Modelling the influence of land use and land cover change on ecosystem services

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One of the main challenges in monitoring, modeling and communicating land change is the relation between land cover, land use and the provision of goods and services by the land system (ecosystem services or landscape functions). The capacities of the land system to provide goods and services are often referred to as landscape functions (Verburg et al., 2009b). Many studies have assessed the consequences of land use and land cover change on different socio-economic and environmental conditions as a post-analysis or impact assessment, e.g. by a series of indicators (Schröter et al., 2005; Helming et al., 2008). However, in reality the functionality of the land is intricately linked to the characteristics of the land system. A change in the provision of goods and services by the land is often not just a result of land cover change but an important driving factor of future land cover dynamics as well. The Millennium Ecosystem Assessment has requested specific attention for the way in which land cover change and ecosystem functioning are linked. Such assessments are difficult because there is no one-to-one relation between land cover and functionality. Functionality is often determined by both local and contextual factors synchronously. In addition, landscape function may not be observed and monitored by standard techniques used in land cover observation. In many cases landscape function may drastically change without any change in land cover and vice versa. Attempts to quantify landscape functions based on land cover information are often limited since land cover is not always a good indicator for the actual functions performed by the land at that location (Willemen et al., 2008). Therefore, impact assessments based on current monitoring and modeling techniques are often limited to landscape functions that can be quantified based on the land cover (change) map.

This presentation aims at providing an overview of the state of the art in methods and models for assessing land use and land cover change in relation to landscape functions. Methods include:

-top-down, spatially explicit land change models linking global dynamics to regional level impact on land use followed by an assessment of impacts on landscape functions (Kienast et al., 2009; Verburg et al., 2008).

-agent-based simulations of local decision making leading to changes in landscape composition and structure (Valbuena et al., ; Valbuena et al., 2008)

-regional scale methods to map and model landscape function response to policy and planning (Willemen et al.).

Each of the methods has its own range of typical applications, data needs and potential outcomes. The choice of method is largely dependent on the scale of analysis and dominant processes of land change.

Based on assessments and models of land change and landscape functions hot-spots of changes in landscape functions can be identified. Such hot-spots analysis may be used to target interventions and more detailed assessments. At the same time, it is not the change in single landscape functions at a specific location but rather the trade-off between functions as result of these changes that is of importance. The costs of increasing production at a location may be large in terms of a range of other functions at the location itself or in other areas as result of teleconnections. Therefore, tradeoff analysis tools to analyze the effects on multiple functions need to be used, both on-site and off-site. The quantification of land use change impacts on landscape functions is not straightforward and different methods are used depending on the scale of analysis and available data.

In order to be able to target policies to make best use of regional potentials of landscape functions methods are proposed that quantify the region-specific potentials of the landscape to support different landscape functions. The identification and simulation of the potentials of a location to provide landscape functions provides an additional layer of information complementary to the assessment of actual landscape functions and their change. At local level participatory scenarios may be used to identify the local potentials by confronting stakeholders with possible scenarios and visualisations (van Berkel et al., in prep). At larger scales simulation methods and indicator assessments are needed to quantify these potentials. Most critical is the assessment of pathways towards better using these potentials. Therefore, confronting explorative scenarios with visions on regional potentials may help to identify the region specific assets and constraints towards moving into sustainable development pathways.

Literature

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