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Multi-functional landscape evaluation and multicriteria optimization of land use for the catchment area management

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The procedure presented contributes to solving the land use decision problem, which is necessary for river catchment management. Methods for the derivation of ecological targets, the assessment of environmental functions, scenario technologies, and integrative procedures for decision support are combined for this approach.

The main objective of the project „Analogy of methods of the decision making of function-related goals of the landscape evolution in heterogeneous spatial units" carried out by the Saxon Academy of Sciences and the Centre for Environmental Research (UFZ) is the formulation of ecological targets for areas on the meso-scale. Meso-scale areas form the spatial basis of the project. They relate to natural units (micro-geochores) and landscape units of lower order which are determined by land use. Micro-geochores are natural units of lower order assembled within altitudinal belts according to petromorphic parameters (substrate, relief, hydromorphy) (Sandner 2002). Landscape units are classified according to land use (Krönert 1999). Data availability differs for the two types of reference areas. A data base containing a wide range of aggregated data for Saxony is available for micro-geochores. Whereas, different public digital data sets are used for the assessment of landscape units.

The method to elaborate ecological targets, called "Leitbildmethode Westlausitz" (Bastian 1999, 2002) (Figure 1), was linked with the method of "Multicriteria Optimization of Land Use" (LNOPT by Grabaum 1996, Grabaum et al. 1999, Meyer und Grabaum 2003) in a study area. The size of this area, situated in the south-east of Leipzig, is almost equivalent to the catchment area of the river Parthe.

Apart from the hydrological functions such as water retention capacity, ground water recharge, and ground water protection, the multifunctional assessment of landscapes also includes the potential biotic yield, the habitat function, the resistance to soil erosion and the function of recreation. Based on evaluations, an interference analysis and the determination of actual and potential risk areas of landscape functions and landscape components will be continued. In the course of the identification of mono-sectoral goals, the achievement of targets or differences between state and goal for current and future decisions of land use are shown. A balanced landscape-ecological concept for conservation and development contains both the combination of function-related aims for integrated comprehensive complex targets and recommendations to reduce differences between targets and state. By means of a decision tree the multicriteria optimization program LNOPT will compile land use scenarios for the conflict area.

This optimization represents the ideal compromise between different land use options for the whole catchment area while enhancing the capacity for the natural balance at low "social expenses". A heterogeneous mosaic of land use would meet these requirements. In a final step areas with identical or similar landscape-ecological problems/goals will be classified.
The method described offers the possibility to outline conflicts between environmental goals and actual states in a quantitative and qualitative way. For the management of catchment areas results are presented as GIS-based scenarios. Thereby aims for land use decisions can be integrated. This methodology can be very helpful for policy consulting and some planning instruments.

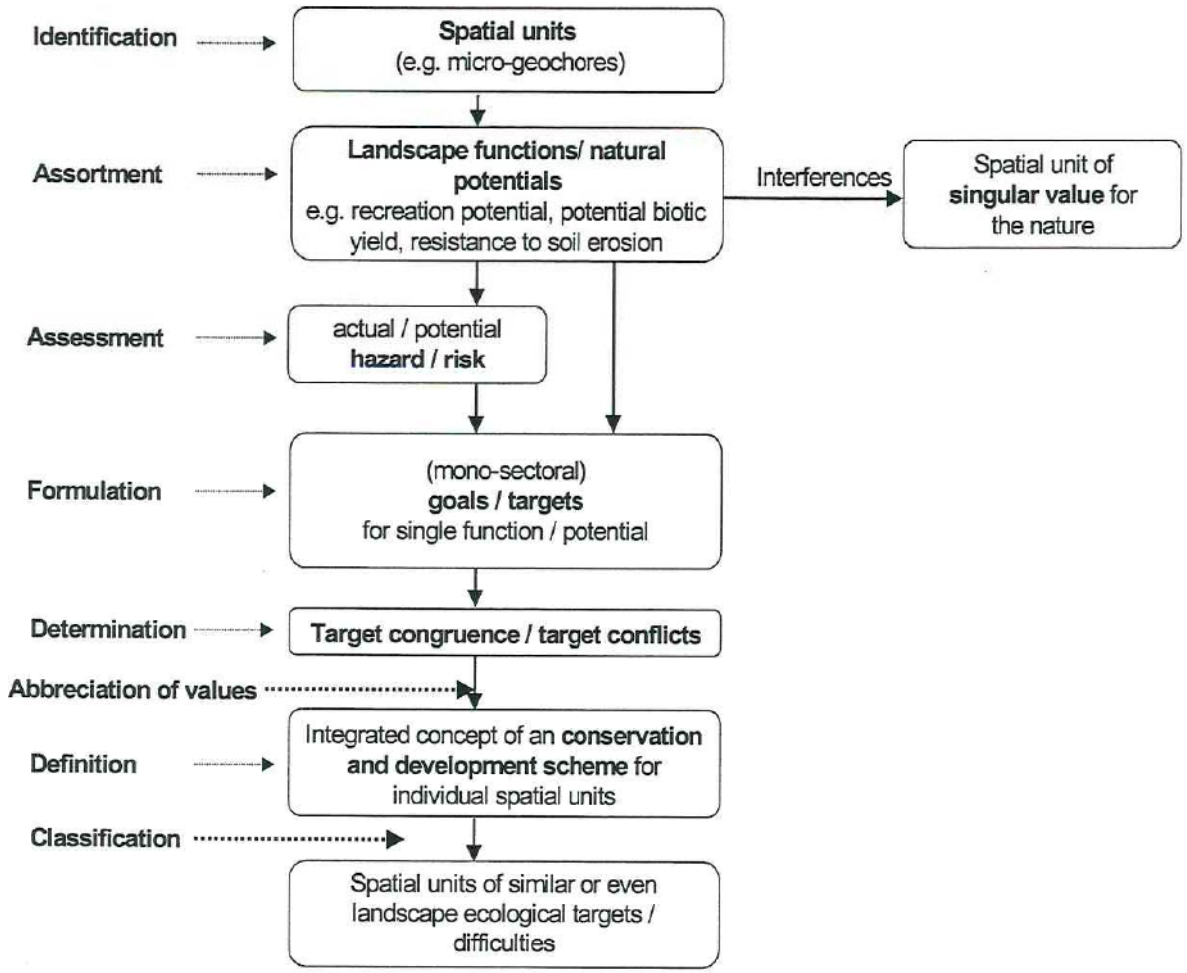

Figure 1: Algorithm to elaborate ecological targets (Leitbildentwicklung) for spatial units (Bastian 1999, changed)

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