE theory. Thus, the aim of this paper is to build a conceptual framework for introducing TCE to the analysis of farmland conversion for urban development, and to apply it in two empirical studies, China and Germany; two countries that differ significantly in terms of property rights and governances structures. The results provide some experiences exchange between the two countries on improving the efficiency of governing farmland conversion, and furthermore, it can outline prospects for further research, in particular on linking governance structures for farmland conversion with performance, i.e. the costs and benefits of land use change.

Keywords: farmland conversion, Transaction Cost Economics, land use planning, conceptual framework

Does social capital influence the best farm management option in the presence of Agri-Environmental Schemes?

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There are various approaches that can be considered to estimate farmer production decisions, including those that consider farmers profit maximizer agents (Röhm & Dabbert, 2003), and others which extended this analysis introducing multi-criteria analysis (Gomez Limon et al., 2004). In the existence of an agri-environmental policy option, a different approach is mainstream. Farmer behaviour is analysed within a utility maximisation framework using random utility models in discrete choice scenarios (Vanslembrouck et al, 2002; Dupraz et al. 2003). Results from these models show that AES enrolment depends both on farmers' extrinsic factors (program and market characteristics) and intrinsic factors (farm and farmer features). Within farmer's intrinsic factors, previous studies have identified social capital as a relevant factor showing a positive effect on AES adoption (i.e. Mathijs, 2003). The concept of social capital cannot be captured by a single definition (Coleman, 1988), however recurrently references to social capital involve social structures or networks which enhance certain actions, such as the adoption of technology or practice, trade, etc. Relation with other actors (public institutions, cooperatives, farmers union, etc.) as well as any other variable related to the farmer social environment are crucial in the concept of social capital. This paper deepens the analysis of social capital impact by studying whether social factors modify the farmer opportunity cost of contracting and thus affect the best farm management decision. A theoretical model is proposed which assumes that forgone profit related to the AES technical prescriptions does not depend on social capital variables. The forgone profit is supposed to be completely described by farming system characteristics while social capital variables influence the decision in a separable way. This model is tested on a sample of farmers in Aragón (north-eastern Spain) eligible for an AES which implies a change in crop distribution at the farm level. In order to define the influence of social capital in the enrolment decision, and whether it corresponds to the farm maximizing profitability derived from technical features, two probit models estimating the probability of adoption are compared: the first one is based on technical features only and the second one is based on the same technical variables augmented by social capital factors. Estimations were carried out on the sub-sample of farmers who knew the existence of the AES. Simulations were performed on farmers who were not informed in order to assess if they would have contracted whether they had been informed. The results presented show that the introduction of social capital variables does not significantly change the effect of farming system characteristics on the contracting decision, supporting our assumption. Comparing the estimated probability of adoption on a farm per farm basis, it can be seen that social

capital correctly reinforced the best management decision for a majority of farmers who knew the existence of the AES, while it only leads a minority of farmers to take the wrong decision. In addition, simulations show that one third of farmers who were not informed are potential adopters taking into account their technical features. Therefore there is a task for the social actors involved in the agri-environmental process to improve the AES related information of farmers.

Keywords: Agri-environmental schemes, Social Capital, Adoption, farm management options

Some changes with new regulations on land use in Turkey

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European Union adoption process is brought some changes within rules and regulations in Turkey. these changes are in organisational as public administration responsibilites and legal regulations to spatial aspect perpectives. These changes are reflected spatial dimension also. Land use changes appear also. Municipalities borders were widen within 30 km. and some villages were changed their situations to Municipalities. There are negative or positive conclusions for the settlements in this context. On the other hand scale problems to prepare plans for settlements appear if it was metropolitan cities or small cities for in this 30 km. borders. In organizational dimension resposibility problem appears if it was included municipality borders or not. If ministry is responsible for this area or municipalities discussions is begun at this point and important for the settlements because of the urban rant. Illegally structured buildings effected also from these regulations in urban lands. Housing demand is increased with these changing and industrial areas also.Therefore, it will be discussed regulations of land uses cause and effects in this study. Positive and negative effects, responsibilities of the public adminitrations as local or central and how reflections of the changes of the regulations before 2004 and after to land will be discussed for Turkey.

Keywords: legal aspect to land, Turkey, municipalities, urban land, public administration

Icelandic landscapes: A preliminary classification and role of environmental factors

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As part of an Icelandic Framework Plan for sustainable energy development, a method was designed to quantitatively describe and classify landscape according to visual physical characteristics. The project will extend to all landscapes and regions in Iceland, excluding urban areas. Data are systematically sampled within a 10*10 km grid system, yielding a total sample size of about 130 sites. The method is based on 23 physical visual characteristics that are scored on a 5-point scale. We first present a preliminary multivariate classification of 105 sites sampled in 2006 and 2007. Cluster analysis effectively distinguished natural landscape types, i.e. classes that are related regionally and reflect geological, historical and/or ecological relationships, based on their similarity or rather dissimilarity. The results from the cluster analysis are presented on a dendrogram. We then explore, again through multivariate analysis, the role and importance of several environmental variables in shaping the basic visual characteristics of the landscape. These variables are landscape age and glaciation history, geology (bedrock type, surface sediments), volcanism (Pleistocene and Holocene activity) and climate (temperature and precipitation).

Keywords: landscape classification, glaciation history, geology, volcanism, climate

Territorial planning of Juquiá municipality (State of São Paulo, Brazil), using an integrated analysis of the land cover and slope

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Developing countries face problems due to the lack of planning of their territory occupation, resulting in environmental damages and decrease in quality of life of the population. In the Juquiá municipality (in the southeastern region of Sao Paulo State, Brazil), the disorganized land occupation has resulted in an increase of the Serra do Mar hillside deforestation. The region is characterized by very high slopes, fragile soils and high precipitation rates, which are concentrated in the months of November through February. This scenario is a perfect condition for soil erosion and landsliding. The objective of this study was to present an integrated analysis of the land-use/land-cover map and slope, aiming at the best territorial planning of the Juquiá municipality, in São Paulo State, Brazil. The land-use/land-cover map was produced by supervised digital classification (Maximum Likelihood Algorithm) of CBERS images (CCD camera). The slope map was generated by the interpolation of the digital elevation model got from SRTM images. The analysis indicated that 61% of the urban areas present slopes up to 8%; urban areas with slopes between 8% and 20% sum 30%; and only 8% of the urbanized area are on terrains with the highest slopes. Juquiá is covered by 45% of pastures and 43% of agriculture. These areas are concentrated in the intermediate hillsides, in slopes between 8% and 20%. The native forest occupies areas with the most elevated slopes (87% of the forest remnants are located in regions with more than 20% of slope). Finally, it is concluded that spatial distribution of human activities in the municipality has been concentrated in regions with the lowest slopes, since the river navigation beginning in the first half of the XVI century, privileged the occupation of the plains instead of hillsides, mostly for cultivation of rice and, later, banana.

Keywords: Territorial planning, Slope, Land cover, Serra do Mar

The Measurement of Ecosystem Goods and Services within the Spatial Framework of Landscape Units

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This paper describes the potential utility of the measurement of ecosystem goods and services within the spatial framework of landscape units. A major problem with the measurement and monitoring of ecosystem goods and services for a sustainable future under land use impacts, is determining the appropriate scale of analysis. Using recent examples from England the paper describes the development and application of landscape units of different spatial scales that capture the physical and cultural attributes of the landscape. Landscape character assessment (LCA) is used to derive landscape units at 3 spatial scales: approx 1:250 000; 1:50 000 and 1:10 000. Information on the physical (soil, geology and topography) and the cultural (settlement pattern, land use and historical woodland pattern) are used to define landscape units that capture relatively uniform landscapes at different spatial scales. Using examples from England the paper demonstrates the potential of the spatial landscape framework for the measurement of ecosystem goods and services within the context of a multi-functional landscape. In particular, examples are based on the role of woodland to provide: flood alleviation; carbon storage; biodiversity and recreation. The paper concludes that different goods and services need to measured at different spatial scales and that landscape units provide a convenient and appropriate framework within which to map, monitor and, importantly evaluate the impact of future change as we move toward a more sustainable future.

Keywords: ecosystem goods and services, landscape character assessment, woodland, monitoring, landscape units

The VisuLand framework: an example of a data flexible framework for analysing changes in visual character

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Landscape visual character is important for several landscape functions such as tourism and recreation. Landscape changes resulting from policies for renewable energy, agriculture and forestry may have a major impact on the visual character of the landscape and hence affect many landscape functions. Landscape character underpins advice in relation to landscape change processes, such as development of renewable energy facilities, and important planning implications in several European countries. In order to monitor changes in landscape visual character and their effect on people's aesthetic appreciation of landscape, indicators are being used. However, many existing frameworks addressing visual landscape character have limitations in their flexibility regarding possible data sources. The recently developed VisuLands framework is a theory-based and data-flexible indicator framework for analysing landscape character in relation to landscape change. This paper presents the VisuLand framework and gives examples on how this framework could be applied for a range of data sources from study areas in Scandinavia. The data sources include remote sensing data, land cover data, landscape photographs and field observations. The paper discusses the usefulness of different data sources in developing monitoring schemes for landscape change. The study highlights the benefits of a flexible framework of indicators encompassing a variety of data sources for the analysis of consequences of changes in landscape structure and their related landscape functions.

Keywords: Data sources, Visual impact, Landscape indicators, Landscape character, Landscape change

Urban Expansion and tha environmental problem: A landscape approach in Rio De Janeiro City, Brazil

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Landscape approach can be an effective tool for dealing with issues of sustainable development of land use (LU). It focuses on the spatial and temporal scales, important for LU planners and managers. Understanding LU change patterns, their drivers and socio-environmental impacts, should improve the ability to predict future land use dynamics and help to establish LU guidelines and to guide local management decisions. Multitemporal LANDSAT5-TM images were used to identify different patterns of LU classification along the Campo Grande and Santa Cruz Districts0, both in Rio de Janeiro City, Brazil. The study area consists of a land cover mosaic, with native covers like forest and mangrove, as well as agricultural and urban areas. For this reason, this area is strategic for research on modelling aiming at predicting, testing, and choosing between different urban growth scenarios. Eight land cover classes were defined: Forest, Shrub, Mangrove, Flooding Area, Agriculture, Exposed Soil, Anthropogenic Areas and Urban Zone. The results point to a landscape dynamics with an expressive expansion of the urban areas and a decrease in the shrub and agriculture areas. The maps show, besides the urban expansion processes, the direction of these changes, which occur mainly in the direction of the slopes, which represents risks for the environment and for the population, and in the direction of the main highways, such as Avenida Brasil. The methodological approach was helpful to enable an understanding of the landscape dynamics of the region. The use of GIS and modelling techniques allowed the integration of data and information to better characterize landscape dynamics. The landscape characterization enabled to identify different units, each with their own potentialities and limitations. It can be an effective tool to the desing of management guidelines and for LU planning and territorial ordnance, integrating concepts of urban development and environmental preservation.

Keywords: Landscape, GIS, Environmental planning, Urban areas, Rio de Janeiro

European Landscape Preference Assessment through Client-oriented Internet Services

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Since the reform of the European agricultural politics (MacSharry 1992; Fischler 2000), and especially with regard to recent political decisions to shift from production-oriented agricultural subsidies towards rural development objectives, the role of agri-environmental indicators has found increasing among policiy makers and researchers alike (OECD 1998; Wascher 2000). Among these indicators, the emerging field of cutural landscapes is met with a great deal of expectation to address some of the more intricate issues of sustainable development and social valuation, namely cultural amenities associated with landscape type and quality. Despite substantial advances in developing European-wide landscape references such as indicators and typologies (Mücher et al 2006), recent European project have been confronted with the methodological problem of arriving on nationally and regionally accepted views on landscape preferences. Landscape indicators such as diversity, coherence, openness-closedness and presence/ absence of linear or punctial natural and cultural landscape elements defy a European-wide interpretation as landscape perception differs from region to region. Most of all, landscape perception should not be left entirely to the expert judgement, but should - in line with successful methodological approaches such as Landscape Character Assessment of Contingent Value Methods be derived from direct stakeholder feedback. In the light of lacking information on stakeholder views on landscape preferences, European research projects have failed to provide satisfying indicator assessments at the European level.

With the arrival of internet-based querry and service facilities, it seems that new and effecient survey methods for landscape perception are at hand. This paper is demonstrating the possible role of a Landscape Information System for Tourism (LIST), developed primarily as a serivice to European citizens, as a stakeholder data generator on key landscape preferences. A LIST prototype has been developed and tested in the Netherlands, a European version is ready to be launched.

Keywords: Landscape Character, Tourism, Perception, Socio-economy, Preference

Sustainability Impact Assessment of land use changes: The Rehabiltation of Eastern German Lignite Mines

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The devasted lignite mining areas of the former GDR became Europe‘s largest landscape remediation site. A huge remediation programme was set up after reunification in 1990 under the agreements concluded between the Government of the Federal Republic of Germany and the new German Federal States (German Länder) affected by lignite mining. The opencast lignite mines, that could not be sold to private investors, an area of around 100,000 hectares, were given to a state-owned company, the Lausitzer und Mitteldeutsche Bergbauverwaltungsgesellschaft mbH (LMBV; www.lmbv.de) in order to recultivate them in accordance to the law.
Since 1992, a total amount of almost 9 billion Euro was spent on safety measures, cleaning up toxic sites, restoring the water-balance and creating a new and different landscape as a catalyst for future orientated sustainable development. The new lake landscapes will, in their final stage, consist of around 27,000 hectares of water and almost 18,000 hectares of nature conservation areas. Local, regional and federal authorities are working together closely involving the people and the stakeholder groups.
The landscape restructuring in the region Lausitz and near Leipzig is unique and rightly being recognised internationally. The restructuring process stimulated innovative technologies and planning skills. The clean-up programme has considerably benefited employment in the region and offers an entirely new quality of life and new economic opportunities. Post-mining landscapes in Germany have become a benchmark for remediation practice. They are an important issue of international cooperation and experience exchange.

The European Environmental Technologies Action Plan ETAP: Improving the Performance of Environmental Goods

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The European Commission´s Communication on the Environmental Technologies Action Plan (ETAP), published in 2004, aims to gain Europe a leading role on the global market for environmental goods. It describes measures to support environmental innovation and improve the framework conditions for research, development, application and the global marketing of environmental technologies. ETAP contributes to the Lisbon Strategy to make the EU the most competitive economy in the world by 2010.

In the framework of the ETAP the Commission supports several research projects. ETAP explains that possible obstacles to making use of the potential of environmental technologies may be found in the economy (e.g. amount of investment costs, availability of risk capital) or in administration due to detailed provisions which inhibit progress. Research efforts made within the EU should be reviewed with regard to their specific impact on environmental technologies. Other issues are improving information and training and stimulating the demand of the public sector as well as of consumers.

The European Commission and the Member States cooperate closely to implement the ETAP. Germany submitted a national roadmap in spring 2006 and created a national ETAP network in 2007. It is planned to extend the network to actors from industry, science and major groups. The aim is to inform and exchange experiences openly within the meaning of network pursuant to the ETAP. This will be the basis for a continuation of the German roadmap.

Low cost treatment technologies for reduction of environmental impacts of waste deposits in Silesia, Poland

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One of the sustainability issues in post-industrial regions such as Silesia is an accumulation of waste deposits which are scattered in the landscape. This concerns both urban and rural areas as these land use functions interact with each other and often form an extensive interface of a dual character. Waste deposits, particularly smelter slag, have a detrimental impact on the environment and human health. This is due to leaching of contaminants such as zinc, lead and cadmium to ground and surface waters, as well as a movement of fugitive dust. Human exposure to heavy metals is either trough inhalation of dust or by consumption of locally produced food and drinking of contaminated water. Most of the smelter waste deposits are barren of vegetation which intensifies their vulnerability to leaching and wind erosion. Natural attenuation and succession of vegetation is limited as these materials are highly phytotoxic. It has been demonstrated in our study that stabilization of these sites can be achieved by a treatment consisting of a proper chemical form of lime and high sorption capacity biosolids. Long term monitoring and spatial assessment of treated sites provides an evidence that reduction of metal mobility is sustainable over a longer time period. Testing biological activities of waste surfaces indicates that fundamental soil processes important for supporting plant vegetation are present. Moreover feeding trials with animals show that transfer of metals from biomass established on revegetated surfaces to blood and organs are negligible. Leaching potential of metals has been also greatly reduced as a result of treatment. The overall conclusion of the study is that fast and low cost stabilization of smelter waste in Silesia could greatly reduce existing environmental and health risk.

Keywords: post-industrial, waste deposits, heavy metals, health risk, contamination

Internalising the costs of fragmentation and nutrient deposition in spatial planning: extending the Land Use Scanner

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The Land Use Scanner, an integrative spatial economic modelling framework for land use planning in the Netherlands is extended to internalise two environmental externalities of land use, namely nitrogen deposition and habitat fragmentation. The model is used to assess fragmentation, as well as the effectiveness of market instruments in promoting more efficient land allocation. Results suggest that particularly rain-fed mires are very susceptible to fragmentation. Furthermore, internalising the damage costs of fragmentation resulted in smaller changes in land allocation than internalising those of nitrogen deposition. This study demonstrates the flexibility of spatial economic modelling by using the LUMOS toolbox and specifically the Land Use Scanner as a modelling framework.

Keywords: environmental externalities, habitat fragmentation, nitrogen deposition, spatial economics, land use change

Preliminary study on the effect of land use change on terrestrial ecosystem carbon sequestration in China

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The influence of land-use change on terrestrial ecosystem carbon sequestration has received widely attention in global carbon research, and the carbon sequestration capacity is vital to assess the sustainable impacts of multifunctional land use on the environment, especially on the climatic change. For the past several decades, land use has been changed dramatically and such change will be continuously with the economic development in China. In order to evaluate the effect of land-use change on terrestrial ecosystem carbon emission or sequestration in China, firstly, this study compared the land-use change from 1980s to 2020s. The future land-use pattern of 2015 and 2025 were set up with the predefined policy scenarios based on SENSOR-IP instruction. Secondly, the response of ecosystem carbon sequestration to land use changes of different decades were simulated and analyzed with a process-based model (CEVSA, Carbon Exchange in the Vegetation-Soil- Atmosphere). The preliminary results showed that the terrestrial carbon sequestration capacity varied with the land-use among different decades, especially in certain region with the implementation of large forestry construction and natural conservation policies. Due to the complexity in terrestrial carbon sequestration and uncertainty in climatic changing, more work was needed to quantify the effect of land-use change on terrestrial carbon sequestration, and provide information for policy-maker to identify effective policy to control and reduce terrestrial CO2 emissions or enhance sequestration by human-induced land use and land-use changes.

Keywords: land-use change, carbon sequestration, CEVSA, China

Response of land use changes to policy impacts in China

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Land use changes coupled with environmental, social and economic impacts of the changes are critical for sustainable development of China. Policies affect significantly land uses in China, thank to the governmental ownership of land resources and centralized resource management system of the country. This research aims to assess land use changes as a response of policy impacts in sensitive regions of China in the history and the future, and to analyze impacts of land use changes on land use functions (LUF). Following Drivers-Pressures-States-Impacts-Responses (DPSIR) approach and Spatial Regional Reference Framework (SRRF), the research makes cluster analysis of the entire country, more than hundred region clusters have been identified based on bio-physical and socio-economic features of the regions, and major characteristics of the representative clusters described. The study has further analyzed land use changes and major drivers over the past decades in few selected sensitive region clusters of China, and developed policy scenarios looking at land use changes as a response of policy impacts in the future. It was identified that policies affect mostly land use changes in the future include (but not limited to) land conversion, agricultural subsidy and bio-energy use. Land use changes and associated impacts on LUF are obvious in the sensitive regions under study. The study is significant as it would provide valuable suggestions for decision makers of the country for sustainable management of land resources.

Keywords: land use, policy scenarios, region clusters, impacts

Land uses mixture evolution through time in Greece-case study Atticas basin

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Greek legislation has enacted 8 categories of land uses, that are allowed in Greek cities. The most used category, General Residence which allows a huge number of uses in the urban tissue, has provided the enterprises freedom to be allocated in most city‘s parts, without taking into consideration environmental or traffic parameters but with market forces as the exclusive allocation criterion. Our research aim is to show how Greek cities are functioning, today with the existing legislation, how their functions allocation has changed through time, and how new land uses categories can prevent the problems that are caused by the thoughtless enterprises mixture

Keywords: mixture, Greek legislation, General Residence, market forces

Evaluation and comparative analysis of data-driven indicators and theoretical issues of sustainable land use policies

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The Module 6 in SENSOR represents a bottom-up procedure in gathering data to characterize sustainable development at local level, which ought be linked to the top down analysis of issues and driving forces of sustainability in as sensitive defined regions. According to the three dimensions of sustainability, as relevant issues in the sensitive regions were identified population density, unemployment rate, loss in cultural identity and tourist exploitation and also effects on environmental issues such as water supply, loss in biodiversity and land degradation and fragmentations, for instance. In Module 2 (D2.3.2) a selection of indicators having made to measure sustainability in terms of identified issues. However the scientific analysis of bottom-up data and its complementary to the top-down perspective are essential for successful implementation of political measures in terms of environmental, social and economic effects of multifunctional land use in European Regions. Our major activities are concentrated on examinations by exemplary data processing like (cross) correlation analysis, similarity and dissimilarity tests and by applying adequate cluster analysis procedures. Furthermore, ArcMap-Projects were created to support evaluation and visualisation of data selection and analysing methods by GIS. Overall objectives are to examine the validity of given data and their suitability to characterise sustainable development in SACS with reference to the SENSOR objectives and the identification of general and specific sustainability characteristics in the 7 case studies. The evaluation and comparative analysis of M2 indicators and M6 SACS data by IOER resulted in an identification, selection and visualisation of most relevant information to characterise situation and trends of sustainable land use.

Keywords: land use indicators, data management, visualisation b GIS

Agroforestry as an environmental technology for multiple purposes and for atmospheric carbon dioxide and nitrogen fixation in the sensitive region Lusatia

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Agroforestry seems to become more prominent in temperate regions since this land use system fits to multiple human needs such as food, energy incl. climate-change mitigation issues, timber, landscape diversity and biodiversity. Agroforestry can be defined as land-use type and technology where woody perennials such as trees, shrubs, palms and bamboos are cultivated in some spatial and temporal arrangement together with agricultural crops and animals for beneficial ecological and socio-economical interactions. Such land use systems were established at the recultivation sites in the sensitive area case study 'Lusatia' in 1997. The main objective of this presentation is to give an overview on agroforestry systems and to show the modification of young soils in Lusatia after 9 year of 'alley cropping'. It gives some insights on the organic C and N accumulation and changes in soil microbial indicators referring also to carbon isotope characteristics during soil development. Soils were sampled at 0 to 3 cm, 3 to 10 cm and 10 to 30 cm depths under black locust and poplar, transition zone and in the middle of alley under rye. Soil organic carbon was highest at 0 to 3 cm soil depth under nitrogen-fixing black locust and reached 778 g Corg m-2. Soil microbial respiration varied around 0.80 µg CO2-C g-1soil h-1 across vegetation types decreased with soil depth. Compared to the deposits in 1997, soil organic carbon was more than doubled with high annual soil carbon sequestration rate averaged 151 g Corg m-2 yr-1. The soil carbon isotope signature as reflected by the δ^{13} C value ranged between -18.9 and -16.5 ‰ for the total carbon and between -25.1 and -24.7 ‰ for the organic carbon (soil treated with phosphoric acid) and both increased with depth. The isotope signature of the soil microbial respiration ranged between that of the organic and total organic carbon and approached that of the total carbon with depth, indicating fractionation processes in these calcareous quaternary sediments particularly in deeper soil horizons. In conclusion, the soil microbial respiration and the organic carbon content showed improved soil quality and the soil carbon isotope signature reflected significant organic inputs during the 9 years of recultivation.

Keywords: Agroforestry, alley cropping, post-mining landscape, soil quality, carbon isotope characteristics

Agroforestry systems as an environmental technology for sites susceptible to drought stress

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The post-mining landscape of the Lusatian lignite-mining district in NE-Germany is characterized by low precipitation and soil in its initial stage of soil formation showing low water retention capacities. Establishing an economically feasible land use on such sites is a challenge for farmers and foresters. Due to the limited water availability conventional land use systems often fail in terms of a reliable and efficient plant production. In order to restore the economic function of reclamation sites an alley cropping system with short-rotation woody crops and arable crops is being tested on a farm scale as a new approach for such sites. Among other benefits the integration of tree hedgerows on arable land improves the microclimate by shading and the reduction of the wind speed. As a consequence soil moisture and soil temperature will be more balanced. Therefore, the growth performance of crops grown between tree hedgerows may benefit from an alleviation of the impact of serious droughts. However, because of the competition between trees and crops for moisture and nutrients, it is still unclear whether yields of alley cropping systems are equal or even exceed those of traditionally managed agricultural systems under same conditions. In order to assess the overall impact of hedgerows on crop yields at poor sandy soils an alley cropping system was established in 2007 in the Lusatian lignite-mining district. Alfalfa (Medicago sativa L.) established in the alleys will provide an annual income during the time black locust (Robinia pseudoacacia L.) hedgerows mature. The interactions between trees and crops will be characterized by measuring weather and yield data in different distances from hedgerows. Based on these results recommendation for an optimization of the tree-crop interaction will be developed in order to increase the reliability of plant production as compared to monocropping systems. The use of growth models for agroforestry systems allows a prediction of the future development of the system. The project is part of a research cooperation between different institutions covering low-productive and high-productive arable land. First results will give indications for target regions for agroforestry systems in Germany.

Keywords: Agroforestry, Alley cropping, post-mining landscape, microclimate

Long-Term Dynamics in the Arable Land Resources and the Driving Forces in the Upper Jinghe Watershed

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Arable land resources are considered as the essential condition of agricultural production. And it is connected with food supply and food security. This research integrates county and municipal level statistic arable land data from 1949 to 2004, remote sensing data national detail survey of land resources and national survey of land use changes to aim at analyzing the dynamics of arable land use and the driving forces. History of arable land transition is first reviewed. And then, impact from the national police which induces changes of arable land is described in detail. Furthermore, spatial transition is explored using digital map of land use and principle analysis, multiple regression analysis and structure equation models are applied to indicate driving forces. The results show thatï¼š(1)the tendency of arable land appears to be in pattern of fast increaseâ€”fluctuating changeâ€”fast decrease â€”stableâ€”rapidly decrease after 1949, national polices in different stage impose important impact on arable land; (2)quantity of arable land increases from 1986 to 2000ï¼Œbut quality of arable land falls; (3) social and economic factors are the determinant factors in arable land transition, in direct structure impact the sequence from high to low is economic, population and agriculture production output, and in indirect structure impact the sequence from high to low is scientific input and population, economic development may still stimulate arable land increase for some reason, however, in the long-term trend combine action of population, economic and urbanization would shrink the arable land areas.

Keywords: arable land change, driving forces, national police, economic development

Strategic Environmental Impact Assessment of the 400 kV Overhead Transmission Line Okroglo (Slovenia) – Italian border

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The corridor tracing process was based on the information that included environmental considerations as well as criteria of functional and rational overhead transmission line sitting. The criteria used in corridor tracing process derived from the guidelines prescribed by The Spatial Order of the Republic of Slovenia (Ur. l. RS, 122/2004), from discussions within experts groups and from some other sources like various overhead transmission line sitting projects, from the discussions carried out in local communities etc. In order to define the most acceptable corridor two types of land suitability models have been prepared – land attractiveness model and land vulnerability models. The aim of the attractiveness model is to find out the sites within the whole region where the construction and the maintenance costs for the overhead transmission line will be the lowest. Land vulnerability models are prepared in order to predict the potential environmental impact of the overhead transmission line sitting on the environmental qualities (land resources, human environment and natural qualities). The importance of the impacts of overhead transmission line is evaluated in accordance to the predefined acceptability of the change of the environment and its components. The unacceptability of the environmental change is commonly defined as exceeding over the thresholds that are defined by environmental norms or standards, e.g. noise levels, concentrations of pollutants, protected areas, etc. The suitability map is prepared on the basis of the suitability matrix that enables a test of various possible compromises between conservation and functional/economic criteria. The presented corridor tracing methodology also showed its importance in the phase of tracing the alternative corridors and alignments. Despite the fact that corridors already imply conservation criteria they are still not equally acceptable from the environmental conservation point of view. Therefore the assessment of the environmental acceptability of alternative corridors was also prepared.

Keywords: strategic environmental impact assessment, corridor tracing, vulnerability models, suitability models

Sustainability impact assessment and environmental technologies in Lusatia, Germany

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Lusatia is located in eastern Germany close to the Polish border and can be considered as sensitive with reference to sustainable development. The region represents a key energy source from open cast lignite mining at maximal up to 70 % of the total GDR energy requirement before the German reunification. After the German reunification, the employment rate decreased and still stays at lower level due to regional restructuring. Emigration is expected to increase further during the next decades. The re-cultivation of the post-industrial region introduced renewable energy such as large scale biomass production and also referred to aquatic and terrestrial nature conservation issues. Tourism became also regionally important. Environmental technologies have been applied to neutralise the acidified lakes of the old mining landscape and also developed modern technologies to mitigate the carbon dioxide derived from lignite combustion. Furthermore, new villages reconstructed due to the mining activity considered the demographic developments and the need to use efficiently the available energy. The sustainability impact assessment seems useful in assessing the efficacy of environmental technologies to improve old socio-economic development strategies in Lusatia.

Keywords: Sensitive regions, environmental technologies, cross-cutting problems, sustainable development

Key sustainability issues and the spatial classification of sensitive regions in Europe

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Cross-cutting environmental, social and economic changes may have harsh impacts on sensitive regions. To address sustainability issues by governmental policy measures properly, the geographical delineation of sensitive regions is essential. With reference to the European impact assessment guidelines from 2005, sensitive regions were identified by using environmental, social and economic data and by applying cluster analysis, United Nation Environmental Policy priorities and expert knowledge. On a regionalised 'Nomenclature of Territorial Units for Statistics' (NUTS) level and for pre-defined sensitive region types (post-industrial zones, mountains, coasts and islands) 31 % of the European area was identified as sensitive. However, the delineation mainly referred to social and economic issues since the regional data bases on environmental indicators are limited and do not allow the separation of medium-term vital classes of sensitive regions. Overall, the sensitive regions showed indicator values differing from the EU-25 average.

Keywords: Sensitive region types, Key sustainability issues, Cluster analysis, Expert knowledge, UNEP priorities

Assessing Sustainability of sensitive Regions within Europe: The case study Eisenwurzen in Austria

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Within the past two decades and particularly since the "Brundtland Report" sustainability has become a key term in emphasizing the relationship between economic progress and the protection of the environment. One key difficulty is the definition of criteria and indicator for assessing sustainability issues and their change over time. Within the EU project SENSOR we have developed a regional data base covering environmental, social and economic indicators across six so called sensitive areas case studies (SACS) in Europe including the Eisenwurzen region in Austria. The idea of these SACS is to ensure and link the bottom up dimension of sustainability versus the top down approach at the European scale. The top down vs. bottom up link is achieved by: (i) each sensitive area consists of at least one NUTSx region, (ii) only indicators which are available at different regional levels are considered for comparison, (iii) regional policy cases are assessed by stakeholder involvement to allow the testing and validation of European policy strategies within the selected sensitive areas. In this paper we present the results derived (i) from statistical analysis using the SACS data base and (ii) compare these results with the stakeholder survey. The hypothesis is that available data from public sources are collected according to certain sustainability interests or needs. Thus it must be possible to derive sustainability measures from these data. The stakeholder survey is important for assessing the reliability of the data driven results. Our results suggest, that available data sources are a very useful tool for assessing sustainability measures, the comparability of data across regional scales may be strongly hampered by differences in the available data and their definitions, and the combination of stakeholder surveys with available data are a very efficient way in assessing regional sustainability issues.

Keywords: Sustainability, sensitive areas, scaling problems, Europe

Land use effects on woody cover in a inland water-land ecotone of the Orinoco lowlands: pattern and fractal analysis

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This work analyzed the effect land use changes on the structure, dynamic and functioning of a inland water-land ecotone (i.e., Morichal) of the Orinoco lowlands. Morichals are systems found in the river headlands of the dissected lowlands, where the soil is saturated by the groundwater. We considered the following: if elucidating the mechanisms permitting ecotone sustainability is a major challenge in ecotone ecology, then the dynamic array of possible ecotones and landscape fragmentations should capture the complex behaviors inherent in ecotones. In the studied morichal, the changes of the woody cover and patch fragmentation were evaluated using aerophotographs (years 1977, 1992 and 1997) and GIS. Results indicate that changes in the phreatic level experienced a substantial drawdown and the vegetation pattern has been fragmented through time. During the temporal sequence, the patch size ranged from 5 to 177,493 m2, and the patch density spanned from a maximum 0.1132 patches m-2 in 1977 to 0.0143 patches m-2 in 1997. The resulting woody cover varied from 17.0 percent in 1977 to 42.6 percent in 1997. For each year, the resulting patch size was ordered in a rank size distribution, and adjusted to fractal models. From 1977 to 1997, the rank patch distribution was fitted by the stretched exponential distribution model which depended on the dynamics of the largest but less abundant patches. The multiplicative levels of the cascade (i.e. 1/c) reflecting the patch dynamic increased from 16 in 1977 to 100 in 1997, where the index c stage for the cumulative distribution. The temporal increase in woody cover and variations in the fractal distributions reflected the invasion by woody species from the nearby dry savannas, due to the effect of land use change on the phreatic level in the morichal system.

Keywords: fractal analysis, stretched exponential distribution, landscape fragmentation, inland water-land ecotones, Orinoco lowlands

Onion production in the Brazilian Savanna in a minimum tillage cropping system

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Concerned on establishing a system that conciliates sustainability and profitability, Coopadap (Alto Paranaíba Agricultural Cooperative) and Embrapa Vegetables developed a work from 2005 until 2007 at the Coopadap Experimental Field, located at Rio Paranaíba, Minas Gerais State, Brazil. The work aimed to adapt a minimum tillage (MT) technology, a variation of the non-tillage system, to produce onions in the Brazilian Savanna. The non-tillage system is based on a located tillage of the planting lines, keeping the soil coverage with straw and using crop rotation. In the MT, the soil was tillage in 100% of the surface, but only superfitially. A demonstrative unit with 2.5 ha was established in March 2007, with the direct seeding of onion with a seven line driller, using maize as cover crop, following the soil preparation with a chop-stalker and superficial disk harrow. The cultivar Perfecta was used, with an initial stand of 1,087 thousand plants per hectare and 1,562 kg of 4-30-16 NPK fertilization. Total yield obtained was 118 t.ha-1, with 102 t.ha-1 of commercial bulbs in the classes 3 or 4 (in a scale of 1 to 5), classes with higher market value, preferred by the Brazilian market. The production costs, when compared to the conventional tillage system, allowed significant reduction in machinery use, phosphorus fertilization and irrigation. The minimum tillage system also contributed to the soil organic matter and microbial biomass preservation and the reduction of erosive processes.

Keywords: No-tillage, Reduced tillage, Allium cepa, Coopadap, Embrapa Hortaliças

Production of processing tomatoes in the Brazilian Savanna using non-tillage and minimum tillage cropping systems

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In response to the need of establishing a planting system that conciliates sustainability and profitability, Unilever Bestfoods and Embrapa Vegetables started a work from 2006 until 2007 at Unilever Bestfoods Experimental Farm, located in Goiânia, Goiás State, Brazil. The work aimed to evaluate the production of processing tomatoes in the Brazilian Savanna using non-tillage (NT) and minimum tillage (MT) cropping systems in comparison to conventional tillage (CT). The non-tillage system is based on a located tillage in planting lines, keeping the soil coverage with straw and crop rotation. The MT is a variant of that, where the soil is tilled in 100% of the surface, but only superfitially. NT and MT plots were prepared using a stalk-chopper. Aditionally, MT plots were prepared with a superficial disk harrow. CT plots were prepared with subsoiler and roto-cultivator. After drilling and fertilizing with a driller, the transplanting was done manually, with 150x22 cm planting distance. It was used the pearl-millet as cover crop and the hybrid Heinz 9992, the most planted in Brazil. The yield in MT and CT did not differ statistically and were superior than NT, as a result of stand failure due to mechanical difficulties in drilling, in consequence of the excess of residues (straw). A smaller percentage of rotten fruits were observed in NT and MT plots due to the development of fruits above the straw, avoiding direct contact with soil. The NT and MT costs were smaller, specially due to the reduction in machinery use. Additionally, NT and MT contributed to the preservation of the soil organic matter, increasing the cationic change capacity, verified by soil analysis, and the reduction of erosive processes.

Keywords: reduced tillage, Unilever Bestfoods, Embrapa Hortaliças

Transfer Unit 'Integrative Evaluation of Energy Crop Production' – Assessment of environmental and economic effects of land use change induced by biogas plants

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The increased use of biomass as a source of energy is a central element of the German climate protection policy. One result of this is an increasing number of biogas plants. For a cost-effective operation, energy crops, e.g. maize, have to be cultivated for the whole life time on a certain area of arable land in the vicinity of each biogas plant. Therefore the installation of such a plant may lead to considerable changes of land use and, subsequently, affect ecological indicators like biodiversity and nutrient cycling. Additionally, the recent raise of world market prices for foods leads to an economic competition between food an energy crop production. To evaluate the ecological and economic consequences of land use change induced by increased installation of biogas plants, the German Research Foundation funds the new Transfer Unit (TU) 'Integrative Evaluation of Energy Crop Production' within the Collaborative Research Centre 'Land use Concepts for Peripheral Regions' (SFB 299). Within this TU four scientific projects of the model network ITE2M (Integrated Tools for Ecological and Economic Modelling), established within the SFB 299, work on the integrated assessment of the effects of biogas plant installations and on an optimisation of their location in the region South-Hesse, central Germany. The local power supplier is the business partner of the project and the operating company of the planed biogas plants. A fifth project deals with aspects of public relations and aims to inform the broad public as well as children and pupils in the project region about environmental and economic aspects of energy crop production as well as integrated impact assessment in general. The poster shows the conception and structure of the new TU.

Keywords: energy crop production, ITE2M, integrative evaluation, biogas plant, biomass

Assessment of compost application to coal ash disposal sites to promote the rapid vegetation establishment

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In the city of Tuzla, located in Bosnia and Herzegovina, a coal fired thermo electric power plant is operated by the company JP ELEKTROPRIVERDA BIH TERMOELEKTRANA "TUZLA". High amounts of ash are produced by the power plant, which are currently disposed into settlement ponds bordered by dams in natural valleys. A total of four ash disposal sites covering an area of approx. 170 ha have been established during the last decades. Due to the fact that residual ash from coal combustion was found to contain a variety of trace elements (Ni, Cr, As, B), it must be assumed that ash disposal of that magnitude constitutes an environmental problem which is investigated within the EU-FP6 / STREP project "Reintegration of Coal Ash Disposal Sites and Mitigation of Pollution in the West Balkan Area" RECOAL. The main hazards relate to soil and groundwater contamination due to leaching toxins, dust dispersion, and toxins entering the food chain as these disposal sites are used for agricultural purposes. In order to rapidly establish a vegetation cover on barren ash dumps that particularly would prevent dust erosion we assessed the applicability of compost, produced from locally available municipal and industrial organic residues as an amendment to ash to improve substrate fertility. The envisaged remediation technology was considered to be a low cost, easy applicable and rapid method capable of substantially enhancing living conditions of residents in the vicinity of the abandoned disposal sites. Various compost application rates were evaluated in the field on experimental site Divkovici I in Tuzla and additionally in the greenhouse environment at Brandenburg Technical University Cottbus. Field and laboratory tests revealed that plant growth and cover rate can substantially be improved by mixing compost into the upper ash layer to a maximum depth of approx. 20 cm. Besides direct growth observations in the field analysis of soil parameters gave evidence that the fertility of ashy substrates amended with compost produced from locally available sewage sludge and saw dust can be improved. The metal content of grass grown in the various treatments was considered to be elevated compared to normal contents. However, metal uptake in compost treatments was lower than in untreated plots. A preliminary cost assessment, comparing the remediation technology tested on site Divkovici with a standard soil covering technique revealed financial benefits for the compost method due to significant lower application rates.

Keywords: coal ash, landfill, rehabilitation, sewage sludge, heavy metals

Methods for the analysis of sustainability issues within Lusatia

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Providing the European Commission with tools that enable a political decision making oriented at the principles of a sustainable development policy cases will be explored all over Europe and validated in sensitive areas (Sensitive Area Case Studies - SACS). Lusatia was selected as one of the SACS comprising 7200 km² and representing a typical post-industrial zone. The data gathered for SACS led to the identification of a large number of variables being congruent with those provided by the European Impact Assessment Guidelines (COM, 2005). Out of 60 variables related to the sensitivity of the Case Study Lusatia have been geographically referenced and referred to so called NUTS categories (Nomenclature of Territorial Units for Statistics NUTS, EU, 2003) representing different levels of resolution of information being available at the institutional level. About 130 NUTS5 cells cover the major part of ‚Süd-Brandenburg' and provide the sound data basis to classify and to integrate all relevant information to enable both an evaluation of regional distinctions and a validation of policy cases. Novel scale dependent analysis methods adequate for heterogeneous data are applied to enhance top-down and bottom-up evaluation of sustainability related data for the SACS Lusatia.

Keywords: Lusatia, socio-economic and ecological issues, sustainability, data analysis

Sustainability Impact Assessment in Sensitive Region of Guyuan District, Ningxia Hui Autonomous Region

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The aim of this piece of research is to assess environmental impact of land use change in Guyuan district of Ningxia Hui Autonomous Region of northwest China. The district was chosen as a sensitive region for study due to its complex landform, limited resources and vulnerable environment and changeable policy for land use, in comparison with other regions of the country. As an economically backward region of the country, the district has been facing lots of problems in the context of sustainable development including population growth and increasing food demand on small landholdings, intensive land use and land degradation, soil erosion, unclear assessment of sustainability of input-intensive production practices, and specifically, there is no scientific assessment of environmental effect caused by land use changes. Under the framework of SENSOR, the specific objectives of the research are to investigate data sources for sensitive region of Guyuan and assess temporal and spatial coverage of data, to built a database for quantitative analysis of sustainability issues, to explore land use changes and major drivers, and finally to assess soil erosion as affected by land use changes through developing models and applying index approach such as land use structure indexes and soil erosion intensity indexes. Policy scenarios of land use change are also developed for further improvement of land management system of the region. It was found that soil erosion is accelerated by irrational land use in the region. The relationship between dynamic change of land use, including types, quantity, quality and spatial structure, and soil erosion is observed. For instance, the changing trend of land use structure indexes is associated with that of soil erosion intensity indexes, proving that the predicting soil erosion intensity via using land use structure indexes is theoretically reasonable and practically meaningful.

Keywords: land use change, soil erosion, sustainability issues, land use structure, Guyuan of PR China

Energy region Goms (Switzerland)

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The use of biomass, water and solar radiation for energy production is an important future asset both for mitigating further emission of green house gases and to become more independent from fossil energy sources. At the same time Alpine agriculture and forestry struggles for maintaining farms and firms. Furthermore many alpine landscapes, which are the historic product of a multifunctional land use system, today are in the process of decline or change of these land use types.
The project was initiated by the non-profit association "unternehmenGOMS" and aims to establish a new sustainable basis for the energy supply for the region of Goms. The region with an area of 650 km2 but only 5'200 inhabitants is part of the Canton of Valais in Switzerland. The project provides for a new approach, to analyse the regional energy supply system in a holistic and systemic way by systematically bringing together the communities, the companies and external experts in a moderated process. It combines a participatory approach, a systems analysis and expertly presented and analysed potential alternatives. This guarantees at the same time, that the best solution by ecological, social and economic criteria is discerned and implemented, because all the stakeholders are part of the solution finding process, can understand the criteria by which the solution was defined, were integrated into the process and thus support the solution. The concept is based on the analysis of the individual energy consumers and their potential for savings and the eclipsing of the requirements of the system elements.
The expected results will realise the future supply of the region with an adapted, regional, renewable energy mix on the basis of wood, biogas, combined generation of heat and power, hydropower, solar power and eventually wind and geothermal power.

Multi-Criteria Decision Analysis in sustainability impact assessment of Forestry-Wood Chains - concepts and implementation

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EFORWOOD is an Integrated Project of the 6th EU Framework Programme pursuing the goal to develop a quantitative decision support tool for Sustainability Impact Assessment of Forestry-Wood Chains (FWCs) at regional, national and European scales. Within EFORWOOD a set of sustainability indicators has been developed in an iterative process involving experts and stakeholders based on relevant European sustainability guidelines and regulations. These indicators are characterizing economic, ecological and social sustainability aspects of production, consumption and recycling processes occurring along FWCs. Beyond reporting a collection of indicator values of optional FWCs approaches are needed to aggregate and communicate information on sustainability impacts of FWCs. Cost Benefit Analysis (CBA) and Cost Efficiency Analysis (CEA) may be used to aggregate some indicator themes on a monetary scale. However, CBA and CEA miss the explicit inclusion of stakeholder preferences and interests in weighing indicators and judging specific indicator values. To support sustainability impact assessment of FWCs we therefore propose the use of Multi-Criteria Decision Analysis (MCDA). MCDA is an umbrella approach that has been applied to a wide range of situations where the ultimate goal is to take explicit account of multiple criteria in helping individuals or groups explore a set of decision alternatives. MCDA offers an analytical environment where multiple goals, objectives and perspectives of multiple stakeholders and interest groups can be accommodated and analysed collectively and holistically. This approach is intended to foster transparent decision-making processes and support inter alia group-decision environments within the FWC. In our contribution we employ the PROMETHEE method which had been selected based on methodological analysis and stated demands of experts and stakeholders. PROMETHEE is based on the concept of dominance among alternatives and the additive aggregation of pairwise comparison values. A MCDA software prototype has been developed that builds on client-server architecture and is designed to guide users through the iterative process of comparing and evaluating alternative FWCs: (a) selecting indicators, (b) weighing indicators, (c) judgment about indicator values, (d) aggregation of individual indicators to a holistic index value or a sustainability profile with a subsequent ranking of alternative FWCs regarding to their preferability. We demonstrate the use of the software for sustainability impact assessment (SIA) by means of an example from a stakeholder workshop in a model-region within the project. Conclusions are drawn on the demands on indicator sets for SIA in a MCDA-framework as well as on the requirements for a MCDA tool to satisfy stakeholder needs. An outlook is given on further development.

Keywords: Multi-Criteria Decision Analysis (MCDA), sustainability impact assessment, Forestry-Wood Chains, sustainability indicators, stakeholder involvement

Sustainability Choice Space: Expert and Stakeholders Approaches

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Sustainability impact assessments (SIA) are inherently difficult because they often require policy advisors to compare things that are not easily compared. For example, they generally require an evaluation of policy proposals or options across the 'three pillars' of economy, society and environment. In this presentation we explore how decisions are made in relation to questions about the sustainability of policies, and show how the consideration of sustainability limits can help integrate thinking across the economic, social and environmental domains. It is argued that in relation to questions about the sustainability of actions or policies, outcomes merely need to be sufficient to maintain human well-being and that the search for optimal strategies is probably misleading. The concept of a sustainability choice space is developed as a way of helping policy advisors visualise and explore what 'room for manoeuvre' they might have in the design of a specific policy. The sustainability choice space can be used to describe the degree to which alternative policy outcomes are acceptable to stakeholders across a range of criteria. The presentation concludes with a discussion of the role that the concept of a sustainability choice space might have as part of the sustainability impact assessment toolkit (SIAT) being developed through SENSOR, and how it can be extended by the involvement of stakeholders in the definition of sustainability limits and the kinds of trade-offs that need to considered in a multifunctional landscape.

Keywords: SIA, Multifunctional Landscapes, Participatory Approaches, Sustainability Limits

Assessing the sustainability impacts of European policies – stakeholder-based research methods and results

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This paper reports on the design, execution and results of stakeholder-based research in European case study regions conducted within the Integrated Project, SENSOR (Sustainability Impact Assessment: Tools for Environmental Social and Economic Effects of Multifunctional Land Use in European Regions), funded by the European Commission under Framework Programme 6. SENSOR sets out to deliver Sustainability Impact Assessment Tools (SIATs) that will be used to forecast the impacts of European policies affecting 6 land use sectors (Forestry, Agriculture, Tourism, Energy, Nature Conservation and Transport). Stakeholder-based research in case study regions performs two primary functions within the SENSOR project. Firstly, stakeholder-based analyses of policy scenarios are used to validate the outputs of model-based assessments. This research is supported by a detailed examination of sustainability issues in each case study region, informing the selection of relevant policy cases, sustainability criteria and indicators. Secondly, a framework for stakeholder-based policy analysis is developed. In combination with the assessment of policy impacts and limits and supported by the analysis of key sustainability issues, stakeholder preferences for different policy scenarios are elicited through the examination of sustainability criteria. The paper starts out by addressing the instrumental and ethical rationales informing the design and implementation of the research. Particular attention is given to the orientation of participatory research in relation to issues of critical relevance to policy-making in Europe, namely: - the diversity of sustainability issues and problems faced by different European regions; - the necessary analytical limitations of model-based approaches; - the complexity of assessing policy impacts on economic, social and environmental resources; - a commitment to an open, transparent and inclusive approach to developing and implementing policies. Then the framework for stakeholder-based policy analysis is presented. An overview of the research design is given, detailing a process of research development that has enabled a range of methodological approaches to be tailored to a specific application within the context of policy impact assessment. Techniques and approaches to case study profiling, to the analysis of national policy implementation and land use change, to the selection and analysis of sustainability criteria and indicators, to the assessment of policy impacts, to the identification of acceptable limits and to the elicitation of stakeholder preferences are discussed in detail. Finally, the results of stakeholder-based assessments of biodiversity policy in Malta are presented and discussed. The integration and application of these results within the wider SENSOR project is also covered. By outlining the rationale,

design, execution and results of this programme of research, this paper sets out to provide an example of the key role that can be played by stakeholder-based research with the decision-support context of impact assessment, both in terms of its ability to provide policy makers with invaluable information in the form of stakeholder-driven, context-specific assessments of policy impacts, and through the provision of insights into stakeholder preferences for different policy scenarios and land use futures.

Keywords: participatory research, case studies, policy scenarios, impact assessment, sustainability criteria

Stakeholder Participation in Sustainability Impact Assessment: Insights from the SENSOR Malta sensitive area case study

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This paper draws on participatory research into sustainability impact assessment tools (SIAT) carried out within the context of the SENSOR project, providing insights into some of the challenges associated with involving stakeholders in impact assessment of EU policies. The Malta case study was selected within the SENSOR project as a representative of European island regions, considered sensitive for sustainable land use. In this context, two workshops were held in Malta to test the SIAT. The process was informed by extensive participatory research into Malta's sustainability issues carried out in the first phase of the SENSOR project. The first workshop consisted of an expert-based assessment of the impacts for sustainable land-use of a set of scenarios based on the SENSOR EU biodiversity policy case. During this meeting, participants agreed upon how to adapt the SENSOR M2 biodiversity policy case and policy variables to the Maltese context, on three scenarios for biodiversity policy in Malta, and on assessment criteria. These criteria were then scored according to their overall importance in relation to sustainability in Malta. The next part of the workshop focused on the sustainability impact assessment, during which participants recorded impacts on a scale of +3 (high positive impact) to -3 (high negative impact). The second workshop, which included stakeholders from the environmental and agricultural communities, began by identifying acceptability limits related to the previously identified impacts. Participants were then asked to prioritise the various assessment criteria in relation to their importance for Malta's sustainable development. The workshops raised a number of issues related to stakeholder participation in the impact assessment of EU policy. In particular, the experiences from the workshops highlight the difficulty of presenting the complexity of sustainable land use change and multifuntionality to diverse audiences, and to ambivalence about overly quantitative approaches to impact assessment.

Keywords: sustainability impact assessment, land use, participatory research, European islands

Sustainable or not? The roles and limitations of user involvement in setting reference levels for indicators via computerized tools

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Key requirements of computerised tools for impact assessment are that they must be open, generic and transparent. Selected examples are SIAT, SEAMLESS-IF, EURuralis. SEAMLESS-IF operationalizes a set of sustainability indicators for the assessment and comparison of ex-ante agricultural and environmental policy options. SIAT analyses the impact of user defined land use related policy options on regional sustainability issues. EURuralis is a toolbox with data and models on four major scenarios designed to support interactive discussions and decision making on the future of rural areas in the EU27. In order to interpret indicators and assess the impact of different policy options on the sustainability of agricultural systems, adequate reference levels are crucial. It has been proven that the involvement of participatory groups is essential in developing the integrated tools. Furthermore, the computerised tools are built in a way that they enable interactive visualisation of sustainability indicators. Furthermore, by allowing users some choice in terms of indicator selection, particular metrics that are components of the overall sustainable development concept can be isolated and examined. The paper starts with a review of the approaches used to establish reference levels for indicators followed by a discussion on the role of institutions in setting reference levels via legislation as well as societal pressure. The paper provides illustrations from selected tools on the possibility of interactive visualizations of indicators of sustainability. It concludes with a discussion on (a) how additional flexibility can be introduced by allowing users to define weighting factors in so-called composite indicators of sustainability (where economic, social and environmental dimensions are integrated into an index-number) with a cautionary note on the statistical limitations of permitting different weights within a composite index and (b) the applicability of such frameworks to situations outside of Europe for example in sustainability studies in developing countries (www.lupis.eu).

Keywords: stakeholders,, computerised tool,, reference values,, sustainability indicators

An explorative participatory scenario approach for the development of sustainable futures in the GBR catchments

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The Reef Water Quality Protection Plan aims at 'halting and reversing the decline in water quality' entering the Great Barrier Reef (GBR) by 2015. To this end, water quality improvement plans are developed for catchments in the GBR region, aiming to provide sustainable solutions for future development that address economic and social change while enabling water quality improvement, remediation of landscape and ecosystem degradation and preservation of environmental values. In this paper we present a decision support tool that is being developed to assist natural resource managers and local communities in exploring options for sustainable future development. The Landscapes Toolkit (LsT) allows for the spatially explicit assessment of the impact of stakeholder-defined land use change scenarios on environmental and socio-economic values, using a linked modelling approach. We argue that this kind of explorative and participatory scenario approach plays an important role in catchment management planning and can support social learning relative to projective and predictive approaches in landscape analysis. Where the latter approaches forecast likely landscape changes based on past changes and aggregate behaviour, respectively, explorative and participatory scenario approaches assist planners and policy- makers in deciding among multiple choices through examination of the potential impacts of alternative future landscape patterns.

Keywords: decision-support tool, land use change, stakeholder involvement, social learning, catchment to reef

Procedures for developing an interactive tool for supporting sustainable land-use management planning – a stakeholder-based approach

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In the context of IT-Reg-EU , an INTERREG IIIA project, an interactive tool "Pimp Your Landscape " (P.Y.L) was developed for supporting sustainable land-use management in the Euro-Region Neisse, the border region between Germany, Czech Republic and Poland. Following a user requirements analysis, P.Y.L is designed as web-based tool with focus on visualizing and evaluating changes in the land-use pattern. Participatory approach: the user requirements analysis was carried out in the form of a Delphi-study, including experts and scientists from forestry, water-management and nature-protection from Germany, Czech Republic and Poland. The tool-properties for supporting discursive processes between stakeholders were identified and a conceptual framework for P.Y.L. was designed and tested. According to the Delphi-study's outcome, the tool aims to be easy to use, offers open access and is based on expert knowledge and scientific results. Information on the land-use pattern is based on CORINE LAND COVER 2000, which is transferred into GIF-format. Each pixel represents the dominating land-use type and by clicking the pixel it is possible to assign a new land-use type. The impact of each land-use type on sustainable development out of economical, ecological, tourism, and water quality perspective is ranked on a relative scale and displayed as a diagram. This ranking is based on approved indicator sets and expert knowledge. The user can choose between "Expert" and "Game" mode, the first offers the possibility to include regional expert knowledge into the evaluation of changes in the land-use pattern. The second forms the interface to regional citizens. The tests showed that i) further landscape functions, ii) refined evaluation of the land-use type impacts, and iii) neighborhood relationships between different land-use types should be integrated. Future application areas are seen in regional optimization of energy-crop cultivation and evaluating the effects of planning measures regarding the EU-soil protection directive.

Keywords: Sustainable land-use management planning, participatory approach, interactive tools, stakeholder involvement, decision support system

Sustainability impact assessment of bioenergy policy measures in Lusatia, Germany

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To estimate the impact of bioenergy policy measures on economic, social and environmental issues in Lusatia, a workshop which was adopted from the integrated EU project SENSOR was done with stakeholders of agriculture, forestry, energy industries and administration. The approach was easily understandable and the sessions (presentation of political instruments, scenarios, functions and criteria and indicators of the landscapes and also the impact assessment of political measures and their acceptability) could be done in time. No and extensive financial support of bioenergy have on the basis of this stakeholder analysis both positive and negative impacts on the 9 considered economic, social and environmental criteria in Lusatia in Brandenburg.

Keywords: Bioenergy, Sensitive area case study, Sustainability indicators, Stakeholder, Lusatia

Development of social indicators of sustainability for the EU project SENSOR

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In this contribution we focus on the social dimension of sustainability and the associated indicators selected for the purpose of the SIAT (Sustainability Impact Assessment Tools) in the SENSOR project. In the poster contribution we describe in detail six social indicators (Unemployment rate, Employment by sector, Deviation of regional unemployment rates, Deviation of regional income, Exposure to air and water pollution, Self-sufficiency index for food); specifically the reasoning behind why they have been selected, issues related to quality and uncertainty of the chosen indicators, data constraints, modelling etc. In developing these social indicators, we found ourselves limited by the specification of policies, specification of the scenarios, and modelling tools utilized. This is due, in the first instance, to the fact that a number of the key factors that influence the social indicators are not included in the policy specifications or are assumed to not be influenced by the policy choices. In addition, many of the social indicators focus on distributional issues, which are not considered in the models. This points to the need in future studies to understand more clearly early on the implications of research design on the achievement of research goals.

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