PRESENTATION ABSTRACTS
(in alphabetical order)

Land use-cover changes in a Mediterranean municipality in the last century (La Vall D'uxó, Valencia, Spain)

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In eastern Spanish Mediterranean areas, land use-cover changes are mainly due to (1) the conversion of agricultural land for urban, industrial and infrastructure uses; and (2) agricultural intensification, through changes from extensive dry farming to intensive irrigated citrus crops. In some cases, transformations could have resulted in the reduction or loss of some soil functions by erosion, salinisation, sealing, and other soil degradation processes. Furthermore, the spatial appearance, cover distribution and terrain fragmentation of landscape structure has been transformed.

In order to evaluate the territorial dimensions (in time and space) of such changes at the municipal scale, a Geographical Information Systems framework has been developed. Apart from cadastral information, spatial land use / land cover information has been extracted from municipal maps (for the year 1908) at the scale of 1:25,000, and from four sets of aerial photographs (from the years 1956, 1978, 1991 and 2002). Land cover maps were produced on the GIS using a common geo-referencing layer: a 1:10,000 scale digital topographic map. The study was applied to a representative, topographically transitional (alluvial plains-mountain ranges) municipality, La Vall d'Uxó, in the autonomous region of Valencia in Eastern Spain.

Results show that land use-cover changes have been significant since 1956. In fact, there has been an important intensification in agriculture, from traditional dry farming crops to irrigation citrus fields in the alluvial plains, which were afterwards extended over steeper areas of the municipality. Land use-cover conversion from agriculture to urban-industrial uses is the second most important process. It has affected the most fertile soils for agriculture, which is one of the most critical elements of soil degradation by artificial soil sealing. Also, there has been an associated process of landscape partitioning produced by the introduction of intensive irrigation parcels on the hill slopes, where traditional dry farming was extensive; the enlargement of the communication and transport network, and the construction of irrigation infrastructures (ponds, pumping shelters) and individual residential buildings.

The described dynamics have resulted in a completely new landscape structure. Nowadays the dominant mainstream of change is the evolution of those covers that at the beginning of the 20th century were not representative (artificial and intensive agriculture uses). Only the areas that are less accessible from a topographic point of view have maintained their original dry farming and natural covers. The evidence of these trends and impact suggests that the extension of similar studies to other areas of the Mediterranean transitional belt would be favourable in order to better assess the actual dimensions of landscape change.

Leisure activities and recreation in tourism landscapes – an environmental strategy for golf in Portugal

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Golf has always had a close relationship with nature. Golf courses are intimately associated with the surrounding landforms and vegetation of a site. These provide both the challenge and setting for golf, and combine to create the uniqueness of each course, marking the difference regarding all other formal outdoors sports that require specialized grounds of fixed dimensions.

Within certain basic parameters in terms of layout, golf courses have an inherent flexibility. The relationship between courses and the environment has been the subject of public concern in recent years; however, golf courses provide important environmental and community assets. They are relevant habitats for birds and other wildlife and recreational places for other activities, such as walking, jogging, bird watching and landscape fruition.

Water is a fundamental factor of golf course management, and its conservation is clearly a major issue confronting the golf industry; however, this needs to be seen in comparison with other economic activities such as agriculture, which is by far the greatest water consumer.

Agricultural land is usually targeted for golf development as a result of diversification, because more landowners are seeking alternatives to the uncertainty of agricultural production; intensive agricultural land is generally considered to be of low ecological and landscape value, and the prospect of converting some less valuable land into green fields allows for greater diversity.

The identification of appropriate technological tools and environmental guidelines for the management of land use systems and landscape units constitutes the basis for proper golf course management. Water, soil and vegetation play a most important role that must be valued and qualified both at specific and local as well as at global and integrated levels.

The key factors to take into account in irrigation design are: soil and vegetation types and evapotranspiration; different grasses have different water requirements and crop factors, and the most suitable ones should be applied according to climatic conditions. In Portugal, the "golf development boom" generated reactions from public opinion and environmentalists concerned about the impact of new golf courses. Major questions related to the visual perception of a golf course as an artificial "suburban landscape" placed in a "semi-rural" environment; the dimensions of the surrounding real estate developments; and the impact of the significant terrain modelling, with few trees and shrubs, mainly along the seacoast, in the Algarve.

In this presentation the emphasis is on the role of water, in addition to its importance as a major element in life and vegetation support. Also, each golf course /landscape type requires a clear recognition and identification of all of the particular relations between soil, water, vegetation, other land attributes, the local landscape and socio-economic assets.

Tourism and landscapes within multifunctional rural areas: the French case

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The link between landscape and tourism is more obvious in the case of outstanding sites located in coastal or mountainous areas. There, some hard tourism leads to an actors' game where decision is concentrated, conflicts are explicit, demand on landscape may be coupled with real financial means and so on. However, recreational activities and tourism in rural areas have expanded significantly in all developed countries. In France, on the basis of the statistics on overnight stays provided by the National Permanent Conference on Rural Tourism for 2001, the countryside is ranked as the first destination for recreation at the national level. On the other hand, the recognition of the multifunctionality of agriculture/rural areas tends to become a privileged way of development, making it possible to propose an alternative to productivism for rural territories in crisis or under pressure, by creating close links between agricultural production and territory, and by combining this with other activities, in particular tourism. In this article, we shall therefore explore other types of situations where tourism is more soft and diffuse but progressively induces a new qualification of the landscape.
The public actions and coordination of the actors are at the core of the relation between tourism and landscapes in rural destinations. This article thus analyzes the relation between tourism and landscapes in rural territories from an economic standpoint. We begin our analysis with a brief description of tourist's preferences for rural landscapes. Then we pursue our theoretical investigation with a description of public action on rural landscapes within an economic approach. Different forms of public action are available to regulate the conservation/transformation of the rural landscape at different levels: the definition of property rights, incentive contracts for landowners, incentive information or action on social representations. We propose a typology of these forms of public action and discuss their suitability in responding to social demand. We can observe that public action on the rural landscape is not often linked to public action on rural tourism. In this context, a typology of actors is needed in regard to problematic topics. Actors who are interested in the "commodification" of landscapes must be distinguished from actors who are interested in the "production" and management of landscapes. The actions of the Regional Natural Park (RNP) in France constitute a good example of management for multifunctional areas. The explicit remits of this institution are twofold: first, to improve the socio-economic development of the territory (including support for tourism as an economic activity) and second to manage (i.e. protecting, improving, value giving, regulating use of and access to) the environment and landscapes.

The concept of multifunctionality and some critical questions

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The word "multifunctionality" emerged during the nineties in the context of discussions about changes in agricultural policy and the future of agriculture, both at the international level, particularly within the OECD, work and in the WTO multilateral negotiations on agricultural trade, and at the national level. Often the use of this word is fuzzy, ambiguous and close to sustainability. To make this word a concept, it is necessary to offer some clarifications, controversies and national case studies at the European level to assess its added value for research work promoting future demands for landscape goods and services.
The goals of this paper are:

- to clarify the relationship between the concepts of multifunctionality and sustainability,
- to illustrate the co-existence of different national Concept Oriented Research Clusters (CORC),
- to provide some elements of criticism about this concept,
- to discuss the difference between the multifunctionality of agriculture and the multifunctionality of landscape, and the relevancy of these two approaches.

A clarification of multifunctionality and sustainability

Several approaches will be surveyed to elucidate the differences between and common points of the two concepts, which in policy-related debates are often regarded as synonyms. In Multagri our hypothesis is that the multifunctionality of agriculture and rural areas is a way to reinforce and promote sustainable agriculture and integrated rural development. Passing from sustainability to multifunctionality and the reverse is often quite easy, but raises some fundamental questions. For the OECD, the concept of **sustainability** is essentially **goal-oriented**, implying that resources should be used in such a way that the value of the entire stock of capital (including its option value) does not diminish, and an indefinite stream of benefits can be obtained. ***Multifunctionality*** refers to the fact that an economic activity may have **multiple outputs** and, by virtue of this, may contribute to several societal objectives at once. Multifunctionality is thus an activity-oriented concept that refers to specific properties of the production process and its multiple outputs. Hediger presents an analytical framework for jointly addressing the main issues of multifunctionality and sustainability. He presents efficiency, stability, criticality and equity as key issues of sustainability, and tries to put them in relation with the multiple functions of agriculture.

The co-existence of different national Concept Oriented Research Clusters (CORC)

The emergence of this word has given rise to many political and theoretical discussions at both levels, within which several definitions and conceptions of multifunctionality have been presented.
Eight CORCs can be identified from our national case studies in Multagri, characterized by a relative homogeneity in the research questions addressed, in the concepts used or discussed by scientists in their work, and by the scientific disciplines, the stream of thought or possibly the epistemic community researchers belong to.

- Multifunctionality as the joint production of commodities and public goods
- Multiple impacts and contributions of agriculture/rural areas on society, local communities and the environment
- Multifunctionality as a necessary connection between commodities and identity goods
- Farmers' strategies and practices: multifunctionality, technical changes, livelihood systems
- Multiple use of rural space and regional planning
- Multifunctionality as a way towards sustainable agriculture and rural development
- Multifunctionality as social demand towards agriculture
- Roles of agriculture to be officially addressed by policy (coordination of supply and demand)

Some criticisms of this concept

Most of the criticism came from non-European countries, especially in the past trade negotiations in the framework of the WTO and various fields of international discussion. The public choice theory is the basis of this criticism.

For the Cairns group, some countries, such as the Member States of the EU, Japan and Korea, have recently coined the term 'the multifunctionality of agriculture' to describe a range of agricultural non-trade concerns. Some argue that their particular non-trade concerns, or the multifunctionality of their agricultural sectors, justify the maintenance of production-linked agricultural subsidies and high levels of border protection. But the Cairns group argue that other countries with the same or similar non-trade concerns do not resort to agricultural support and protection to address their policy objectives. Moreover, the Cairns group pointed out that those arguing that the multifunctional nature of agriculture is a reason why agricultural trade should not be subject to reform have not been able to explain why they must use production-linked support rather than utilising first-best policy options, targeted to address specific non-trade concerns, instead of trade-distorting agricultural support and protection.

For less developed countries (LDC), multifunctionality has been invoked for supporting agriculture in developed countries. But the problem is that the extreme support has a counterpart ofnegative effects on other economic activities and social groups, leading in several instances to a lower level of welfare for the society as a whole. Moreover, for poor countries it is not possible to win the battle of subsidies against industrialized countries. As in the case of industrialization, to intervene in order to support and protect private producers generates a trade distortion.

Multifonctionality of what : agriculture or/and landscape?

As we saw before, there are different concepts and conceptions linked to society's needs and demands. In this section we discuss the interest of each concept and its limits with two kind of issues:

(1) the relationship between the concepts used in different countries and the political requirement for the research;

(2) what improvements could be used from this survey on the concept of multifunctionality to improve the research goal for the multifunctionality of landscapes approach

The interest of the concept (as a whole) is also to emphasis and to develop an approach related to the complexity of the word. The scientific approach is mostly based on analytical dimensions through disciplines or thematic areas. The core issue of multifunctionality, however, is about the complexity of the interrelation between the functions in several topics (expectations of consumers, joint productions, modeling…). It also raises fundamental questions for disciplines.

Modelling multifunctional farming in multifunctional landscapes - a review of data needs and possibilities in seven EU landscapes

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What consequences will rural and agricultural policy have on landscape goods and services provided by European farming? How do we assess these services and how do we obtain the appropriate information to make these assessments? These questions are addressed in this paper, based on results from the European Strategic Research Project MEA-scope (www.mea-scope.org).

The project aims to develop a tool to model the production of commodity outputs (CO) and non-commodity outputs (NCO) from agricultural systems within the EU. The tool links three different models, AgriPoliS, MODAM and FASSET, each of which covers a range of COs and NCOs at different scales. First, a number of typical farm types are identified for the target landscape, and each farm present is allocated to one of these types. The agent-based model AgriPoliS then simulates the expected change in the population and structure of farms, based on scenarios in the economic and regulatory environment. Secondly, the linear programming model MODAM optimises farm resource allocation for typical farms to obtain COs and NCOs from farms within the landscape. Finally, the biophysical model FASSET performs a detailed simulation of the production, energy consumption and nitrogen pollution from agriculture. The linked MEA-scope tool will be tested in seven study landscapes situated in Denmark, Germany, Poland, Slovakia, Hungary, Italy and France.

The construction of this tool is a challenge. First, in order to get the model running, high quality data input is required from each individual model. Second, in order to add value and insight to the study of COs and NCOs, the results of the three models need to be made consistent. A full integration of models, however, would be infeasible due to tractability and complexity. Consistency is therefore achieved by testing the model's results for plausibility in comparison with available data sources and local knowledge in the seven landscapes. Third, the tool must accommodate a wide range of scenarios relating to rural and agricultural policy (e.g. water supply and compliance with the EU Water Framework Directive, biodiversity conservation in NATURA 2000 areas, tourism). Fourth, the structure and function of individual rural areas in Europe reflects the unique geographic, cultural and historical environment within those areas. The tool must be sufficiently adaptable to individual areas that the picture it draws can be recognised by local stakeholders, while at the same time retaining sufficient generality that it allows EU and national policymakers to draw broad conclusions across a much larger spatial scale. At the same time, data requirements should be modest and basically be obtained from existing databases. Ideally, only a few additional surveys should be necessary.

This paper focuses on how to obtain the landscape information and farming data needed for the MEA-scope modelling tool. This includes a review of the EU- and Europe-wide spatial datasets describing the economic, land use and biophysical characteristics of rural areas and the extent to which these can be used to describe the structure and function of those areas. However, since these wide-area datasets alone are insufficient for use in MEA-Scope, it will also describe the landscape-specific data that must be collected, and the methods necessary to collect and use them.

The concept and valuation of landscape goods and services

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Natural and semi-natural ecosystems and landscapes provide benefits to human society that are of great ecological, socio-cultural and economic value (e.g. Costanza, et al., 1997; de Groot et al., 2002). These benefits consist of a mix of goods and services, both private and public, provided by multi-functional landscapes, which are therefore sometimes referred to as our "Natural Capital".

In environmental planning and decision-making, however, these benefits are often not fully taken into account, and productive, multi-functional landscapes continue to be converted into simpler, often single-function land use types (e.g. croplands) or turned into wastelands (e.g. eroded land after clear-cut logging or polluted and over-fished shelf-seas). Nevertheless, studies are increasingly showing that the total value of the multi-functional use of natural and semi-natural landscapes is often economically more beneficial than the value of the converted systems (de Groot, 2004, in press). In the last decades, the multiple benefits that are provided by ecosystems and landscapes have been described in a large number of studies which provided the basis for a recent global assessment of ecosystem goods and services (Millennium Ecosystem Assessment, 2003). Many studies have presented conceptual frameworks addressing (part of) the complex issue of linking ecosystem (and landscape) functions to economic values. However, few frameworks presented to date consistently link the physical and ecological characteristics of ecosystems and landscapes to their potential values, and one of the main outstanding issues is that ecosystem functions are performed at different temporal and spatial scale levels (Hein, 2005).

In this paper, an attempt is made to define a consistent and broadly applicable framework for the valuation of the multiple benefits provided by ecosystems, that specifically addresses the spatial and temporal scales (dynamics) at which ecosystem goods and services are supplied. The framework also offers a way to avoid the double counting of functions in economic valuation, and recognises the importance of linking goods and services provided to stakeholders.

The paper is based on an extensive review of the relevant literature, integrating insights from physical geography, ecology and economics. Three main groups of functions are distinguished: production, regulation, and information functions (roughly corresponding to the provisioning, regulating and cultural services categories used in the Millennium Ecosystem Assessment (2003)). A fourth category, habitat or supporting functions, is presented and discussed in light of the danger of double-counting their economic value. Distinguishing these function categories facilitates the assessment of ecosystem goods and services because of the fundamentally different nature of the goods and services supplied by the three groups, and the different value types involved. These function groups are linked to the value categories defined in economics literature (e.g. Turner et al, 2000). The framework also incorporates recent ecological insights in the field of scales and ecosystem dynamics (e.g. Gunderson and Holling, 2002).

Political and research perspective on multifunctional land uses

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In 2005 the EU began implementing the cross-compliance aspects of REGULATION (EC) No 1782/2003. Among the requirements of Annex IV, two specific requirements will probably have a strong impact on land use and landscapes: "Minimum level maintenance" and "Ensure a minimum level of maintenance and avoid the deterioration of habitats". Both requirements seek to indirectly internalise one of the functions provided by agricultural production: the preservation of the landscape and the environment in general.
In this paper, this regulation will be analysed under the frameworks of the Lisbon strategy, its contribution to the competitiveness objectives in a knowledge-based society, and the goals established by the Göteborg council in providing for sustainable development. The paper will be concluded with the actions taken by the EU in terms of research to inform and accompany the policy decision-making process.

Making problematic cases successful in traditional landscape management - use of repetitive photographs in communicative planning context

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The case is a river valley landscape in Southern Sweden, which was declared of national interest for conservation interests in the 1970s. It is called 'Bräkneåns dalgång'. Scientifically our research project has used an unusual approach and time span, comparing three different times: 1975, 1995, and 2005. The intention was to search for a communicative planning, in which the future-lead, visionary thinking were better linked to the conservation interests. As approach we used a combination of photographs, retaken from the same places and interpreted, and deep interviews of what we call insiders and outsiders. In a final step we are using the seminar form as a base for future management planning. Parallel, a 40 minutes television film was made, which has been watched by 2.5 millions of people in Sweden. The study indicates a much too low profile in communicative-lead contacts and planning efforts today in practice. It could be claimed to be a really problematic case, but meanwhile, it is a quite successful case. In many parts of the valley the traditions in land use continues, in other situations totally new uses appear, but also these latter are surprisingly much based on traditions. The case illustrates the importance to use the creativity within the local society. Parallel, it shows the importance to support key persons rather than to give subsidies for the management of different objects. It shows the necessity of outsiders as bridge persons. It highlights the importance to widen and deepen our meaning of words like *traditional, authenticity, environmental aesthetics, and multi-functionality.*

Stakeholder platforms and “Innovative Cooperation” for multifunctional land use development - analysing case studies from Switzerland

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The establishment of ”stakeholder platforms for multifunctional land use development” is a promising way of dealing with complex natural resource management problems, as well as a way of negotiating in order to avoid overexploitation and inter-user conflicts. “Innovative Co-operations” then take over the task of realising the ideas developed by such platforms. The first part of this paper introduces and discusses the concepts of platforms and innovative co-operations, which are two complementary institutions for sustainable multifunctional landscape and regional development. We propose that these institutions can be the common basis for development processes run by the various stakeholders. In particular, the chapter highlights the learning processes and their characteristics, which are constitutive elements of both institutions. In the second part, the chapter illustrates the concept with two concrete case studies from Switzerland, involving integrated storm water management and mountain forest development.

Sustainability impact assessment of multifunctional land use in the European policy context

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Multifunctional land use is a central point of policy and management at different levels of governance. Its successful implementation requires tools for the ex-ante assessment of policy options and multifunctional land use strategies on sustainability issues.

This paper reports on the conceptual research design of the EU Integrated Project SENSOR, which will build, validate and implement sustainability impact assessment tools (SIAT) for the analysis of multifunctional land use in the context of European policies on a regional scale. The assessment tool will include a GIS-based data management system and a spatial reference framework. The scientific challenge is to establish relationships between different environmental, social and economic processes as characterised by sustainability indicators. Scenario techniques will be established within a modelling framework of macro-economic, sectorial and cause-effect-chain environmental models to analyse various aspects of multifunctionality and their interactions. Modelling results will be cross-checked through participatory valuation techniques in selected European regions. Specific emphasis will be on the development of expert rules for threshold identification as well as of stakeholder-driven procedures for the valuation and prioritisation of sustainability aspects of land use. The confrontation of data-driven quantitative analyses with stakeholder-driven qualitative analyses provides a new approach of valuating modelling results and gives rise to the analysis of conflicts and synergies of interacting landscape functions affected by policy-driven land use changes.

With its conceptual design, SENSOR aims at delivering novel solutions for integrating models, spatial and temporal scaling, indicator selection, database management, sustainability threshold and target definition, and the prediction and analysis of land use trends. SIAT will be made available to policy makers at the European level, providing scientifically sound procedures for the assessment of environmental, social and economic responses to multifunctional land use.

Rehabilitation of disturbed landscapes: Lusatian lignite mining district, Germany

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The restoration of surface mining landscapes requires the (re)creation of ecosystems. In Lusatia (eastern Germany), large-scale open-cast lignite mining operations generated spoil dumps widely consisting of acidified, phytotoxic substrates. Amelioration and rehabilitation measures were developed and applied to these substrates since the 1950s. However, it is still not clear whether these approaches are sustainable.

At first sight, pine stands on mine sites along a chronosequence comprising about 35 years did not show differences compared to stands on non-mined sites in the general region. Furthermore, with some modification, conceptual models for flora and fauna succession in forest stands on non-mined sites seem to be applicable, at least for the early stages of forest ecosystem development on rehabilitated mine-sites. For example, soil organism abundance and activity at mine sites already reached levels typical for non-mined sites after about 20-30 years.

In contrast, mine soils are very different compared to non-mined soils in the test region. Chemically, mine soil development is dominated by processes originating from pyrite oxidation. Furthermore, geogenic, i.e. lignitic, soil organic carbon was shown to substitute for some functions of pedogenic soil organic matter. Rooting was hampered but not completely impeded in strongly acidified soil compartments on mine-sites. Roots and mycorrhizae are apparently able to make use of the characteristic heterogeneity of young mine soils.

Considering these recent results and the knowledge accumulated during more than 30 years of research on mine site rehabilitation internationally, it can be stated that mine site restoration could be used as an ideal case study for forest ecosystem development starting at “point zero” on “terra nova”.

This also offers a wide range of opportunities to shape these new landscapes in a different way and to turn away from a conventional, generally mono-structural agriculture. One of the most promising options is the implementation of complementary forms of land use for bioenergy production and the creation of low-input agroforestry systems on reclaimed overburdened sediments and adjacent marginal arable land, thus harmonizing social, economic and ecological demands.

Lignite production in the Lusatian mining district has caused a lowering of the water table on an area of 2,000 km^2. Actually, the regressive run-off of mining water into rivers and lakes is causing a water scarcity on a landscape level and even far beyond. However, it remains unclear to which level a reduction in open-cast lignite mining will raise the water table in the next 30 years, and which options will then be needed to compensate for this new type of disturbance. Therefore, it will be essential to provide different prospective tools and related options to flexibly respond to such changes.

The rehabilitation of disturbed landscapes in Europe – the Northern Estonian oil shale mining area

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The Estonian oil-shale field is the largest commercially exploited oil-shale deposit in the world (>6600 million tons, over 60% of explored reserves), and its output yields 70% of the world's oil shale production. The mining of oil-shale began in 1916; presently, 2 underground mines and 2 opencast mines are in operation. All of the operating mines are located in north-east Estonia, i.e., in the central and eastern part of the deposit. In this area, the overburden reaches ranges of 0-70 m due to the gentle southward dipping of the Ordovician strata. Pit mining began to spread intensively in 1959. Pits are now efficiently used in digging up to a depth of 30 m. If oil shale is deeper than 50 m underground, mining is used. Nowadays, around 50% of oil shale is mined in pits. Until 2005, around 12,900 ha was mined, and 10,188 ha of the area is afforested. The land use before opencast mining was natural – the area of the Narva mine was covered mainly by forests (53%) and bogs (44%). The predominant wet forests were of low site quality, and the main tree species were *Pinus sylvestris*, *Betula pubescens* and *Alnus glutinosa*. The reclamation order of exhausted oil-shale pits was determined by the Estonian government as early as 23 November 1923. The planned afforestation of oil-shale pits began in 1960. More than 365 ha of experimental stands are planted on smoothened oil-shale pits to ascertain the most suitable indigenous and introduced tree species and bushes (a total of 52 species have been used).

Up to recent years, mainly coniferous trees have been planted on smoothened oil-shale pits; the share of pine, birch, spruce, larch and black alder stands in restored forests represents 86%, 9%, 3%, 1.6% and 0.2%, respectively. Fire and insects endanger the spread of monocultures of *P. sylvestris*. Pine stands need also need thinning at a young age, which is not necessary in birch and alder stands. Also, growth rate and soil improvement ability are higher for silver birch and black alder than for Scots pine. Hence, the proportion of birch (*Betula pendula)* and black alder stands is increasing, forming 11.5 and 0.3% respectively at the Narva mine in 1995-2004. Among introduced species, *Larix europaea, L. sibirica,* and *L. kurilensis* show quite good growth on calcareous mining spoil. Since 2002, rhizosphere processes and morphological adaptations of absorbing roots of Scots pine, silver birch and black alder are studied in restored forests on the opencast oil shale mining area. The higher growth rate of deciduous trees is in accordance with the higher activity of microbial communities in their rhizosphere than for Scots pine and the greater mean specific root area of ectomycorrhizas 155±8, 194±15 and 62±4 m^2kg^{-1} for young (4 years old) black alder, silver birch and Scots pine respectively.

The majority of oil-shale is used for electricity generation in 2 thermal power plants in North-Eastern Estonia. Thus Estonia has an energy mix that is unique in the world, as about 96% (6.7 TWh in 2002) of electrical energy generation is based on oil-shale, which is a low-grade fossil fuel (average ash content 46%). Each year more than 4.5 million tons of ash is dumped, and ash dumps contain a total of over 200 million tons of ash and cover more than 16 km^2. Wind farms have been considered as a measure for the ecological and economic rehabilitation of the abandoned oil-shale ash dumps of the thermal power plants. Low but dense vegetation cover minimizes the surface roughness length and wind drift of the dust, enhances soil formation, improves the rate of evapotranspiration (up to 508 mm/year), which in turn reduces the surface runoff of highly alkaline precipitation waters. Wind turbines favour the increased height of the ash dump (relative height 6-22 meters) and large open area (the biggest abandoned oil-shale ash dump covers 576 ha), which leads to a stable wind profile with a mean annual wind speed of 7.0 m/s at hub height. Wind turbines have an average availability rate of over 0.3 and a mean annual energy yield of 6-6.2 GWh/year per 2 MW wind turbines and 8-8.5 GWh/year per 3 MW wind turbines.

No landscape planning without a vision – introduction to an extended process-oriented Leitbild methodology

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As shown in many publications, a variety of planning approaches exist to develop the landscape of tomorrow. Nevertheless, it is necessary to address this topic, due to the lack of approaches combining scientifically qualified expert opinions based on scientifically proofed criteria with a more transdisciplinary reflection of social needs, economical demands and political constraints. Controversies still exist in developing the "optimal state" of a landscape regarding its system-immanent natural potentials and the realisation of these states compared to the constraints arising from social, economic and political perspectives. It becomes apparent that "soft" requirements such as agricultural funding strategies, laws and directives etc. need to be taken into account.
The pros and cons of the purely "academic approach" and the "transdisciplinary approach" of Leitbilder has been widely discussed in the literature. However, the research has not yet been able to overcome the weaknesses of the two separate approaches. Therefore, a praxis-oriented methodology combining both approaches will be introduced. This has been done in order to steer the landscape towards an aspired state in the mid-term future by providing a set of guidelines for action. The fundamental goal of this analysis is to capture the basic characteristics of the natural balance in order to avoid irretrievable damage to the environment and its resources. These characteristics refer to environmental conditions, states, processes, functions, potentials and risks. The capacity of the landscape budget was measured and - combined with socio-economical criteria - the goods and services were determined. This has been done using an extended process-oriented Leitbild approach comprising several modules. For example, a matrix of functional superimpositions and a matrix of buffer stripe areas are of special significance. Joined to a hierarchical framework, they operate as a base to allocate an appropriate land use / land cover type to an explicit spatial area of consideration. Further essential elements are the additionally attached modules of social demands, economical requirements and political constraints, which together allow for a pursuable and transparent landscape planning. Having converted this complex approach into the ArcGIS 9.x environment, it supports semi-operational analysis towards the aspired state of the future landscape.
Problems remain from the huge amount of data needed. The timeframe of acquisition and the data management required to allow for semi-automatic derivation of the Leitbild in a GIS environment was huge. On the other hand, the possibility of easily deriving scenarios that take into consideration different aspects that will to be developed in the future were elaborated.
Having tested this approach in a grassland-dominated area in Austria, this methodology seems to have been proved suitable in praxis. Furthermore, the first attempts to transfer this methodology to another test area also appear to have been successful. Therefore, the main benefit of this approach is that it contributes to more holistic future planning and supports practitioners with a practical ArcGIS toolset.

The post-productivist landscape as an example of multifunctionality – Between the mythical and post-industrial wilderness

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The term „wilderness" is today often referred to as the opposite of a „cultural" landscape or landscape in general. Nevertheless, this distinction is not objective, but it is rather a cultural construct. In this sense Nature, traditionally perceived as an independent phenomenon, is a socially constructed reality and "the primary social demand for the countryside is a cultural one" (Buller, 2001). In this paper it is argued that at least two important aspects can be identified in the perception of wilderness. The first where wilderness is represented as something „cruel" or „ungovernable". Wilderness is perceived as the opposite (a rival) of an order carefully created by culture. The existence of wilderness itself represents a source of anxiety and unease. The second view understands wilderness as uncultivated wasteland as opposed to a cultivated land, which for the first farmers was a space gained with a great difficulty at the expense of the wilderness. Both of the above-mentioned levels blend together in Czech mythology.

The evolution of the perception of wilderness is described together with the analysis of a transition towards a post-productivist countryside. The cultural dimension of areas from the industrial era left by civilisation could be a question for aesthetic discussion; however, it is visible at first glance – dilapidated buildings, rusty pipes, geometrical chaos. This is what one can observe not only in former industrial sites, but also in collapsed farms from the communist era. On the other hand, such localities represent potential habitats for many valuable botanical and zoological species. The concept of a „post-industrial" landscape is presented as a conjunction of previously characterised approaches, unifying culture and wilderness. This is illustrated in the Ostrava region (in the North-Eastern part of the Czech Republic), which serves as an example of a post-industrial landscape that allows space for the existence of many valuable habitats of "wild" character. Their emergence can be considered to be one of the by-products of human work. Examples of the cultural and biological importance of the post-industrial landscape are described and visually presented, thus broadening the concept of landscape multifunctionality (Helming and Wiggering, 2003; Brouwer, 2004).

The process of the implementation of multi-functionality in land use planning in Denmark in the last two decades

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The concept of multi-functionality has gained increasing attention within the area of agricultural policy as well as within landscape science - despite the fact that the concept is by no mean clearly and unambiguously defined. In terms of land use, however, Brandt and Vejre (2004) have argued that three general types of multi-functionality can be defined: (1) a spatial combination of separate land units with different functions, (2) different functions devoted to the same land unit but separated in time and (3) the integration of functions on the same unit of land at the same time.

In the ongoing debate about agriculture, the environment and the need for sustainable development, the concept of multi-functionality has been the answer to at least three main problems related to modern agriculture and rural areas: environmental damage and the maintenance of landscapes, surplus production and the lack of rural development and, often in relation to the first point, the lack of justification for the continuation of ongoing economic support to agriculture. In this paper we will pay attention to multi-functionality as an answer to the problem of environmental damage and the maintenance of landscapes.

Our aim is to address the policy level and analyse: How and to what extent the concept of multi-functionality has been incorporated in the Danish land use planning and agricultural legislation and what shapes and constrains the process incorporating the concept of multi-functionality.

The incorporation of multi-functionality in agricultural policy as a means to solve the problem of environmental damage and maintenance of landscapes has, at least from an analytical point of view, many similarities with the concept of Environmental Policy Integration. The point of departure for our analyses is therefore closely linked to the concept and theory of Environmental Policy Integration.

It can be argued that land use planning by nature is a tool for integrating multiple functions/land use interests. Through a balancing or weighing of interests, it shapes the integration and results in a spatial combination of separate land units with different functions. Land use planning may, however, also include the coordination of land use interests and thereby lead to an integration of functions on the same unit of land at the same time. To what extent and how this coordination of interests has taken place in the last two decades is the main topic in our analysis of multi-functionality in land use planning.

According to Nilsson and Person (2003), studies of processes of environmental policy integration may include three different perspectives or approaches: *the issue of process*, with focus on policy co-ordination between agencies, intra-governmental relations, communication processes etc., *the policy outputs*, which focus on the statements, objectives, strategies, actions and regulatory measures put in place, and *outcome perspective*, which include an examination of how policy has stimulated changes in environmental behaviour. In our study the focus will be on the issue of processes and policy output, with emphasis on the latter. The study will build on interviews with policy makers, policy documents, legislation etc., including structure plans from three counties in Denmark.

Landscapes of transitional economies: the Estonian coastal zone

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The main goal of this paper is to analyse issues of environmental and socio-economic sustainability in the Estonian coastal zone, one of the most sensitive and rapidly developing landscape areas in Europe. Estonia has a long and winding coastline (up to 3800 km) with an abundance of islands and small islets which makes it spectacular and rich in biodiversity. Traditionally, there has been a relatively large portion of open grasslands, wooded meadows, wet meadows and alvars in the Estonian coastal zone. Settlement was concentrated in fishing villages, while rural settlements active in agriculture were highly dispersed.

Since the 1950s, coastal settlement, especially fishing communities, gradually declined, as access to a large proportion of coastal areas was limited by the Soviet military. The main settlement shifted from the coast further inland, yet thin soils vulnerable to drought did not support intensive crop farming, and most importantly, agricultural activity was cattle breeding (dairy farming). This kind of "closed coastal zone" had a dual impact on the landscape: the former cultural landscape (wooded meadows, patchy natural grasslands) slowly degraded, while natural ecosystems (forests, coastal meadows, dunes) thrived.

During recent decades, marginalization, the low demand for agricultural products and diluted earnings have reduced cattle breeding, thus further contributing to the expansion of abandoned land and overgrown wooded meadows.

At present, the most important socio-economic aspects of sustainability issues in the Estonian coastal zone are: the marginalisation of rural areas, low investment rates, a high unemployment rate, the abandonment of agricultural lands, the lack of land use concepts, land ownership changes, conflicting nature conservation, the development of coastal fisheries and tourism, and high potential for ecotourism integrating islands and coasts.

To avoid further marginalization and maintain natural diversity in coastal regions, there is a high need for supplementary activities to assure a higher employment rate and give land additional surplus value through multifunctional land use. Part of the abandoned agricultural land has been converted to forest (approximately 2%). However, this may have a side impact, as in several cases old overgrown wooded meadows and natural grasslands are planned for forestation instead of mowing. This can lead to a decrease in biodiversity and pleasant views.

Another factor imposing rapidly increasing pressure on coastal ecosystem, but also on the social environment, is real estate development. Coastal areas around cities are found to be attractive for the establishment of large suburban dwellings which are largely monofunctional and in the long-term impose the risk of simultaneous obsolescence. In contrast, distant coastal areas are attractive for the establishment of summer cottages. Their inhabitants seldom have any link to the local community, but increase the seasonal use of local resources. The high concentration of summer cottages and urban sprawl on account of new dwellings (comprising 8% of land use in a 1-km-wide zone in Northern Estonia) have a significant impact on land use fragmentation and further promote the use of private instead of public transportation.

Integration of multifunctional goals into land use - the planning perspective

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The integration of multifunctional goals into local or regional planning refers to several landscape-related scientific models and assessment approaches, and also to European local legislative demands. Integrative landscape goals must be developed on the basis of a multiplicity of related functional targets to land use decisions. The planning perspective relates to the system approach, e.g. to expert or model systems for spatial decision support (SDSS). This paper presents some examples of the use of spatial planning instruments for the optimisation of the spatial development carried out on different levels, from local to regional. One of them is SMART GROWTH, which associates the ideas of sustainable land use, sprawl control and spatial order into the concept of the planning perspective. Smart growth, like sustainable development, is at the same time productive and environmentally, economically and socially sound, while enhancing the choices that people have regarding housing, jobs, recreation and transportation. The long-term needs of people, businesses and the environment ultimately define the future perspective of planning concerning the multifunctional potential of socio-natural components. In the construction of strategies, an essential role is played by the generation of optimum solutions linking land use and landscape multifunctionality, and the establishment of the foundations for the sustainable development in each of the sectors of the economy, across the entire natural-economic-social system. The primary goal in this process is to enhance the existential safety and quality of life of the inhabitants.

The second instrument used for the optimisation of spatial development is MULBO (multikriterielle Bewertung – und Optimierung)-Approach (multicriteria assessments and optimisation) was developed in recent years in Leipzig from a landscape ecological background with several examples mainly for the local scale but also for the regional scale. MULBO is based on different model types, which are used to analyse and assess the landscape goods and services (environmental, economic and social landscape functions) related to the chosen land uses. MULBO calculates an optimal compromise for future land uses including all landscape functional goals in an area of investigation. The major outcomes are maps and statistics as land use scenarios. The approach can be used for planning purposes as an open framework that at the moment integrates a large amount of ecological, economical and social spatial functions related to sustainability and planning. The spatial differentiation of the scenarios depends on the scale of input data and the selection of the related main functions. Up to now, several fundamental and applied projects have been carried out in intensively used agricultural and suburban landscapes. Recently a project was founded by the German Environmental Foundation (DBU) "IUMBO" (Integrative Umsetzung des multikriteriellen Bewertungs- und Optimierungsverfahrens), with the aim of developing an expert system for use in landscape planning on the basis of MULBO. The scenario results of MULBO are the basis for enhanced landscape structuring for increasing biodiversity and solving functional problems in the Querfurt-region in Saxony-Anhalt. The application is realised on the participatory work of farmers, planning authorities and scientists.

Optionally, the paper can explain the future scientific demands for the assessment and protection of goods and services related to the planning perspective in the domains of societal goals, data, assessment models (expert systems), optimisation models, application and public relations.

Multi-functional land use supported by agri-environmental measures

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For much of the 20th century, agriculture was viewed as a "primary industry" – the function of farmers was to produce food and fibre to feed and clothe the rapidly growing urban population, and minimal consideration was given to the environmental impact of agriculture. During the post-war years especially, issues of food security became a major driving force for agricultural policy in Europe (irrespective of political regime) and various political interventions led to agricultural activities being expanded to occupy greater areas of land, becoming more specialised (including the separation of crop and livestock production) and intensified with the greater use of capital technological inputs, including fertilisers and pesticides.

Since the early 1980s, however, there has been a major shift in Europe in the perception of agriculture and its relationship with the environment, the wider rural economy and society in general:

- firstly, it became obvious that the post-war "industrial" model of agriculture was responsible for causing significant (and often irreversible) environmental damage, and so various counter-measures were implemented in an attempt to reduce this environmental damage;
- secondly, an alternative perspective on agriculture began to emerge that viewed the farmer not only as a "primary producer" of food, but also as a provider (or potential provider) of a wide range of non-food goods and services, and
- thirdly, it has come to be understood that a) many of the non-food functions of agriculture are actually highly valued by society and cannot be produced by other economic sectors (the most obvious example of which are the unique landscapes and biodiversity associated with the many semi-natural habitats created by hundreds of years of traditional agricultural activity), and b) that farmers are not compensated for these non-food functions (in other words there is no "market" for them)

The challenge now is how to exploit this understanding of the "multi-functional" role of agriculture in clear and coherent policies that will support and encourage farmers in the delivery of real and measurable environmental goods and services that adequately meet the future demands of wider society.

The most promising policy instruments available to EU Member States are the so-called "agri-environment programmes", which are an obligatory component of EU rural development policy and offer farmers a positive financial incentive in the form of an annual compensatory payment (usually per hectare of agricultural land) to modify their patterns of land use and/or management practices to produce specific environmental benefits. Such programmes commonly consist of a range of measures and sub-measures with different objectives (e.g. nature conservation, landscape management, soil and water protection etc.), management requirements, geographical scope and payment rates.

The paper will examine the role of "agri-environment measures" in promoting multi-functional land-use by reviewing the existing literature and comparing the experiences, mainly of two contrasting EU Member States – Estonia and the United Kingdom. Specific reference will be made to:

- trends in policy development
- uptake and experiences in different member states
- positive impact of existing agri-environment measures
- the key characteristics of effective agri-environment measures
- relationship with other farm diversification activities, including agri-tourism and the processing and marketing of local and/or speciality food products

An ecosystem-based framework to link landscape structures, functions and services

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Landscape management should be based on clear analyses of the structural and functional aspects of a landscape's condition and on an evaluation of the potential services the area can provide. At present, the integration of ecosystem functional (ecological process based) components in landscape indicator sets has not been realized satisfactorily, and nor has the connection of ecological features with the aspects of ecosystem goods and services.
In this paper, we will demonstrate a theory-based approach that is capable of indicating the ecological states of landscape components on a holistic basis. The indicators have been derived on the base of the orientor approach, which is one actual branch of recent ecosystem theory. 8 focal indicators have been nominated, which can be quantified at the landscape level on the basis of GIS-based modelling. The indicators are aggregated from data on ecosystem structures and from the model-based budgets of energy, water and nutrients.
Some case studies are presented that refer to ecosystem comparisons, watershed budgets and wetland development in the Bornhöved Lakes District in Northern Germany. In a further case-study this information is accomplished by a set of simple socio-economic indicators. This example is based on landscape management scenarios in Northern Finland. Finally, the potential of the ecological information gained by that approach for the estimation of ecosystem goods and services is discussed.

Bukovské vrchy in the Slovak Carpathian Mountains – landscape changes and trends

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The Bukovské vrchy Mts. are located in the NE corner of Slovakia. The study area lies in the territory of Poloniny National Park, in the Slovak part of the Eastern Carpathian Biosphere Reserve. This area has a marginal position within Slovakia, and is in the periphery of economic interest. The region was colonized relatively late – the first villages were established at the end of the 14th century, during the co-called Wallachian colonization.

We studied the more recent history of land use changes – since 1950. The main functions of this region were identified. We can classify this region as a forestry-agricultural mountain landscape. Forests dominate in the region, and therefore the production of timber and other forest goods represents the main function of this landscape. This function is reinforcing – the proportion of forested area in the territory studied grew from 65% in 1949 to 85% in 2003.

The area is settled, and therefore the housing function is also important, even for the changes during the last 50 years. It is possible to detect a very similar trend in the majority of villages: a smooth increase in population until the late 60s or early 70s of the 20th century, and a continuous decrease after that point. Currently, the majority of villages exhibit the lowest number of inhabitants during the last 200 years. The largest village – Ulic – represents an exception, and there the decrease in population has not been so rapid.

The housing function was significantly influenced by the construction of the Starina water reservoir in the 1980s, which resulted in the evacuation of 7 villages and the establishment of a relatively large settlement-free area in the western part of the study area (creation of hygienic zones for protection of water sources). From this political decision, another important function in the region arose – water management. The management of the Starina water reservoir with its hygienic protection zones is focused on strict protection from the beginning, since it represents the main source of drinking water for East Slovakia. No human interventions influencing the reservoir's water quality have occurred in the territory.

In non-forest part of landscape, grasslands predominate, and arable land covers only a small portion of agricultural land. The total area of agricultural land has been continuously decreasing during the last 50 years, especially as remote grasslands and areas in displaced parts of the region are gradually abandoned. In the early 70s a new phenomenon appeared in this landscape – the formation of intensive grasslands. Their origin is connected with the so-called collectivization of agriculture and its intensification. Intensive grasslands persist to this day.

The function of nature conservation has been improved during the studied period. This can be documented by the growing number and area of protected areas, and the establishment of a Landscape Protected Area, and later a Biosphere Reserve and National Park. The main objects of protection are: native ecosystems, primeval forest, unique grassland communities with endemic East-Carpathian species and undisturbed landscape across the whole territory.

In addition, the recreational function of the landscape has become more important during recent decades, although facilities and services do not correspond with the region's potential.

As so many functions occur in the study area, more conflicts of interest can be seen through institutional involvement. Moreover, attitudes and conflicts are now seen in a new context now – Slovakia's membership in the European Union. These facts, together with the outlining of possible future trends and scenarios of land use and landscape development, are discussed in the paper.

The implementation of multifunctional land use - the management perspective

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When we consider multifunctional agriculture from the management perspective, it is appropriate to focus not only on the landscape functions but also on the demanded non-commodity outputs (NCOs).
Moving from the production of commodity outputs (COs) to the joint production of COs and NCOs involves changes in management practises. Management practises are actually designed to be CO-oriented. Following the societal demand for the implementation of multifunctional agriculture, it is necessary to examine how far the existing management practises are feasible to produce NCOs or how far they are multifunctionally sound (jointly CO/ NCO oriented).
Joint production has to be conscious production, considering the specific "yield potentials" of COs and NCOs at a specific natural site. Therefore, site-specific conditions (potentials) have to be known and integrated into the farmers' management decision-making process. For decision support systems, e.g. micro-economic models, we have to derive the demand for delivering feasible information on NCO-potentials (e.g. by trade functions).
Changes in farm management techniques are economically driven. In addition, economic pressure such as incentives can be identified as driving forces. Both are intensely affected by agricultural policies. Farmers respond to them by introducing changes in farm management, which can range from the abandonment of farms or production branches to changes in the intensity of single production methods. In each case, impacts on the production of COs and NCOs are to be expected.
Analysing changes in the production schemes shows that two main directions are followed:diversification and extensification.
The main impacts of extensification can be identified as structural changes (related to landscape level), whereas the impacts of extensification are mainly determined by the reduction of resource inputs, which result in environmental impacts being analysed at the farm level.
In the FP6 EU project MEA-Scope, an online accessible analytical tool for the impact assessment of multifunctional agriculture is developed by a hierarchical linking of three existing microeconomic models. The multi-scale modelling approach allows the assessment of structural changes and the resulting socio-economic and environmental impacts on farm and landscape level. The MEA-Scope analytical framework will be presented in its general outline.

LandInnovation – An expert network for innovative land uses in the countryside of Eastern Germany

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In the age of enlightenment, the Academies of Sciences and Humanities established a tradition of contributing expert knowledge for the improved use of natural resources. The interdisciplinary research group "LandInnovation" follows this tradition, even though the problems and approaches to solutions have changed considerably since that time. This network opens up the opportunity for representatives of the sciences, engineering technology, economics, law, and the social sciences to develop interdisciplinary suggestions for a future-oriented use of peripheral areas. The research groups involves 24 senior land use researchers from 19 universities, research institutions, and academies of sciences in Germany, Austria, Switzerland, and Poland.

The work of the group builds on an analysis of current uses of rural areas in the German northeastern lowlands. Comparisons to reference areas in other countries will be made. Scenarios for sustainable best-practice land-use including concrete suggestions for relevant stakeholders are to be elaborated. As both environmental conditions and societal demands on land uses in agricultural areas are changing rapidly, there are presently several important questions to be answered, for instance:

- to sustainably supply the population with clean water and high quality food
- to maintain cultural landscapes and secure biodiversity
- to explore the potentials for and consequences of breeding and spreading genetically engineered plants and animals
- to develop sustainable systems of energy supply
- to study aspects of regional sustainability
- to analyze the effects of increasingly globalized markets and their influence on rural regions

The overall aim of the research group is the development of a broad vision for future land use in the Berlin-Brandenburg area. Three important aspects of land-use will be assigned higher priority in the analysis: Aspects of plant production supported by genetic engineering, the question of regenerative energy supply systems and the use of renewable primary products and innovations in animal husbandry. The research pursues aims of science, science policy, and social policy.

A land suitability assessment method for developing a European Land Information System for Agriculture and Environment (ELISA)

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In response to the increasing need for information on the environmental and landscape impact of agricultural policies, the Soil and Waste unit of JRC-IES (2) is developing a European Land Information System for Agriculture and Environment (ELISA). The system will be built to allow for the ex-post analysis of the environmental impact of policy measures and for the ex-ante evaluation of the environmental effects of different policy scenarios in order to enable informed decisions on the implementation of policy options. It will be based on existing databases and tools and should evolve in close contact with both the scientific community and the potential customer DGs, in order to ensure a sound basis with a long-term vision and a system that is adequate to customer needs.

A major task within ELISA is the development of a methodology for the analysis of the environmental sensitivity and land suitability of reference units. A possible option for this analysis is the use of cross-evaluation methods that have been developed to measure complex systems. These methods are based on the mathematical analysis of experts' personal opinions.

After the implementation of such analysis, typical decision-making questions can be answered and recommendations can be made for the implementation of policy options. Typical questions to be answered will be:

Where are the areas to be protected and where are the areas where intensive or more extensive agriculture should be promoted?

Where are the areas with a need for changes in the current land-use systems in order to arrive at sustainable agriculture?

In the paper, we will first present the concept of the ELISA system and the underlying databases (agriculture related and environmental related), and then the theoretical background of the methodology for land suitability and environmental sensitivity assessment and the development of a cross-evaluation weighted method based on expert's opinions will be discussed.

[2] JRC-IES: European Commission - DG Joint Research Centre - Institute for Environment and Sustainability

Multifunctional use in mountainous areas: the Eisenwurzen area in the Austrian Alps

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Although Austria has never been a typical industrialized nation, some few and relatively small-sized industrial regions developed, such as the "Eisenwurzen" region with its iron industry at the Erzberg (Iron Mountain). The great structural changes and crises in Austria's industry had already taken place, and today the so-called "old industrialized regions" have been developed for the most part in (de)-industrialized regions. The Eisenwurzen region serves as an excellent example of a former wealthy and densely populated industrialized region which started all over again out of a history of several serious crises of decline to a new way of self-consciousness and economic development.

The Eisenwurzen region is located in a peripheral area in the middle of Austria. As a primarily alpine region with rich forest resources, the Eisenwurzen offers only few areas for settlement. Although the region belongs to three different provinces (Upper Austria, Lower Austria, and Styria), a corporate economic area has developed which supplied not only Austria but also parts of the neighbouring countries. At present the region is promoted by the European Union with funds for regional development and is on the way to establishing a new economical orientation in strengthening soft tourism.

With several research activities within the region, the Eisenwurzen acts as a Multi Functional Research Platform (MFRP). A virgin forest, two national parks, a biological station, an agricultural test site and a monitoring station for air pollution provide environmental data for air and water quality, biodiversity, land-use and waste. Furthermore, social information like population density or unemployment rate as well as economic data like touristic development or energy consumption are also available.

The management of biodiversity in agricultural landscapes

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Long-term studies of the ecological effects of intensive agriculture carried out since the 1970s in the Turew landscape by the Research Center for Agricultural and Forest Environment in Poznan, Poland, have shown that the state of living resources preserved in rural areas depends strongly on landscape structure. Greater patchiness resulting from the presence of both cultivated fields and natural or seminatural ecosystems creates favourable conditions for the survival of local wild plant and animal populations, enabling their persistence in rural areas. Shelterbelts, stretches of meadows, small mid-field water reservoirs or wetlands provide good shelter for many organisms. Thus, for example, in the Turew agricultural landscape, more then 800 species of vascular plants and about 600 species of fungi were detected. As much as 60-100% of animal taxa represented in the regional fauna have been detected. Thus, for example, about 50 species were found in *Nematoda*, 25 in *Enchytracidae*, about 700 in *Coleoptera*, *Heteroptera* 130, *Homoptera* 145 and *Apoidaea* 258. High biodiversity was also found in the other taxa. Among vertebrates, 12 species of *Amphibia*, 86 species of breeding birds and 48 mammal species were found. The abundance of refuge sites in the Turew landscape enables the existence of big mammals such as the wild boar, badger, roe deer as well as rare nesting birds such as the raven, little owl, great grey shrake, crane and numerous water birds.
Continuous monitoring of the above-ground (epigeic) insect community in the Turew landscape since 1984 has shown substantial changes in its composition. E.g. the increase in *Coleoptera*, the appearance of new pests for crops as well as the leveling of insect abundance in perennial and annual crops were observed. These changes are correlated with alterations in crop structure pattern, climatic changes and others). Despite those changes, however, the biological diversity of the insect community is high. For 11 years, studies have been performed on the effects of introduced shelterbelts on succession of plant communities and invertebrates and vertebrates communities. Some groups colonize newly planted shelterbelts very rapidly, and the influences of plant succession on animals can be clearly recognized. All of those findings have an important bearing on the strategy of living resources protection in rural areas, showing that the optimization of agricultural production with biodiversity protection could be achieved through landscape structuring in refuge sites.

Health-supporting landscapes

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There has been a rapid increase in knowledge regarding the importance of the external environment on our health, even among the broader sections of the population. The external environment has therefore become an increasingly decisive factor in the choices made by people regarding where to live and work. This has meant that the landscape has become a competitive factor in the attempts made by companies and local authorities to attract well-educated, mobile manpower and housing.
Eight characteristics of outdoor environmental qualities corresponding to significant human demands have been created at the Department of Landscape Planning in Alnarp (Grahn et al). Development plans for city planning and infrastructure planning in four different municipalities in southern Sweden have been evaluated through impact assessment and mitigation, and compensation measures are being created to achieve the environmental quality goals. This is a contribution to the development of methodology for impact assessments focusing on the landscape as a resource for health and development.

Assessment, management and reclamation of post industrial landscapes : Silesia case study

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The degradation of landscapes in post-industrial regions such as Silesia, Poland requires a spatial assessment of pollution sources and their impact on the surrounding environment. Theoretically, the structure and diversity of landscapes may significantly influence the dispersion of pollutants in soils and waters. The proper management of contaminated sites at the regional scale should be based on an objective prioritization of reclamation tasks reflecting environmental and human health risks. Scattered nature and the long-term character of contaminated sites, as well as the absence of a complete inventory, limit our ability to develop an efficient management strategy for the reclamation of contaminated sites. The use of multi-spectral satellite imagery was tested in order to identify metal and coal waste contaminated sites in the Silesian region and to generate simple landscape indicators reflecting the spatial scale and magnitude of existing anthropogenic pressures. Landscape diversity is analyzed in the context of contamination level as well as in terms of potential buffering capacity reducing the risk of contaminants' movement in terrestrial ecosystems.
Simple and low-cost revegetation technologies that have the potential to reduce environmental risks related to metal movement within affected catchments are demonstrated.
The approach discussed in this paper may be proposed as a protocol for a risk assessment and regional policy decisions regarding the management of postindustrial landscapes.

Towards an institutional theory of multifunctionality

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This contribution focuses on the theory of multifunctional agriculture. It gives an overview of the existing interpretations of the ”multifunctionality of agriculture” and presents an extended framework which distinguishes the technical and institutional connectedness of the production of commodities and non-commodities. The internal incompatibilities of the current concept of multifunctionality are discussed. The multifunctionality approach is reconsidered from an institutional point of view, particularly by comparing the different impact of integrating and segregating institutions on joint production. The Framework of ”Institutions of Sustainability” (IoS) is outlined as a tool to analyse and design integrating institutions and governance structures for the agri-environmental relationship. In this context the question whether the Institutional Analysis and Development Approach (IAD) could serve as a model for the further development of the IoS Framework is discussed.

Multi-agent systems for the simulation of multiple functions in the rural countryside: a case-study for Winterswijk, the Netherlands

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The rural countryside in Europe has many functions encapsulated by the term multifunctionality. Although its main function is the production of food and other primary goods, the rural countryside also provides the available space for many human activities, and it contributes to human well-being by providing opportunities for cultural, intellectual and spiritual inspiration. Moreover, the rural countryside has the capacity to supply essential ecological processes and services that contribute to the maintenance of a healthy environment.

Whereas for many locations, multi-purpose land use is becoming increasingly important, land users and policy makers must nevertheless make choices between different, and usually competing, land uses. Due to the various functions of the rural countryside and the multiple actors involved, land use allocation problems are complex planning problems. In other words, spatial planning and the allocation of land use involve multi-actor decision-making. Examples of actors are farmers, environmentalists, tourists and inhabitants. One promising approach to include the decision-making architecture of the key actors in an area is the integration of multi-agent systems into land use change models. Multi-agent systems consist of a set of agents that interact in a shared environment. These agents are able to adapt themselves to the evolving interactions and are also capable of modifying their environment.

Another complicating aspect of land use in the rural countryside is the complex interaction between ecological processes and economic activities. It is therefore widely recognised that modelling land use and land cover change should satisfy certain ecological and economic criteria. So far, however, integrated land use models that allow for a coherent integration of a landscape's ecological and socio-economic components of the multifunctional land use and that explicitly take into account the multi-agent planning process have not, to the best of our knowledge, been pursued. Our study tries to fill this gap in the literature.

We approach our task by introducing a spatially explicit, multi-scale model that is based on an integrated analysis of socio-economic and biophysical factors. This model – the so-called CLUE-S model (the Conversion of Land Use and its Effects at the Small regional extent) – makes it possible to simulate multiple land use functions simultaneously. Moreover, the model is perfectly suited to coupling with multi-agent systems, which consist of autonomous decision-making entities (agents) and rules that define the relationship between agents and their environment.

Coupling a multi-agent system to the CLUE-S model offers a promising means of representing multi-actor decision-making. CLUE-S can be defined as a hybrid model that combines biogeophysical and ecological aspects with human decision-making (i.e. by including agent-based or multi-agent systems). We see the multi-agent system approach of land use change as an innovative step towards the modelling of multiple functions in the rural countryside. In this study, it combines a cellular landscape model with agent-based representations of decision-making, integrating the two components through the specification of socio-economic and ecological interdependencies and insights. We apply our integrated CLUE-S model to a case-study area in the Netherlands, namely Winterswijk and surrounding municipalities.

Marginalisation of rural areas: what is it and should we really be concerned?

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The marginalisation of rural areas in Europe is increasingly considered to be a problem, yet only very few studies have been done that actually indicate how serious the problem is. Simply defining the term marginalisation often proves to be a difficult exercise. This paper disentangles the concept of marginalisation by focussing on both the biophysical and socio-economic aspects. A distinction is made between the marginalisation of agriculture and the marginalisation of land use. We draw information from a cross-country study in Europe including Austria, Estonia, Hungary, Norway, Finland, the Czech Republic, Spain and Portugal. Using examples from a few selected countries, we will indicate how serious the problem is. The figure below shows the steps that we followed during the study.

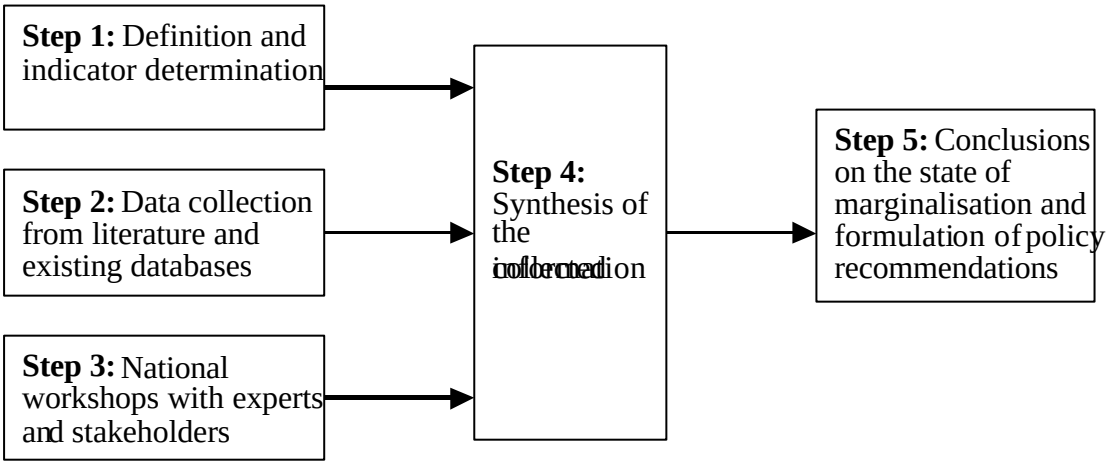

Figure 1: The steps that were taken to provide a better understanding of the marginalisation of land use in the participating countries.

The study shows that in many areas of Europe, marginalisation is a problem that requires serious attention and tailor-made policies. Initial results show that while in some countries marginalisation may not be a major problem at present, vulnerability to socio-economic and biophysical marginalisation is a considerable risk. The study also shows the sensitivity of many rural areas in Europe to changes in the political setting.

The concept of landscape multifunctionality: Land use as interface between multifunctional agriculture and multifunctional landscapes

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In contemporary sciences dealing with cultural landscapes, multifunctionality is used to characterize both the primary production sector (agriculture and forestry) and the landscape *per se*. Though the two share many characteristics, there are notable differences between the two entries to the concept of multifunctionality. There is a need for clarification of the divergence and convergence of the concepts in relation to agriculture and landscapes respectively.

Multifunctionality in relation to agriculture has been an issue in the negotiations on international trade agreements, and has been treated in detail by the OECD (Anon 2001). There is a general consensus that multifunctionality is both a neutral characteristic of agriculture (joint production), but also that multifunctionality as a normative concept is useful in valuing outputs other than agricultural goods (landscapes, jobs, rural population, wildlife). On the other hand, multifunctionality is regarded as a bad excuse for the subsidence of agriculture in the "old world".

Multifunctionality in relation to landscapes follows a more ambiguous path. In essence, all landscapes are by definition multifunctional (e.g. Forman and Godron 1985). In the 1990s, increased focus was placed on the multifunctional character of landscape, not least because many environmental problems of the countryside were related to the segregation of functions and the eradication of other functions than production from the land areas (Brandt & Vejre 2004). There is no general consensus as to the terms function and multifunction of landscapes. In contrast to the agricultural entry, however, functions are normally rated equal in landscapes.

Agriculture and landscapes obviously have much in common, and multifunctionality in relation to the two are often used arbitrarily. One of the prime joint products of agriculture is open landscapes, and among the several functions of landscapes, agricultural production is often a major function. The two systems share a common denominator – land use. Land use is the spatial-related activity of farming, and land use is one of several categories of landscape functions.

The significance of both multifunctional agriculture and landscapes is strongly related to the management of both. In the post-modern world, there is much focus on the externalities produced by agriculture, and in densely populated countries or regions, there is an urgent need to combine different functions in the same territorial units - landscapes. That is, management for multifunctional land use in multifunctional landscapes. In order to target the management specifically, the concepts of territorial and spatial competences may be useful (Hägerstrand 1995). The territorial competence exerted by the single land owner is significant in addressing management that may be dealt with most efficient by the individual. However, in scales encompassing more than one land owner, the authorities must exert spatial competence through legislation, plans or subvention.

The materialization of intangible transcending landscape functions - the role of spatial and territorial competences

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From a landscape ecological point of view, the sustainability of landscapes should be judged according to the joint effects of material processes pertaining to the combined functions of the landscape. Ecosystem services are related to material processes such as ion exchange by soils, habitat requirements for flora and fauna, etc. Land use functions are likewise related to ecosystem processes such as photosynthesis, nutrient cycling, water fluxes etc. A significant part of the commonly accepted landscape functions are not, however, related to material processes. Landscape functions such as aesthetics, cultural history or spiritual meaning are intangible and usually require a relation to a specific cultural context to be perceived. In addition, visions, ideas and plans collectively referred to as symbolic transactions that are superimposed to landscapes constitute intangible functions. Though not tangible in the landscape, these symbolic transactions (e.g. designations, zonations, property delineations) certainly add functions to the landscape. Such perceived or designated functions are denoted as transcending functions. In order for transcending functions to be materialized, action must be taken by actors with the ability to regulate processes in the concrete landscape (actors with territorial competence (Hägerstrand 1995)). This paper analyses the means by which transcending functions are materialized by the conversion of symbolic transactions to material land use or land service functions in the landscape. This conversion is analysed within the theoretical framework of Brandt & Vejre (2004) and Hägerstrand (1995) in four case areas on the urban fringe of Copenhagen. In Søllerød Nature Park, restrictions based on the Nature Protection Act of 1937 were imposed on designated land areas, and later territorial competence was acquired by public land acquisitions. In Vestskoven, territorial competence has been acquired by the Government by land acquisitions within a designated area from 1967. In both cases, the land use differs strongly between the designated areas and the adjacent urban areas, and neighbouring areas are urbanized in contrast to the forested or open countryside landscapes within the designation. In Hjortespring green belt, a designation from 1947 has largely failed, because of a lack of conscious gain of territorial competence by the authorities. The proposed green belt has been fragmented by urbanization. The Gundsø case illustrates the contemporary problem – the front of urban sprawl is about to enter this area. It is concluded that the materialization of intangible transcending functions is possible if the symbolic transactions are followed by the careful acquisition of territorial competence. This acquisition may follow many scenarios depending on the relative role and kinds of land ownership and means of regulation. It is discussed whether the acquisition of a protected countryside in the urban fringe requires spatial competence. The three first cases illustrate the implementation of the Copenhagen finger plan, the containment of urban sprawl in the post-war era by simple legal and planning tools. The last case illustrates the present situation – the potential post-industrial urbanization zone that will be subject to urban pressure in the next decade. It is discussed how territorial and spatial competences are distributed in a neo-liberal phase, with emphasis on voluntary solutions and decentralization, and how open space can be preserved in the context of urban sprawl.

Optimization methodology for land use patterns

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Spatial landscape modelling has been recognized as an important tool to link change in landscape patterns and organization with the ecological conditions in rivers and estuaries. We have built a spatially-explicit landscape model to estimate the impact of economic growth on environmental conditions in Hunting Creek watershed, a small sub-watershed in the Chesapeake Bay catchment area. The model takes into account information about economic indicators (such as land use patterns, the amount of nutrient pollution from various sources, etc.), the physical characteristics of the area (elevation, soil types, etc.) and biological characteristics (habitat types, vegetation types, etc.). We focused on nitrogen as an indicator of environmental quality and were comparing the concentration of nitrogen in the estuary zone of Hunting Creek under a variety of scenarios. The model was further used to find optimal strategies of fertilizer application and crop allocation within the watershed. It was shown that the spatial distribution of development is an important factor for water quality in the estuary.

We have used a scaling parameter λ to describe both monetary (profits from agricultural production) and non-monetary values (concentration of nutrients in the watershed outlet), within the same objective function. The optimization algorithms developed were used to identify the most efficient spatial patterns for agricultural land use under different assumptions and goal functions. Clearly the result depends on the value of λ that we choose. For small λ's the importance of environmental conditions is considered low and we get watersheds almost entirely in agricultural use with the crop that produces the most revenue (soy beans in our case) predominating. As λ grows, the importance of forests in the landscape increases, and the more forests the "optimal" land use allocation will generate. The river buffers (~200 m) appeared as the areas that have the most effect on water quality.

The framework proves that optimization is feasible even for complex spatial landscape models. Moreover, it offers promise in understanding and predicting such complicated processes as land use change. Our preliminary studies have shown that for a certain λ, the optimal land use allocation is very close to the existing land use pattern in the watershed. This gives us an indirect way to estimate the existing value that humans associate (perhaps indirectly) with the ecosystem service (or a combination of them) that we include in the objective function. λ in this case can be thought of as a "shadow price," or an estimate of how humans currently value various services that are implicitly taken into account when making decisions about land use change. This also tells us that if we can guess the "right" objective function, the optimal land use patterns may be close to reality, giving us a better understanding of possible future land use allocations and the driving mechanisms that control them.

Spatially-explicit land use modelling as the basis for multifunctional land use evaluation

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The term "multifunctionality" is at the centre of the political and public discussion accompanying the increasing interest in protecting landscapes. It covers not only economic and ecological, but also cultural and social aspects (Council of Europe, 2000). This necessitates an interdisciplinary modelling approach to cover and evaluate the multiple landscape functions. The key component of such an evaluative framework must be a land use model, as changes in land use distribution have a strong influence on landscape functions (Lambin et al., 2000).

A significant factor in land use decisions is the Common Agricultural Policy (CAP) of the EU. In June 2003 the EU ministers of agriculture adopted a fundamental reform of the CAP. A key element of this reform is the de-coupling of transfer payments from production. The effects on individual farm operations have been widely discussed, while the associated land use changes on a regional level find little attention. However, the public discussion on the multifunctionality of landscapes should incorporate the CAP reform, as it will alter landscape functions and their values.

Assessments of multifunctionality also require models of biodiversity and hydrology, which depend on spatially-explicit information. Thus, a spatial land use prediction considering economic, political and natural conditions is essential (Bockstael, 1996).

The article elaborates the concept of the ProLand land use model (Prognosis of Land Use, Kuhlmann et al., 2002), and presents simulation results for the current CAP (Agenda 2000) and the reformed CAP as outlined for 2013.

The ProLand model is a comparative, static model that generates spatially-explicit maps of land use distributions under various socio-economic and political conditions. It takes into account site-specific natural conditions (e.g. soil type, slope, temperature, precipitation) and, as an economic model, also estimates indicators (production volumes, input factor volumes, labour requirements, value added, etc.) describing the region's economic performance. Estimated changes in the spatial distribution of land use systems in Germany attributable to the CAP reform, and major changes in economic indicators will be pointed out.