

# **Integrating Ecosystem Services in Landscape Planning: Options, Implications, and Recommendations**

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## **Abstract**

Although landscape planning in Europe is well positioned to successfully support decision-making concerning sustainable landscape development, its planning proposals often experience substantial implementation deficits. The concept of ecosystem services could arguably contribute to bridging this knowledge-to-action gap. This cumulative habilitation thesis aims at both exploring potential implications of and deriving recommendations for integrating the ecosystem services concept in landscape planning. The thesis focusses on landscape planning in a European context, and uses the German system as a case study. The research design consist of developing an analytical framework that identifies landscape planning domains in which integrating the ecosystem services could yield changes, and synthesizing insights from 13 journal articles that together comprise this thesis. One of the results of the thesis is that integrating the ecosystem services concept can yield changes in all landscape planning domains considered, but the degree of incurred changes will depend on the specific planning context and instrument considered, as well as the actual definition, framing and application of the ecosystem services concept applied. Theories in landscape planning can change through the introduction of new terms and statements. Changes in the theories of planning may include stronger emphasizing transdisciplinarity and values of ecosystem services as derived from citizen and actor consultation as bases for reasoning planning proposals. Different options and respective implications exist for integrating the ecosystem services concept in landscape planning methods for assessment, target development and the proposition of implementation measures. Planning outcomes may be altered as well, both in terms of the kinds of information generated and the changes induced in the knowledge and relationships of participating actors. The thesis concludes with recommendations for further research, for practical experimentation, and remarks for ways forward in Germany.

## **Zusammenfassung**

Landschaftsplanung in Europa besitzt ein großes Potenzial, Entscheidungen bezüglich einer nachhaltigen Landschaftsentwicklung erfolgreich zu unterstützen. Trotzdem bestehen oft erhebliche Defizite in der Umsetzung von Planungsvorschlägen. Das Konzept der Ökosystemleistungen könnte wichtige Beiträge leisten, um diese Lücke zwischen Wissen und Umsetzung zu überbrücken. Ziel dieser kumulativen Habilitation ist es, mögliche Implikationen einer Integration des Ökosystemleistungskonzepts in die Landschaftsplanung zu erörtern und Empfehlungen abzuleiten. Die Habilitation bezieht sich auf Landschaftsplanung in Europa und nutzt das deutsche Planungssystem als Fallstudie. Das Forschungsdesign besteht darin, einen Analyserahmen zu thematischen Bereichen der Landschaftsplanung zu entwickeln und die 13 Zeitschriftenartikel dieser Habilitation dahingehend auszuwerten,

inwieweit eine Integration des Ökosystemleistungskonzepts Veränderungen in diesen Bereichen induzieren kann. Ein Ergebnis der Habilitation besteht in der Erkenntnis, dass eine Integration des Ökosystemleistungskonzepts Veränderungen in allen betrachteten Bereichen der Landschaftsplanung bewirken kann, das Ausmaß dieser Veränderungen jedoch von dem spezifischen Planungskontext und -instrument, der verwendeten Definition, der Rahmensetzung und der Art der Anwendung des Ökosystemleistungskonzepts abhängt. Theorien in der Planung könnten sich durch die Einführung neuer Begriffe und Aussagen verändern. Mögliche Änderungen von Theorien der Planung bestehen beispielsweise hinsichtlich einer stärkeren Betonung von Transdisziplinarität und der Berücksichtigung von Wertzuschreibungen für Ökosystemleistungen durch Bürgerinnen und Bürger als Begründung von Planungsvorschlägen. Eine Integration des Ökosystemleistungskonzepts kann Veränderungen der Methoden zur Erfassung und Bewertung sowie zur Entwicklung von Zielen und Maßnahmen bedeuten. Die Ergebnisse von Planungen können sich sowohl im Hinblick auf die produzierten Inhalte als auch auf im Planungsprozess entstehendes Wissen und die Beziehungen beteiligter Akteure verändern. Die Habilitation schließt mit Empfehlungen für weitere Forschungen und praktische Erprobungen sowie mit Hinweisen für nächste Schritte in Deutschland.

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# 1 Introduction

## 1.1 Aim and objectives

In many European landscapes, halting the loss of biodiversity and safeguarding or enhancing the delivery of essential ecosystem services upon which humanity depends remain key societal challenges (European Commission 2011; Maes et al. 2012). Some examples from Germany illustrate the diversity of challenges. For example, around 70 hectares of land are still converted in Germany each day for settlement and infrastructure development, leading to substantial decreased in agricultural areas and grasslands. Species diversity and landscape quality still decreases despite ambitious targets and continues monitoring. The loss of moorlands causes substantial emissions of greenhouse gases (GHG) and around 90% of German rivers and lakes do not yet reach the EU Water Framework Directive's target of a good ecological status (Bundesministerium für Umwelt, Naturschutz 2015; Albert et al. 2017a).

Landscape planning, understood as a “strong forward-looking action to enhance, restore or create landscapes” (European Landscape Convention, Article 1, Council of Europe 2000), arguably has much potential to address this challenge and to provide relevant information and decision-support to navigate landscape development towards more sustainable pathways. In Germany, landscape planning is institutionalized in the Federal Nature Conservation Act (BNatSchG) and charged with the task of spatially concretizing nature conservation objectives, including the development of concepts for implementation. Three key tasks of landscape planning have been identified (von Haaren et al. 2008): (i) Providing a basis for governance, (ii) delivering information to facilitate participation and enhance environmental awareness, and (iii) contributing to the valorization of nature and landscape. Despite of the well-established system of landscape planning at various spatial scales, substantial implementation deficits remain as reflected in the above introduced challenges.

A potentially particularly useful concept for enhancing the uptake and effectiveness of landscape planning is ecosystem services. The ecosystem services concept has been put forward in the late 1990s and early 2000s as a new approach to assess and communicate the benefits of nature and landscape for people. Definitions of ecosystem services are legion, including ‘the benefits people obtain from ecosystems’ (MA 2005), ‘the direct and indirect contributions of ecosystems to human well-being’ (TEEB 2010). More recently, the Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES) has adopted the concept of Nature's Benefits to People (NPB) referring to all benefits that humanity obtains from nature (Díaz et al. 2015). After initial application at global and national levels, for example by the Millennium Ecosystem Assessment project (MA 2005), the ecosys-

tem services concept found increasing interest among landscape planners interested in exploiting its potential power to better assess, evaluate and communicate the significance of nature and landscape for and to people. It was hoped that integrating ecosystem services in landscape planning could enhance the uptake and implementation support among decision-makers and the public (de Groot et al. 2010; von Haaren and Albert 2011; Goodstadt et al. 2012; Grünwald and Wende 2013). Despite much research and increasing knowledge on ecosystem services in general, it became apparent early on that substantial challenges need to be address in efforts for implementing ecosystem services in planning and management (de Groot et al. 2010).

Against this background, the aim of this habilitation thesis was to explore implications and recommendations of integrating of the ecosystem services concept in landscape planning. More specifically, the habilitation addressed two main objectives:

1. to investigate options and implications for landscape planning theory, methods and impacts that might result from an integration of the concept of ecosystem services, and
2. to derive recommendations for further research and practical application.

The thesis is cumulative and consists of several papers. Most papers use the system of landscape planning in Germany as a reference. The synthesis findings and recommendations are thus of particular relevance for Germany and other European countries with similar, well-developed planning systems.

## **1.2 Research design and method**

The research design of this thesis consists of developing an analytical framework, and synthesizing insights from 13 articles published in international journals that together comprise this thesis. The author served as first author in eight of the papers, and as co-author in the other five contributions. An overview of the papers is provided in chapter 2. Each of the papers relates to one or both of the main objectives listed above.

The analytical framework (fig. 1) was developed to guide the synthesis of findings and recommendations across the research questions and papers. The framework identifies two main components of the synthesis conducted in this habilitation: The first component addresses the assessment of potential changes in three landscape planning domains that might result from an integration of the ecosystem services concept. The three domains considered are 'landscape planning theory', 'methods' and 'impacts'. The second component looks across all contributions to derive some cross-cutting recommendations for further research and practical application. In the synthesis part of this thesis, insights from the reviewed papers are brought together to characterize options and potential implications from integrating the ecosystem services concept in the three landscape planning domains, and to



deliver cross-cutting recommendations. The synthesis considers only potential changes induced to the terms and statements of landscape planning, as it is not yet possible at this early stage of research to identify a common set of statements around ecosystem services in landscape planning that would form a coherent context of even theory.

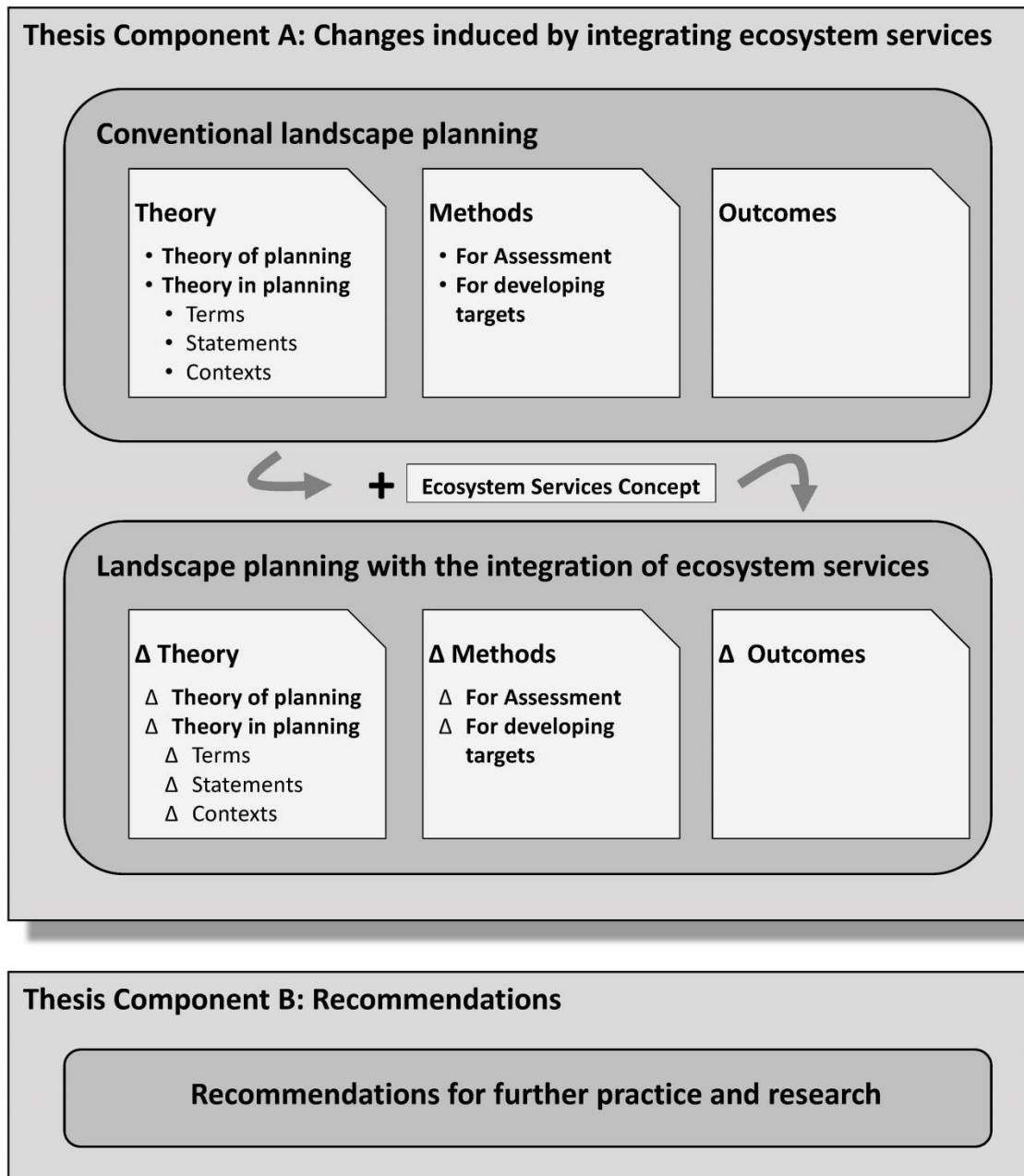


Figure 1: Research design

Several terms used in the analytical framework above require definitions and characterization which is provided in chapter two. The characterization refers to conventional landscape planning, i.e. without an integration of the ecosystem services concept. At the same time, this characterization of conventional landscape planning serves as the comparison standard against which potential changes

induced by integrating the ecosystem services concept are subsequently identified and evaluated. The remainder of the habilitation thesis consists of an overview of the papers included in the analysis (chapter 2) and a synthesis chapter summarizing the key insights (chapter 4).

## **2 Characterizing landscape planning and ecosystem services**

### **2.1 Definitions and objectives of landscape planning**

Landscape planning can be defined in various ways. According to the broad definition of the European Landscape Convention, landscape planning can be understood as “a strong forward-looking action to enhance, restore or create landscapes” (Council of Europe 2000). In a more narrow sense for the context of Germany, landscape planning is charged by the German Federal Nature Conservation Act (BNatSchG, 2010) with the tasks of specifying and spatially concretizing the purposes or targets of nature conservation and landscape management, and identifying appropriate approaches and measures for achieving those purposes.

In general, landscape planning can provide useful information for considering of environmental objectives in spatial decision-making (von Haaren 2004; von Haaren and Albert 2011). Furthermore, landscape planning can be supportive in facilitating participatory plan and decision making due to their function as an interface between science and practical implementation (Nassauer and Opdam 2008).

### **2.2 Landscape planning theory**

Spatial and landscape planning theory has the task of systematically explaining and thereby supporting planning actions. In the German context, two major fields of planning theory can be distinguished as outlined by Schönwandt & Jung (2005): The first field, ‘theories in planning’, concerns the technical and content-related planning issues, but not the process of planning. According to Schönwandt & Jung (2005), theories in planning refer to what is being assessed or planned. Examples of such content are habitats for species or areas of importance for ground water formation. Theories in planning deal with particular descriptions of reality, so-called constructs. These constructs include ‘terms’ such as landscape functions, ‘statements’ such as “Landscape functions fulfill societal needs” and ‘contexts’ as the totality of statements in one thematic domain. Theories then consist of and emerge from these constructs in cases where relevant statements in one thematic domain reach a sufficient degree of saturation.

The second field of planning theory is ‘theories of planning’, referring to the actual planning process. The procedures and processes employed in planning have changed substantially over the last decades, leading Schönwandt (2002) and others to characterize three main generations of theories of planning. Along this line, the first generation follows a rational planning model, involving five main steps: Defining the problems and/or goals, identifying alternative plans/policies, evaluating alterna-

tive plans/policies, implementing plans/policies, and monitoring effects of plans/policies (Taylor 1998). This rational planning model was based on a number of assumptions such as the availability of comprehensive information that turned out not to be present in many cases. In response to emerging critique of the rational planning model, Rittel and Webber (1973) introduced the idea of wicked problems for which neither objective problem descriptions nor optimal solutions could be identified. This second generation of planning contributed to a more contextualized understanding of real-world planning processes. However, it remained rather conceptual and did provide little guidance on how to address these issues in practice (Schönwandt and Jung 2005). A third generation of planning intended to integrate various aspects of planning in a coherent and systematic way. To this end, the third generation of planning identifies a 'professional planning community' which is part of the overall context of the particular situation and place. While the professional planning community shares some common understanding and reasoning, the overall context is influenced by many more actors and agenda setting activities. Planning theories of the third generation thus acknowledge that planning always takes place within a particular context which needs to be understood and considered to fully understand, investigate, and address planning progress (Schönwandt and Jung 2005).

In essence, this brief review has illustrated that theories of planning and theories in spatial and environmental planning in Germany have always been altered and further developed in response to new societal challenges, requests or requirements. The interesting question, then, is how theories in and of planning might change from inducing the ecosystem services concept as it is the key aim of this habilitation.

### **2.3 Landscape planning methods**

Landscape planning methods can be distinguished into three main types (cf. von Haaren 2004): methods for assessing and evaluating landscape functions and impairments, methods for developing objectives and measures, and methods for implementing proposed objectives and measures in reality. In general, methods in landscape planning need to reflect that landscape planning is positioned at the interface between landscape ecology and natural sciences on the one side, and politics and governance on the other side (Bastian and Schreiber 1994). In this light, landscape planning draws on insights from various natural sciences and transforms this basic scientific knowledge into operative knowledge through the use of indicator-based methods. Placed at the interface between science and decision-making, the key orientation of landscape planning methods is to provide relevant and robust information for decision-making in the context of often limited data and resources availability in practice. Against this background, landscape planning methods should be as simple as possible, and only as complex as necessary to provide the needed information.

The first group of methods in landscape planning, assessment methods, focus only on those compartments of nature and landscape that are relevant for the provision of landscape functions. Landscape planning assesses landscape functions in a spatially comprehensive manner. The specific methods to be used depend on the respective data situation. The assessment methods distinguish areas of more or less similar importance for the provision of a particular landscape function, and assign a particular level of importance to these areas by using specific indicators. Landscape planning assessment methods usually do not aim for quantitative values. Instead, the measurement of the level of importance is based on a quantitative or qualitative description of the functional characteristics which is then transformed into ordinal scales. If necessary, sensitivities against environmental impacts are illustrated in addition to the level of importance (von Haaren 2004; von Haaren and Albert 2011; Albert et al. 2016).

Methods for developing objectives and measures in landscape planning translate general environmental objectives from legislation into spatially explicit objectives and measures, based on the information generated in the assessment and evaluation of landscape functions. In this process, landscapes are classified into functionally interconnected and spatially overlapping compartments such as soil and water. These compartments are then further distinguished into functionally characterized areas such as biotopes or water catchment areas for which specific targets and actions can be usefully proposed.

Methods for developing objectives and measures include the development of 'Leitbilder' as visions for future development, as well as the development of scenarios as opportunities to explore potential pathways of change and their respective consequences. The general process of developing objectives and measures can follow several subsequent steps (von Haaren 2004). The objectives include (i) to identify overarching targets and conventions (e.g. from legislation), (ii) to derive specific nature conservation targets for the study area, distinguishing between binding minimum targets and flexible, complementary objectives, (iii) to develop alternative nature conservation 'Leitbilder' as visions of potential future landscape changes, and (iv) to assess relevant legal, economic, social and cultural context conditions and the interests of relevant actors. Further objectives are (v) to develop scenarios as potential pathways of change, (vi) to clarify priorities for targets and measures from the perspective of nature conservation, and to discuss them with other relevant actors, (vii) to identify areas for cooperation, targets that can be implemented unilateral without cooperation, and areas of conflicts, and (viii) to develop a target and implementation concept for the study area.

Methods for implementation in landscape planning refer to the development of a strategy for implementing the nature conservation targets. The process of strategy development needs to take into account several aspects (von Haaren 2004): the different approaches and instruments available for

implementing nature conservation targets, the procedural character of implementation, the interest and objectives of relevant actors, as well as the legal and economic context conditions that may inhibit or support particular implementation pathways. In terms of the instruments to be applied, landscape planning can draw on a wide range of possible approaches, ranging from legal instruments such as the designation of protected areas to the integration of targets in other planning sectors, the harnessing investment opportunities from environmental impact regulation approaches, communicative approaches and the use of co-financing of implementation from market or philanthropic sources (von Haaren et al. 2008).

## **2.4 Landscape planning impacts**

Two general kinds of potential impacts of landscape planning can be distinguished (Albert 2011). The first kind of impacts is the production of substantive outputs such as plans, concepts, maps and reports which can provide information for decision-support. The second kind of impact is the change that may or may not occur within the networks of relevant actors as a result of an involvement within, and exposure to a participatory planning process. For example, involving actors within a participatory landscape planning process can lead to an enhanced mutual understanding and willingness to cooperate in the implementation of developed targets and measures.

## **2.5 Ecosystem services**

The term 'ecosystem services' is used ambiguously in the literature. Divergent definitions exist with overlapping and sometimes conflicting meanings. Differences in definitions exist concerning the terms used, the concepts applied for these terms, the ecosystem services classification system considered, and how actual ecosystem services are defined (von Haaren and Albert 2011; Albert et al. 2015b).

Despite this ambiguity, the definitions applied in three major international assessments provide a good overview and orientation as those definitions are most often referred to and applied. The Millennium Ecosystem Assessment (MA 2005), the first global assessment of the state of ecosystems and biodiversity, defined ecosystem services as "the benefits people obtain from ecosystems". The international study on The Economics of Ecosystems and Biodiversity (TEEB 2010) provided a refined definition of ecosystem services as the "direct and indirect contributions of ecosystems to human well-being". By doing so, TEEB emphasized the role of ecosystem services for human well-being and disentangled the concept of ecosystem services from the benefits they provide. Most recently, the Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES) adopted a new term and definition of ecosystem services as nature's contributions to people (NCP) (Diaz et al. 2015; Pascual

et al. 2017). NCP considers all “positive contributions or benefits, and occasionally negative contributions, losses or detriments, that people obtain from nature”. As such, NCP would relate to the ecosystem services term, but stronger acknowledge other worldviews and knowledge systems (Pascual et al. 2017).

Numerous conceptual frameworks for ecosystem services have been proposed to clarify key elements of the concept and their relationships. To provide an overview of the diversity of concepts, the frameworks employed in the three major scientific assessments of the MA, TEEB and IPBES will be reproduced here as examples. The MA (2005) put forward a conceptual framework that focused on clarifying the links between drivers of change, ecosystem services, and human well-being, and the multi-level nature of these relationships (Fig. 2).

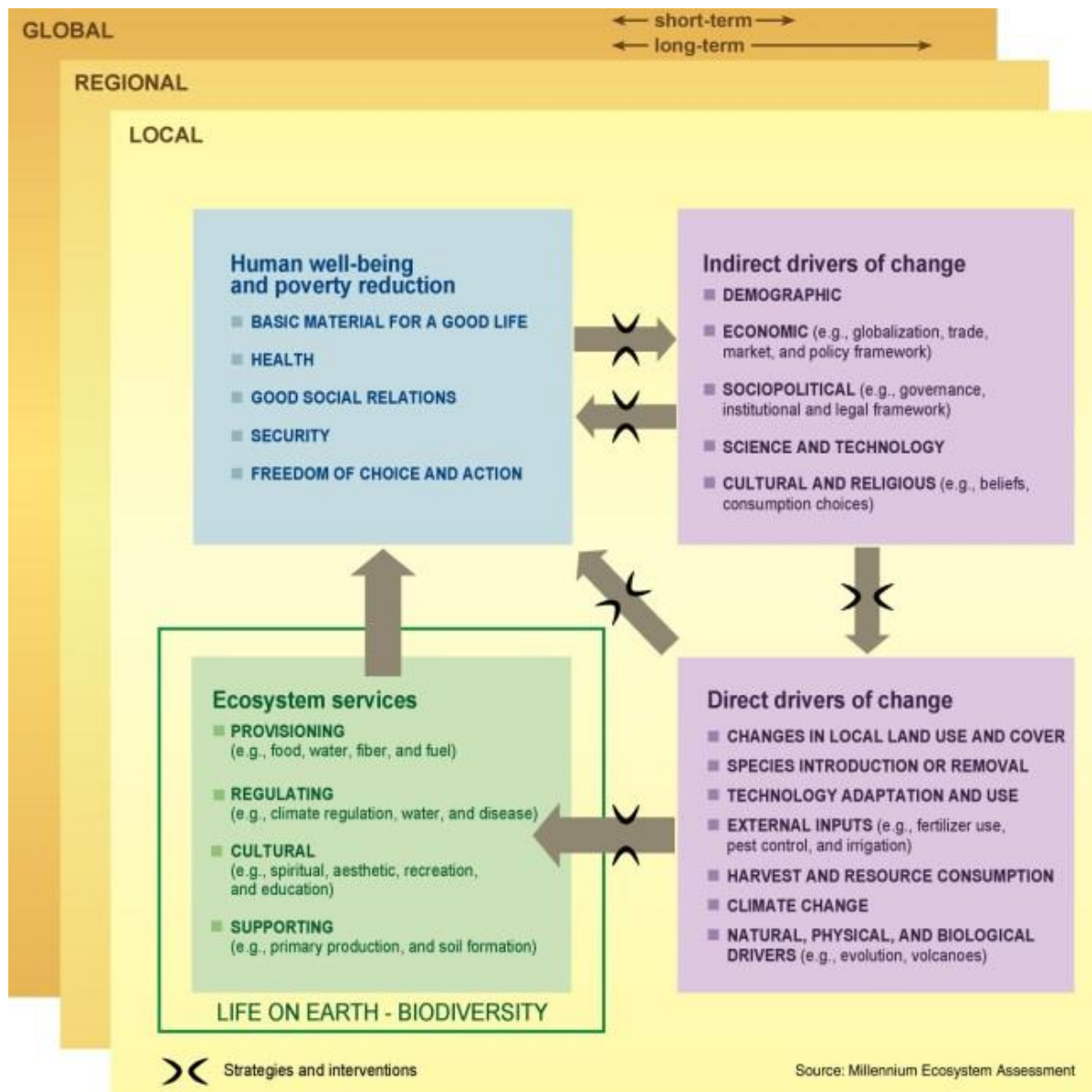


Fig. 2: The conceptual framework of the Millennium Ecosystem Assessment (MA 2005)

The conceptual framework of TEEB aimed at further disentangling the pathways from ecosystems and biodiversity to human well-being. By building on prior work by Haines-Young & Potschin (2010), the TEEB framework proposed a five-step cascade from biophysical structure or process to function, service, benefits, and values (figure 3). This framework found wide interest in the science and policy communities, and has spurred numerous scientific publications proposing further revisions and amendments, including for example paper 3 of this thesis.

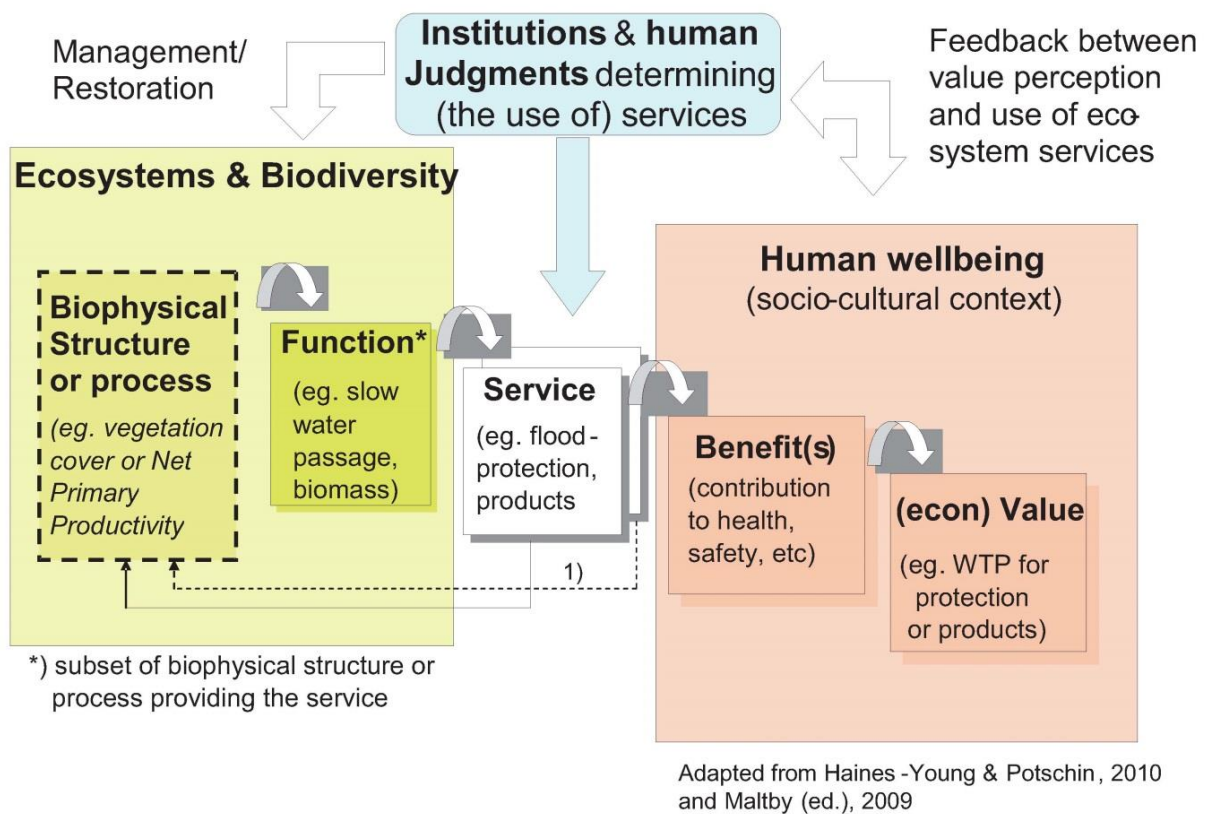


Fig. 3: The cascade-model of ecosystem services applied in TEEB (2010)

The recently proposed framework of IPBES stronger emphasized two main issues: First, it stressed the importance of institutions and governance in influencing change by situating them at the center of the diagram. Second, the IPBES conceptual framework is the first that explicitly acknowledges the multiple values and knowledge systems that are at play in debates and decisions around relationships between nature and people. To do so, the IPBES conceptual framework suggests alternative terms that can be used for the various components of the framework.



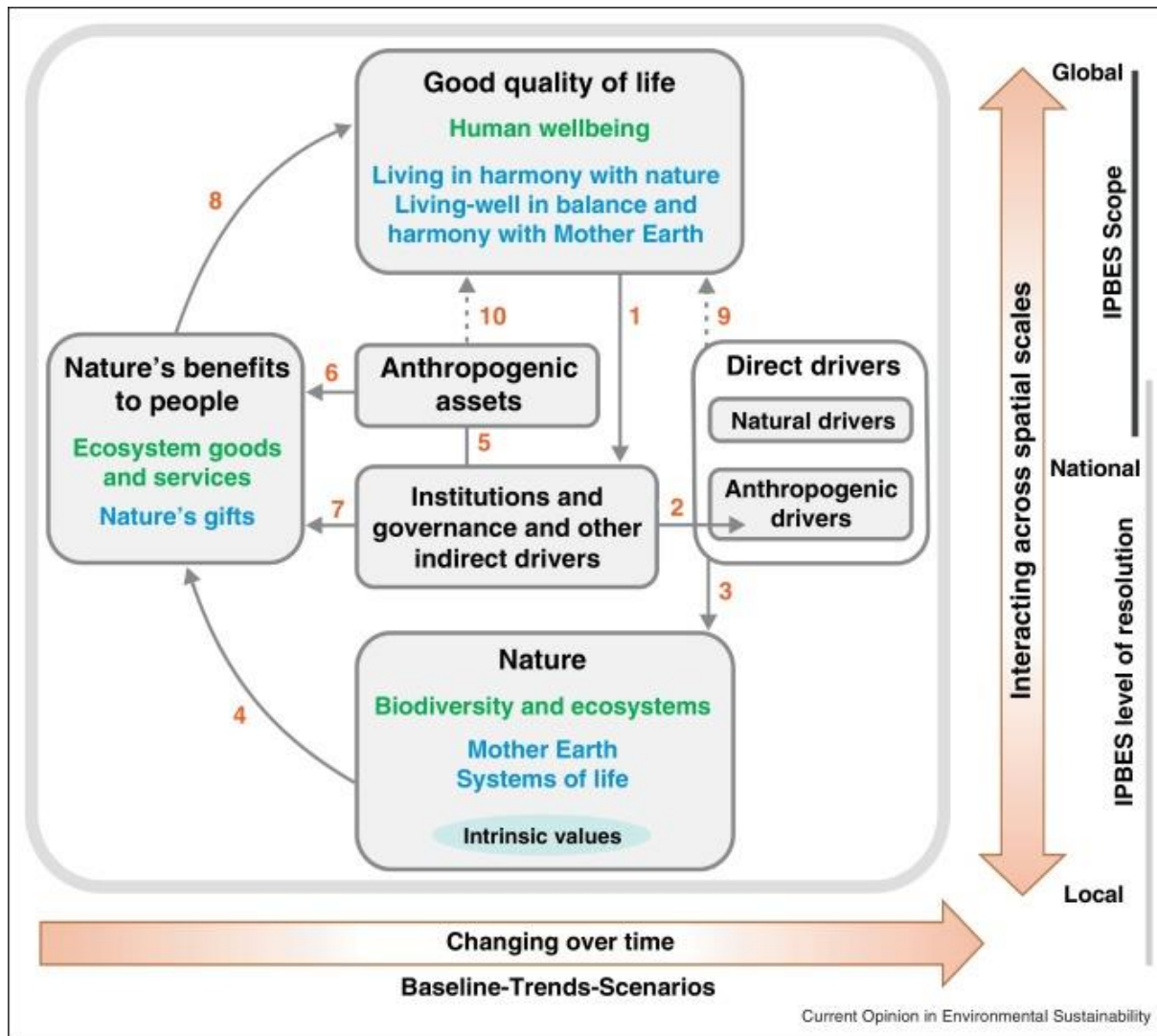


Fig. 4: The conceptual framework of IPBES (Díaz et al. 2015).

Given the diverging definitions and conceptual frameworks of ecosystem services as applied in the three major assessments, it is no surprise that different classification systems have been proposed for providing some organization and systematics to ecosystem services analyses. The classification systems differ with respect to the proposed field of application (e.g. application in accounting vs. planning), with respect to the terms and systematics used to group individual ecosystem services, and with respect to the individual ecosystem services considered. The MA (2005) distinguished four groups of ecosystem services: Provisioning services, regulating services, supporting services, and cultural services. TEEB (2010) generally followed this approach but proposed to not consider supporting services as they would rather be ecological processes instead of services. However, TEEB introduced the category of habitat services to account for the role of ecosystems to provide habitats for species. More recently a Common International Classification of Ecosystem Services (CICES) was de-

veloped by Haines-Young & Potschin (2013) as a framework for accounting ecosystem services at national levels. A more detailed comparison of some of the classification systems is provided by Englund et al. (2017) and will not be reproduced here.

In the context of applying the ecosystem services concept in the field of landscape planning, some scholars have argued that the term landscape services, originally proposed by Termorshuizen and Opdam (2009) would be better suited to convey the benefits of nature and landscapes to people. It indeed is a valid argument that many people can relate more to landscapes as providers of services than some abstract ecosystems. In addition, the term ecosystem services may appear to some as a typical nature conservation idea, while 'landscape services' could have greater potential to enable open discussions across different sectors. The recent years have seen a debate whether landscape services would be a synonym, an alternative, or a complement to the term ecosystem services (cf. Englund et al. 2017). Bastian et al. (2014) have argued that ecosystem services and landscape services could both be useful, depending on the specific context of application. Although the author of this habilitation thesis agrees with this view of landscape services as a potentially useful term, this thesis follows the mainstream approach of using the term ecosystem services to avoid misunderstandings and complications.

### 3 Papers included in this habilitation thesis

#### 3.1 Overview

The papers included in this habilitation thesis can be attributed to three broad topics associated with the domains of landscape planning introduced above. Papers addressing potential changes to landscape planning theory (topic A), papers exploring potential changes in methods (topic B), and papers exploring potential implications on landscape planning impacts (topic C). Despite the fact that each paper is sorted to the topic it is mostly associated with, many papers also provide insights to several other topics. An overview of the papers and their primary allocation to topics is provided in table 1.

#### **Topic A: Exploring the implications of the ecosystem services concept on landscape planning theory**

1. von Haaren, C. & Albert, C. (2011): Integrating Ecosystem Services and Environmental Planning: Limitations and Synergies. *International Journal of Biodiversity Science, Ecosystem Services & Management*, 7 (3): 150-167
2. Hauck, J., Schweppe-Kraft, B., Albert, C., Görg, C., Jax, K., Jensen, R., Fürst, C., Maes, J., Ring, I., Hönigova, I., Burkhard, B., Mehring, M., Tiefenbach, M., Grunewald, K., Schwarzer, M., Meurer, J., Sommerhäuser, M., Priess, J.A., Schmidt, J., Grêt-Regamey, A. (2013) The promise of the ecosystem services concept for planning and decision-making. *GAIA - Ecological Perspectives for Science and Society* 22 (4): 232-236.

#### **Topic B: Exploring the implications of applying the ecosystem services concept on landscape planning methods**

3. von Haaren, C., Albert, C.; Barkmann, J., de Groot, R. S., Spangenberg, J., Schröter-Schlaack, C. & Hansjürgens, B. (2014): From explanation to application: introducing a practice-oriented ecosystem services evaluation (PRESET) model adapted to the context of landscape planning and management. *Landscape Ecology* 29 (8): 1335-1346
4. Albert, C, Galler, C., Hermes, J., Neuendorf, F., von Haaren, C, Lovett, A. (2016): Applying Ecosystem Services Indicators in Landscape Planning and Management: the ES-in-Planning framework. *Ecological Indicators* 61 (1): 100-113.
5. Albert, C. & von Haaren, C. (2014): Implications of Applying the Green Infrastructure Concept in Landscape Planning for Ecosystem Services in Peri-Urban Areas: An Expert Survey and Case Study. *Planning Practice & Research* (DOI: 10.1080/02697459.2014.973683)
6. Galler, C., C. von Haaren and C. Albert (2015). Optimizing environmental measures for landscape multifunctionality: Effectiveness, efficiency and recommendations for agri-environmental programs. *Journal of Environmental Management* 151: 243-257
7. Albert, C., Hermes, J., Neuendorf, F., von Haaren, C., Rode, M. (2016): Assessing and Governing Ecosystem Services Trade-Offs in Agrarian Landscapes: The Case of Biogas. *Land* 5 (1): 1.
8. Albert, C., Bonn, A., Burkhard, B., Daube, S., Dietrich, K., Engels, B., Frommer, J., Götzl, M., Grêt-Regamey, A., Job-Hoben, B., Koellner, T., Marzelli, S., Moning, C., Müller, F., Rabe, S.-E., Ring, I., Schwaiger, E., Schweppe-Kraft, B., Wüstemann, H., 2016. Towards a national set of ecosystem service indicators: Insights from Germany. *Ecological Indicators* 61, Part 1, 38–48.
9. Albert, C., Schröter-Schlaack, C., Hansjürgens, B., Dehnhardt, A., Döring, R., Job, H., Köppel,

J., Krätzig, S., Matzdorf, B., Reutter, M., Schaltegger, S., Scholz, M., Siegmund-Schultze, M., Wiggering, H., Woltering, M., von Haaren, C., 2017. An economic perspective on land use decisions in agricultural landscapes: Insights from the TEEB Germany Study. *Ecosystem Services* 25, 69–78.

#### **Topic C: Exploring implications for landscape planning impacts**

10. Albert, C., Hauck, J., Buhr, N. & von Haaren, C. (2014): What ecosystem services information do users want? Investigating interests and requirements among landscape and regional planners in Germany. *Landscape Ecology* 29 (8): 1301-1313
11. Albert, C., von Haaren, C., Othengrafen, F., Krätzig, S., Saathoff, W. (2015): Scaling policy conflicts in ecosystem services governance: A Framework for Spatial Analysis and Application for Bioenergy. *Journal of Environmental Policy and Planning*. DOI: 10.1080/1523908X.2015.1075194
12. Albert, C., Neßhöver, C., Schröter, M., Wittmer, H., Bonn, A., Burkhard, B., Dauber, J., Döring, R., Fürst, C., Grunewald, K., Haase, D., Hansjürgens, B., Hauck, J., Hinzmann, M., Koellner, T., Plieninger, T., Rabe, S.-E., Ring, I., Spangenberg, J.H., Stachow, U., Wüstemann, H., Görg, C., 2017a. Towards a National Ecosystem Assessment in Germany: A Plea for a Comprehensive Approach. *GAIA - Ecological Perspectives for Science and Society* 26, 27–33.
13. Galler, C., Albert, C., von Haaren, C. (2016): From regional environmental planning to implementation: Paths and challenges of integrating ecosystem services. *Ecosystem Services* 18: 118-129.

### **3.2 Abstracts of papers in topic A: Implications for theory**

1. von Haaren, C. & Albert, C. (2011): Integrating Ecosystem Services and Environmental Planning: Limitations and Synergies. *International Journal of Biodiversity Science, Ecosystem Services & Management*, 7 (3): 150-167

Environmental planning offers an important approach to dealing with the concept of ecosystem services (ESS) in practice. Nonetheless, spatial planning science has failed to connect with the international ESS discussion. Thus, the purpose of this paper is twofold: first, to make relevant environmental planning experience available to ESS researchers; second, to offer conceptual and methodological suggestions for future ESS assessments that consider key insights from European planning science. A systematic literature analysis was used to juxtapose several theoretical and methodological aspects of ESS assessment and environmental planning concepts in order to identify comparative benefits and potentials for an integration of the two approaches. To illustrate the limitations and potentials of the approaches, the example of German landscape planning is described. A better integration of the two approaches has the potential to (i) strengthen the spatial concreteness and scale relation of ESS on low tiers; (ii) foster accounting and monetary valuation in environmental planning, especially for applications on supra-regional scale; (iii) reflect on underlying values in the ESS approach and overcome a latent nature determinism; (iv) more clearly differentiate between public and private goods

for better targeting implementation strategies; (v) help in developing context-dependent classification categories that can accommodate all implementation relevant services and relate services to beneficiaries; and (vi) frame communication and participation processes by reflecting their constitutional role in the political decision-making process.

2. Hauck, J., Schweppe-Kraft, B., Albert, C., Görg, C., Jax, K., Jensen, R., Fürst, C., Maes, J., Ring, I., Hönigova, I., Burkhard, B., Mehring, M., Tiefenbach, M., Grunewald, K., Schwarzer, M., Meurer, J., Sommerhäuser, M., Priess, J.A., Schmidt, J., Grêt-Regamey, A. (2013) The promise of the ecosystem services concept for planning and decision-making. *Gaia* 22 (4): 232-236.

Spatial planning is often affected by conflicting sectoral interests. Frequently, this results in unsustainable management practices. Integrating the concept of ecosystem services into planning and decision-making can facilitate communication among decision-makers from sectors like landscape and urban planning, agriculture or water management. The concept accounts for a broad spectrum of quantitative and qualitative data from local to international level, thus revealing the benefits humans derive from ecosystem goods and functions. We propose that the concept of ecosystem services can complement existing policy instruments that focus solely on a specific task or sectoral interest.

### 3.3 Abstracts of papers in topic B: Implications for methods

3. von Haaren, C., Albert, C.; Barkmann, J., de Groot, R. S., Spangenberg, J., Schröter-Schlaack, C. & Hansjürgens, B. (2014): From explanation to application: introducing a practice-oriented ecosystem services evaluation (PRESET) model adapted to the context of landscape planning and management. *Landscape Ecology* 29 (8): 1335-1346

The development and use of the conceptual framework of ecosystem services (ES) has been very successful in supporting the broad diffusion and application of ES within science and policy communities. However, most of the currently proposed interpretations of the framework neither correlate to environmental planning nor to decision-making contexts at the local and regional scale, which is a potential reason for the slow adoption and practice of the ES conceptual framework. This paper proposes a practice-oriented ES evaluation (PRESET) model specifically adapted to the requirements of local and regional planning and decision-making contexts, and discusses its potential benefits and implications for practice. Through the usage of PRESET we suggest making a distinction between 'offered ES', 'utilized ES', 'human input', and 'ES benefits' as relevant information for decision-making. Furthermore, we consider it important to link these decision-support categories to different value dimensions relevant in planning and management practice. PRESET provides guidance to inject

the ES concept into planning, but needs to be implemented together with concrete assessment methods, indicators and data. The planning strategic benefits of using PRESET include its reference to existing legislative objectives, avoiding the risk that monetized ES values might dominate decision-making, clarification of human contributions, and easier identification of land use conflicts and synergies. Examples are given for offered and utilized ES, as well as for respective evaluation approaches and instruments of implementation.

4. Albert, C, Galler, C., Hermes, J., Neuendorf, F., von Haaren, C, Lovett, A. (2016): Applying Ecosystem Services Indicators in Landscape Planning and Management: the ES-in-Planning framework. *Ecological Indicators* 61 (1): 100-113.

Applying ecosystem services (ES) concepts and indicators in landscape planning requires them to be linked with models for decision-making by practitioners. The objective of this paper is to introduce an ES-in-Planning framework, which combines ES assessment and valuation indicators with the widely used Driving Forces, Pressures, State, Impacts and Responses (DPSIR) model. Within this framework, ES indicators become part of landscape planning as a means of assessing the current state of the environment and for determining how it might change in the future. The implementation and added value of the framework is illustrated in a case study of planning issues in the Mardorf community bordering the Steinhuder Meer Lake, Northern Germany. Two scenarios of potential landscape changes and possible response measures are considered in terms of alterations in a set of ES indicators. The ES examined are food production (a provisioning ES), climate mitigation (a regulation ES), landscape esthetics (as the basis for many cultural ES), and biodiversity. The ES indicators employed distinguish between services valued by humans and those which are actually utilized. Valuation of changes in ES has shown to reflect societal objectives (as institutionalized in legal requirements) and expert-based estimates. However, these valuations could be further validated by including economic and social valuation of impacts. The added value of applying ES in the planning process lies in improved opportunities for developing targeted response measures, for communicating trade-offs between planning options, and for facilitating joint implementation by partners.

5. Albert, C. & von Haaren, C. (2014): Implications of Applying the Green Infrastructure Concept in Landscape Planning for Ecosystem Services in Peri-Urban Areas: An Expert Survey and Case Study. *Planning Practice & Research* (DOI: 10.1080/02697459.2014.973683)

This paper investigates how planning experts understand the potential of integrating the concept of green infrastructure in planning practice in Germany. It develops a systematic approach for green

infrastructure planning at the landscape scale. Research methods include a web-based survey among German planning experts and geographic information system analysis in the case study region of Hannover. Survey results suggest that the green infrastructure concept is not yet well known in planning practice, and that the potential benefits for planning lie primarily in communication purposes. An approach is developed here that sets priorities for green infrastructure development based on its potentials for creating synergies in the provision of ecosystem services.

6. Galler, C., von Haaren, C., Albert, C. (2015). Optimizing environmental measures for landscape multifunctionality: Effectiveness, efficiency and recommendations for agri-environmental programs. *Journal of Environmental Management* 151: 243-257

Agri-environmental measures differ in their capacity to simultaneously enhance the provision of multiple ecosystem services. Multifunctional approaches are hampered by funding schemes that are usually administered by individual administrative sectors that each predominantly focus on one single environmental objective. Developing integrative management strategies that exploit synergies from implementing multifunctional measures is challenged by the need to quantify expected management effects on different ecosystem services. The objective of this paper is to compare uncoordinated versus coordinated management strategies in their contribution to multiple environmental objectives. We developed and applied a method for quantifying effectiveness, as well as spatial and cost efficiency with respect to four key landscape functions: erosion prevention, water quality conservation, climate change mitigation and safeguarding biodiversity. The case study area was the county of Verden, Germany. The following findings can be drawn: Measures for safeguarding biodiversity and climate change mitigation have generally high multifunctional effects, which makes them suitable for integrative management strategies. To make use of the added value of potential multifunctional measures, a spatially targeted allocation of agri-environmental measures is necessary. Compared to uncoordinated strategies, coordinated integrative management strategies either allow the optimization of the ratio of costs to environmental effects or an increase in the effects that can be achieved within an area unit. This is however, usually not simultaneous. Future research should seek to refine the assessment and valuation indicators.

7. Albert, C., Hermes, J., Neuendorf, F., von Haaren, C., Rode, M. (2016): Assessing and Governing Ecosystem Services Trade-Offs in Agrarian Landscapes: The Case of Biogas. *Land* 5 (1): 1.

This paper develops a method to explore how alternative scenarios of the expansion of maize production for biogas generation affect biodiversity and ecosystem services (ES). Our approach consists

of four steps: (i) defining scenario targets and implementation of assumptions; (ii) simulating crop distributions across the landscape; (iii) assessing the ES impacts; and (iv) quantifying the impacts for a comparative trade-off analysis. The case study is the region of Hannover, Germany. One scenario assumes an increase of maize production in a little regulated governance system; two others reflect an increase of biogas production with either strict or flexible environmental regulation. We consider biodiversity and three ES: biogas generation, food production and the visual landscape. Our results show that the expansion of maize production results in predominantly negative impacts for other ES. However, positive effects can also be identified, i.e., when the introduction of maize leads to higher local crop diversity and, thus, a more attractive visual landscape. The scenario of little regulation portrays more negative impacts than the other scenarios. Targeted spatial planning, implementation and appropriate governance for steering maize production into less sensitive areas is crucial for minimizing trade-offs and exploiting synergies between bioenergy and other ES.

8. Albert, C., Bonn, A., Burkhard, B., Daube, S., Dietrich, K., Engels, B., Frommer, J., Götzl, M., Grêt-Regamey, A., Job-Hoben, B., Koellner, T., Marzelli, S., Moning, C., Müller, F., Rabe, S.-E., Ring, I., Schwaiger, E., Schweppe-Kraft, B., Wüstemann, H., 2016. Towards a national set of ecosystem service indicators: Insights from Germany. *Ecological Indicators* 61, Part 1, 38–48.

Target 2, Action 5 of the EU Biodiversity Strategy requests member states “to map and assess ecosystems and their services” (Mapping and Assessment of Ecosystems and their Services – MAES initiative). The objective of this paper is to present and discuss the preliminary outcomes of the approach taken to define indicators for implementing MAES in Germany. The paper introduces the requirements for using indicators from a perspective of nature conservation policy, in particular the need to discern the demand and supply of ecosystem services, including their potentials, actual and future use, as well as the natural contributions and human inputs to the generation of ecosystem services. An adapted, differentiated, ecosystem services terminology is presented and a first set of indicators is introduced and explained. The paper closes with an estimate of potential benefits of information produced by implementation of a national MAES for various fields of policy (e.g. local and regional landscape planning) and proposes some recommendations for further research and practical exploration.

9. Albert, C., Schröter-Schlaack, C., Hansjürgens, B., Dehnhardt, A., Döring, R., Job, H., Köppel, J., Krätzig, S., Matzdorf, B., Reutter, M., Schaltegger, S., Scholz, M., Siegmund-Schultze, M., Wigge-



ring, H., Woltering, M., von Haaren, C., 2017. An economic perspective on land use decisions in agricultural landscapes: Insights from the TEEB Germany Study. *Ecosystem Services* 25, 69–78.

Agricultural landscapes safeguard ecosystem services (ES) and biodiversity upon which human well-being depends. However, only a fraction of these services are generally considered in land management decisions, resulting in trade-offs and societally inefficient solutions. The TEEB Study (The Economics of Ecosystems and Biodiversity) spearheaded the development of assessments of the economic significance of ES and biodiversity. Several national TEEB follow-ups have compiled case studies and derived targeted policy advice. By synthesizing insights from “Natural Capital Germany – TEEB DE” and focusing on rural areas, the objectives of this study were (i) to explore causes of the continued decline of ES and biodiversity, (ii) to introduce case studies exemplifying the economic significance of ES and biodiversity in land use decisions, and (iii) to synthesize key recommendations for policy, planning and management. Our findings indicate that the continued decrease of ES and biodiversity in Germany can be explained by implementation deficits within a well-established nature conservation system. Three case studies on grassland protection, the establishment of riverbank buffer zones and water-sensitive farming illustrate that an economic perspective can convey recognition of the values of ES and biodiversity. We conclude with suggestions for enhanced consideration, improved conservation and sustainable use of ES and biodiversity.

### 3.4 Abstracts of papers in topic C: Implications for impacts

10. Albert, C., Hauck, J., Buhr, N. & von Haaren, C. (2014): What ecosystem services information do users want? Investigating interests and requirements among landscape and regional planners in Germany. *Landscape Ecology* 29 (8): 1301-1313

While political and scientific interests in ecosystem services (ES) information increases, actual implementation in planning still remains limited. We investigated how landscape and regional planners in Germany already use environmental information, and explored their perceptions concerning an integration of additional information on ES in their work. Four themes are addressed: (1) existing decision-making contexts, (2) current use of environmental information, (3) perceived options for integrating ES information, and (4) useful ES information formats. The research method consists of semi-structured interviews and a web-based survey with German landscape and regional planners. Results are disaggregated between landscape and regional planners, as well as planners with and without prior knowledge of the ES concept. Our results illustrate that a broad range of environmental information is already used that could be associated with ES, but the two most frequently consulted data, species and habitats, relate more to biodiversity. Stronger integrating ES information in planning was

generally perceived as useful. However, implementation would often require a mandate from higher-ranking policy levels and the provision of appropriate resources. Project-oriented planning, public information and regional development were seen as promising application contexts. Contrary to our expectations, planners with prior knowledge of the ES concept did not evaluate the usefulness of ES information significantly more optimistic. No single optimal ES information format (ordinal, cardinal, economic valuation) emerged, but context-specific combinations were proposed. The results present valuable guidance for studies and assessments that aim at addressing the ES information needs and requirements of decision makers, and planners in particular.

11. Albert, C., von Haaren, C., Othengrafen, F., Krätzig, S., Saathoff, W. (2015): Scaling policy conflicts in ecosystem services governance: A Framework for Spatial Analysis and Application for Bioenergy. *Journal of Environmental Policy and Planning*. DOI: 10.1080/1523908X.2015.1075194

Effective governance for ecosystem services (ES) is not only challenged by trade-offs between services' provision and conflicts among policies aimed at enhancing individual services, but also by the problem of scale. This paper's objective is to introduce a framework for the systematic analysis of scale issues in ES governance, and to illustrate its application in a case study of bioenergy production. The research questions are: (i) How can the concepts of scale be integrated in an assessment of ES governance? (ii) Which scale effects can be identified in a case study analysis of bioenergy governance? Building upon the DPSIR (driving forces, pressures, state, impacts, and responses) model, a framework for systematically assessing scale effects in ES governance is developed and applied in a nested case study in the region of Hanover, Germany. The case study is the first such study to spatially illustrate scale effects in ES trade-offs and policy conflicts. The results contribute to our understanding of scalar issues in the governance of ES with a differentiated typology of scale effects and their spatial implications within the DPSIR model. The approach supports ex post and ex ante assessments of governance designs, and helps actors considering across-level impacts of policy options in practice.

12. Albert, C., Neßhöver, C., Schröter, M., Wittmer, H., Bonn, A., Burkhard, B., Dauber, J., Döring, R., Fürst, C., Grunewald, K., Haase, D., Hansjürgens, B., Hauck, J., Hinzmann, M., Koellner, T., Plieninger, T., Rabe, S.-E., Ring, I., Spangenberg, J.H., Stachow, U., Wüstemann, H., Görg, C., (2017). Towards a National Ecosystem Assessment in Germany: A Plea for a Comprehensive Approach. *GAIA - Ecological Perspectives for Science and Society* 26, 27–33.

We present options for a National Ecosystem Assessment in Germany (NEA-DE) that could inform decision-makers on the state and trends of ecosystems and ecosystem services. Characterizing a NEA-DE, we argue that its cross-sectoral, integrative approach would have the advantages of increased scientific understanding, addressing specific policy questions and creating science-policy dialogues. Challenges include objections against a utilitarian perspective, reservations concerning power relations, and responsibilities concerning the funding.

13. Galler, C., Albert, C., von Haaren, C. (2016): From regional environmental planning to implementation: Paths and challenges of integrating ecosystem services. *Ecosystem Services* 18: 118-129.

Planning and governance at the regional scale is a promising field for the application of the ecosystem service (ES) concept. The objective of this paper is to explore the potential implications of integrating the ES concept into regional planning and governance. We focus on two pathways of influence: (i) information on ES and their values as decision-support in planning and management, ii) the ES concept as a boundary object for facilitating cross-sectoral interaction and collaboration. A case study illustrates the effects of applying the ES concept in planning processes. The usefulness of the ES concept as a boundary object was derived from focus groups with scientists and practitioners. Integrating the ES information into planning facilitates the consideration of trade-offs and multifunctionality in decision-making. Furthermore, it helps people to recognize how individuals or societies are affected, thus improving preconditions for public participation. Additionally, ES can serve as a mutual reference level within the valuation and monitoring systems of different environmental disciplines. Challenges are found in assessing utilized ES and differentiating benefits for public and individuals. Employing economic valuation could supplement existing planning procedures, but carries risks. There is a need for research in the field of applicable assessment methods and standardizations.



## **4 Synthesis: contributions of this thesis**

### **4.1 Potential changes induced in landscape planning theory**

#### **4.1.1 Potential changes induced in ‘theories in planning’**

##### 4.1.1.1 Terms

Quite obviously, integrating the ecosystem services concept in landscape planning means introducing the new term ‘ecosystem services’ as a complement to or replacement of the term ‘landscape functions’. The potential implications of this change can be usefully discussed by disentangling the term into the two words it is comprised of, thus first focusing on potential implications by changing from ‘landscape’ to ‘ecosystem’ and then on the implications of changing from ‘functions’ to ‘services’.

Using the word ecosystem instead of landscape has both conceptual and communicative implications. Conceptually, there is a spatial difference between services provided by an ecosystem, which not necessarily is also a landscape, or by a landscape which not necessarily is also an ecosystem. The spatial reach of the term ecosystem is not clearly defined. Ecosystems are referred to as areas of varying spatial scale from very local to even global. While some might associate ecosystems primarily as areas of little or no human influence, the ecosystem services research community understands ecosystems very broadly, acknowledging the roles of both human and natural factors. The term landscape can be understood as “an area, as perceived by people, whose character is the result of the action and interaction of natural and/or human factors” (Council of Europe 2000). As such, the term landscape embodies both the role of human perception as well as its co-evolution resulting from ecological and human drivers. As such, the main difference conceptually is that the spatial scale of ecosystems may vary even stronger than the spatial scale of territories referred to as landscapes. With respect to communication, the term ecosystem may have some disadvantages. People probably have more difficulties in referring to ecosystems than landscapes. The meaning of the term ecosystem may be more difficult to convey than the term landscape to which people can have a better personal relationship. Furthermore, using the term landscape can arguably better convey the anthropogenic influences and potential impacts of existing land uses on the current level of ecosystem services provision as important information for decision support (paper 1). In addition, using the term ecosystem may alienate people who do not associate themselves with nature conservation objectives. As briefly mentioned in chapter 2, there is an ongoing debate on whether the terms ecosystem services or landscape services shall be used to address some of the communicative disadvantages of the term ecosystem services.

A greater difference lies in using the word ‘services’ instead of ‘functions’. Conceptually, many models of nature-people-relationships see the term functions more oriented towards the side of capacities of ecosystems or landscapes to provide ‘something’ of benefit for humans, whereas the term service is more closely associated with the actual ‘something’ that is being enjoyed or used by humans. As such, functions remain one step closer to the ecosystem side, whereas services are closer to the side of benefits and human well-being. In addition, using the term ‘service’ tends to stronger emphasize the actual use of benefits from nature and landscape, whereas ‘functions’ might relate more to capacities. This implies that using the term ecosystem services might even stronger emphasize aspects of actual use and demands. In communication, referring to services instead of functions may have several benefits. As the term services relates more to actual uses, demands, and benefits for people derived from nature, it might make the individual benefits from conservation and sustainable use of nature and landscape more visible. Furthermore, referring to services might be more attractive to actors beyond the nature conservation community (papers 1 & 2).

In general, the degree of change induced to landscape planning by the new term ecosystem services will depend on the actual definition used, the conceptual understanding applied, and the kinds of services considered. Depending on the exact definition, the term ecosystem service is more or less overlapping with the term landscape functions used in landscape planning, or substantially different in referring strongly to only those services that are actually used without consideration of potentials or functions (cf. papers 1 & 2). Despite the ambiguity of the actual definitions and conceptualization of ecosystem services applied, it is frequently argued that the term ecosystem services could have advantages over the term landscape functions by helping to better describe and communicate the links between human well-being and the state of ecosystems. In effect, decision-making around nature conservation could be improved. The concept of ecosystem services would draw on a ‘language’ understood across different contexts and sectors, and could help harmonize divergent perspectives on natural resources and their management (paper 2).

Another term frequently used in relation to ecosystem services is green infrastructure. Green infrastructure can be understood as a “network of natural and semi-natural areas, features and green spaces in rural and urban, and terrestrial, freshwater, coastal and marine areas, which together enhance ecosystem health and resilience, contribute to biodiversity conservation and benefit human populations through the maintenance and enhancement of ecosystem services” (Naumann et al. 2011). In this way, green infrastructure presents a strategic spatial concept for safeguarding and enhancing ecosystem services and has initiated a complementary approach to the development of landscape plans. In paper 5, we explored the concept’s potential benefits for landscape planning and tested its application in a case study. We found that although landscape planning documents often

already include the similar idea of habitat networks, the concept of green infrastructure might have a great potential to convey the importance of both linear elements and spatial areas for providing a wide range of ecosystem services as contributions to human well-being. As such, introducing the term green infrastructure could be received well among different stakeholder groups as way for highlighting the diverse benefits for humans derived from implementing landscape planning proposals (paper 5).

#### 4.1.1.2 Statements

Given the great diversity and divergence of statements used ecosystem services literature, it is difficult to extract propositions that are broadly accepted and shared. An exception is the foundational statement that ecosystem services should be safeguarded and sustainably used to enhance human well-being. This statement focuses on the individual human benefits from an appropriate management of nature and landscape and thereby differs from arguments conventionally provided in landscape planning that usually justify proposed strategies and measures primarily with shared societal demands as reflected in respective legislation (cf. papers 1, 2, 3, 13). Integrating ecosystem services in landscape planning can imply a stronger emphasis of the individual benefits in addition to the existing justifications from legislation. Additional arguments could be provided by using the ecosystem services concept for measures proposed by landscape planning (papers 1, 2, 3, 4, 9, 10, 13).

#### **4.1.2 Potential changes induced in ‘theories of planning’**

Depending on the actual definition, conceptualization and application of the ecosystem services concept, it may or may not incur changes to the theories of landscape planning. On the one hand, as ecosystem services are ‘only’ a concept for describing the relationships between ecosystems and human well-being, no direct changes are required to the processes of landscape planning. On the other hand, some indirect changes can be expected. For example, the procedures for assessment and valuation could be further developed to also consider ecosystem services. As ecosystem services relate more to actual use and to the benefits to human well-being, their assessment and valuation can make it necessary to integrate new kinds of data and to interact more closely with citizens and stakeholders to identify specific actual uses, demands, interests, and objectives (papers 1 & 13). Finally, adopting the ecosystem services concept could also mean more substantial changes to the theory of landscape planning, for example if the concept would be used to implement much more participatory approaches to planning that jointly identify ecosystem services of interest for local actors, and then collaboratively explore options for landscape development for acquiring these services (cf. e.g. Liu and Opdam 2014).

## 4.2 Options and implications for landscape planning methods

In general, four principle models for integrating ecosystem services in landscape planning have been identified (paper 4): retrofitting or amending existing plans and programs with considerations of ecosystem services, (ii) incrementally integrating assessments of ecosystem services in existing planning procedures (iii) and ecosystem services-led approach that embeds ecosystem services considerations at early stages of planning, and (iv) an ecosystem approach-based model that fundamentally alters planning procedures towards better considering ecosystem services and their values in decisions.

Different degrees of change will be induced by integrating the ecosystem services in landscape planning depending upon the kind of ecosystem services definition and concept applied, and the way of implementation chosen. For example, if the term 'ecosystem services' is used as a synonym of 'landscape functions', methods for assessment and evaluation would arguably not need to change. Given the likely variations in changes induced, each of the following sections will assume the general differences between the terms as outlined above, and will outline the spectrum of options and respective implications.

### 4.2.1 Options and implications for methods for assessment and valuation

First, methods for assessing ecosystem services instead of landscape functions will usually imply considering a broader set of functions or services than it is the case in conventional landscape planning. Landscape functions usually focus on eight normatively defined landscape functions, namely natural yields, geodiversity, water provision, water retention, climate protection, bioclimate, biodiversity and landscape aesthetics (von Haaren 2004 cf. paper 1)<sup>1</sup>. In contrast to the short list of landscape functions considered in landscape planning, many current classification systems such as the ones proposed by the MA (2005), TEEB (2010) and CICES (Haines-Young and Potschin 2013) identify many more services. The ecosystem services classifications usually distinguish between provisioning, regulating and cultural services with sometimes different terminology.

Second, methods for assessing ecosystem services in general stronger emphasize the actual flow of services as generated by the combined contributions of landscape and human input (for example in terms of actual agricultural goods produced). Landscape planning methods have usually focused primarily on the capacities of nature and landscape to provide such services (paper 1 & 8) without considering the services produced with human contributions.

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<sup>1</sup> Given resource limitations in practice, these landscape functions are only seldom assessed separately but often considered in an aggregated way with respect to five natural assets (see von Haaren 2004) soil, water, climate and air, plants, and species.



Third, methods for assessing ecosystem services stronger emphasize the actual uses, demands and benefits (papers 2, 3, 4, 8, 9 & 13). In paper 3 of this thesis, we propose the PRESET model and some indicators for such a more differentiated analysis. PRESET distinguishes offered ecosystem services from actually utilized services, and it emphasizes that a particular human input is often required to utilize an offered ecosystem service. Applying PRESET within landscape planning can result in valuable information for decision-support through providing additional information and by linking to different kinds of underlying value bases. In paper 8, we propose a set of indicators for assessing the supply and demand of a key set of ecosystem services. While focusing on useful indicators for assessments at the national level, the paper provides several insights of relevance for consideration in landscape planning at community and county levels as well. For example, we suggest that accounting for areas of supply of ecosystem services in relation to areas of respective demand could be helpful. The demand for ecosystem services is currently derived by landscape planning from politically legitimized objectives. Complementary methods would be needed to identify, synthesize and illustrate demands of stakeholders and citizens in the planning process. We also highlight the need for a differentiated analysis of ecosystem services to explain if changes in the actual use of ecosystem services are caused by changes in the ecosystem potential and delivery, changes in ecosystem condition, changes in human inputs, or changes in demands. Taken together, we propose that using the ecosystem services can lead to a more integrative and transdisciplinary perspective on ecosystem services demand and supply that harnesses and integrates experience and information from various scientific and non-scientific bodies of knowledge through a range of qualitative and quantitative methods (paper 2, cf. papers 4, 7, 10 & 13).

Fourth, integrating ecosystem services into landscape planning will often stronger emphasize quantitative methods. This would require amendments to existing methods, i.e. to use models for quantifying the amount of actual groundwater recharge or the amount of greenhouse gases captured by soils. As such, an integration of the ecosystem services concept would stronger emphasize the role of quantitative methods over the commonly used qualitative or semi-quantitative approaches in landscape planning (papers 1, 3, 4, 7 & 13). We provide examples in papers 4, 6 and 13 of how existing data from assessments of landscape planning can be combined with additional data sources in order to quantify ecosystem services provision at the landscape scale (for a review of methods, see Englund et al. 2017).

Fifth, integrating ecosystem services ecosystem services within landscape planning could mean stronger emphasizing social and economic valuation methods. As one example, we illustrate in paper 13 how quantitative assessments of potential CO<sub>2</sub> emissions options can be combined with standard cost values for carbon emissions to estimate potential societal benefits and costs of land

use options. In paper 1, we argue that economic valuation is so far seldom applied in landscape planning, although the data provided by landscape planning could potentially be a good data basis for such valuations. However, economic valuation, and monetary valuation in particular, would need to be used with caution as it is perceived critically and suspiciously among citizens and stakeholders regarding its adequacy and added value for supporting decisions around nature and landscape (cf. papers 1, 2, 3, 4, 9, 10 and 13). An important measure for landscape planning would need to be to clarify the legal decision-space for such economic considerations. While the concept of ecosystem services in essence focusses on illustrating the contributions of nature and landscape to human well-being, it is often perceived as a concept that relates to or aims at monetary valuation (cf. Paper 3 and 10). A potential reason is that the concept has indeed been developed primarily by ecologists and economists, and monetary valuations of ecosystem services have received much scientific, media, and public interests. However, it is important to emphasize that applying the ecosystem services concept does not necessarily mean to also use such valuations.

Sixth, integrating ecosystem services in landscape planning could foster the use of methods for trade-off analyses, i.e. efforts to more comprehensively explore the implications of land use options across a number of different ecosystem services through multi-criteria analyses. Such trade-off analyses benefit from quantitative assessments of ecosystem services. Example of trade-off analyses are provided in paper 4 concerning land use change options for a smaller landscape, and in paper 7 with regard to the potential impacts of alternative scenarios for bioenergy maize production in the region of Hannover. We conclude based on the trade-off analysis that targeted spatial planning, implementation and appropriate governance for steering maize production into less sensitive areas is crucial for minimizing unwanted trade-offs and exploiting synergies (paper 7).

Seventh, integrating ecosystem services in landscape planning could provide a further incentive to stronger emphasize considerations of funding effectiveness. Along this line, paper 6 investigates the impacts of two options for using payments schemes for adapted land use, namely coordinated strategies vs. uncoordinated strategies, and explores their respective impacts on key ecosystem services. The paper finds that coordinating payment schemes for specific ecosystem services can substantially enhance multifunctionality.

#### **4.2.2 Options and implications for methods for developing targets, measures, and implementation concepts**

Integrating the ecosystem services concept in landscape planning would not only induce changes to methods for assessment and valuation, but also for developing targets, measures, and implementation concepts. The kind and degree of change will again strongly depend upon the actual interpreta-

tion of the ecosystem service concept applied. If full integration of ecosystem services assessment should be achieved, it would need to relate to existing frameworks for planning landscape changes, for example the broadly applied Driving forces, Pressures, States, Impacts and Responses (DPSIR) framework proposed by Smeets and Weterings (1999). Paper 4 presents an approach of how such an integration of ecosystem services assessment and valuation into landscape planning could be realized.

Integrating the ecosystem services concept in landscape planning procedures could provide a more elaborated description of potential impacts of alternative landscape development targets and measures (see papers 4, 5, 6 & 7), especially in terms of ecosystem services delivery and trade-offs. This could strengthen planning for multifunctional landscapes and better highlight the individual benefits that local populations could enjoy as an effect of implementing the respective targets and measures. In this way, the commonly provided justification for landscape planning targets and measures in terms of legislative objectives can be complemented with information on the added benefits that would be generated for different stakeholder groups and citizens in terms of ecosystem services delivered.

An integration of the ecosystem services concept could further ease the involvement of stakeholders and citizens in the development – and potentially implementation – of landscape planning targets and measures. As the terms ‘services’ and ‘benefits’ from nature and landscape may be more attractive than ‘functions’ to people, it might yield more interest and enhance the motivation to participate (cf. papers 2, 10 & 13).

Using the ecosystem services concept and its stronger focus on providers and beneficiaries of such services can provide an incentive for considering scale issues more systematically. These scale issues relate to both transboundary and across-level impacts of land use options on biodiversity and ecosystem services. As demonstrated in paper 11, integrating ecosystem services in scalar assessments of land use options can help identifying which spatial levels and governance scales are affected. Furthermore, it can assist in understanding which actors are currently involved a given planning process and which actors should become involved, respectively. This information can be used to design and implement appropriate governance regimes that consider and account for such scale issues. It can help exploring at which governance level land management should be coordinated, and which measures are needed to safeguard and enhance ecosystem services of value for higher governance levels.

Adopting planning strategies such as green infrastructure that are explicitly associated with ecosystem services could help frame propositions from landscape planning in ways that resonate well with the interests and concerns of actors. As illustrated by a case study application in paper 5, using the

green infrastructure strategy can help to better structure, prioritize, and illustrate landscape planning targets and measures. The need to develop multifunctional priority areas and appropriate management measures can be conveyed better than with conventional planning methods. In consequence, the power of landscape planning to communicate the relevance and added value of planning options to decision-makers, stakeholders and the public could be further enhanced (Paper 5). If strategies such as green infrastructure shall be applied, they should be based on solid definitions of terms used and an appropriate spatial assessment and valuation of ecosystem services provision capacities, as well as legislative and other targets and demands for nature conservation and ecosystem services delivery.

The enhanced policy interest and available funding for ecosystem services studies at international and national levels provides new opportunities for landscape planning. Landscape planning offers concepts and methods for developing and implementing a national assessment and valuation of ecosystem services in ways that correspond with and build upon methods commonly by landscape planning at local and regional levels. As such, it could contribute to harmonizing datasets across federal states which would have substantial benefits for landscape planning practice, for example in terms of the transferability of assessment and valuation methods across federal states. Vice-versa, the emerging assessments and valuations of ecosystem services at the national level can emphasize the relevance of and enhance the public support for measures proposed by landscape planning at sub-national levels. National ecosystem services assessments could serve as a reference system for planning and decision-making at lower levels and could help investigate whether local decisions meet national targets (paper 8). Some suggestions of how such national assessments of ecosystem services could be designed and implemented are developed in paper 12. First propositions for concepts, indicators and methods for implementing national assessments of ecosystem services that correspond with approaches used in landscape planning have been proposed in paper 8.

Last but not least, integrating ecosystem services in planning could foster the use of innovative governance, business and funding models for land use management options that sustain, restore or enhance biodiversity and ecosystem services (paper 1). Examples for such approaches to valorize nature and landscape include payments for ecosystem services and new incentives to account for the insurance value of ecosystems. An assessment of ecosystem services supply and demands can also help funneling agri-environmental funds to areas where the provision of certain services needs to be enhanced to meet demands (paper 3). Finally, it could help in identifying those sites where response measures seem to be placed most effectively (paper 4).

## **4.3 Implications for landscape planning outcomes**

### **4.3.1 Implications for the substantive information generated**

As an effect of an integration of the ecosystem services concept in landscape planning, new kinds of substantive information can be generated. A number of different types of new and complementary information can be identified.

If the ecosystem services concept is integrated in landscape planning, information on a broader range of functions or services than considered (see paper 1, 4 & 13). Ecosystem services information can not only consider the capacities to provide services, but also the actual flow of services as a result of human and ecosystem contributions, the actual use of services, ecosystem services demands, as well as associated benefits and contributions to human well-being. This additional information can support identifying synergies, overcoming conflicts, and choosing appropriate implementation instruments (Paper 3 and 7). If applying the ecosystem services concept holds its promise to better link land use changes to the impacts for human well-being, it could help in identifying synergies between economic and environmental interests and enhance public and decision-makers acceptance of such proposals (paper 10).

Ecosystem services information can include more quantitative estimates of services provision and demand than is usually provided by conventional landscape planning. Such information would enable a more detailed analysis of the interactions, synergies and conflicts of interest associated with the supply of various ecosystem services under alternative land uses (paper 9). Furthermore, integrating the ecosystem services concept can provide new information on social and economic values attached to ecosystem services. In drawing on insights from the German TEEB follow-up study on rural areas, we find in paper 9 that economic valuations of benefits and costs of alternative land use options can provide useful information for policy, management, and decision-making. In addition, we argue that economic valuation can help landscape planning communication by raising awareness for nature's values to people in addition to and beyond the important role of ecosystems to conserve species and habitats.

In paper 10, we report ambiguous perceptions among planners concerning the use of economic valuation. While some planners perceived such valuation as generally enhancing understanding and enabling comparisons, others found it difficult to comprehend and communicate the assumptions behind and implications of economic valuation.

Integrating ecosystem services can yield new kinds of information on trade-offs among ecosystem services as resulting from alternative land use options beyond the use of maps. It can also provide a

new incentive to quantitatively evaluate the effectiveness of different approaches to fund agri-environmental measures (cf. paper 6). Furthermore, ecosystem services information can help in communicating values and assess the costs and benefits of alternative land use options for different actor groups (paper 3). Examples provide in paper 7 illustrate the implications of an expansion of maize production for biogas on different ecosystem services in a way that provides a better overview of trade-offs among ecosystem services for different land use options.

#### **4.3.2 Potential changes induced in the relationships among planning participants**

The scope of this habilitation thesis did not include an empirical analysis of how an uptake of the ecosystem services concept within a landscape planning process might influence the relationships among participants. However, the papers comprising this thesis provide some indication of likely implications.

On the one hand, we argue in several contributions (Paper 1, 2, 4, 9, 10 & 13) that using the ecosystem services concept could enhance the interest and motivation of diverse stakeholders to participate. Ecosystem services could function as a boundary object (cf. Abson et al. 2014, Paper 13) to which multiple actors can relate to as a starting point for jointly identifying, planning, and implementing preferred options for landscape development. The concept of ecosystem services and the complementary information it produces for landscape planning can help the public to engage in a more informed debate about options for future landscape development (paper 7). The ecosystem services concept offers an opportunity to pre-process research knowledge into a form potentially more attractive for politicians (paper 9). The concept can help connecting stakeholders in the area of integrated rural development and mainstreaming of environmental considerations across disciplines and sectors. To serve as a facilitator of such discourse, the development of robust and realizable methods tools for practice is required (paper 9). Despite the large potential of ecosystem services to inform public debates, the prevailing critical perspectives of stakeholders towards the concept (Schröter et al. 2014) need to be taken into account and ways need to be found for appropriately addressing them (paper 9)

On the other hand, it is not yet known if the ecosystem services term can really be easily understood by diverse stakeholders and citizens, and if it fulfills its promise to serve as a concept to openly discuss the positive and negative implications of decision-options. In fact, it might be the case that using the new term might be confusing, and that the frequent association of ecosystem services with nature conservation interests on the one hand, or economic and monetary valuation on the other hand might alienate some actors from participating in debates and collaborative decision-making. The survey of regional planners and landscape planners in paper 10 revealed a generally positive

perception of the potential contributions of the ecosystem services concept to landscape planning, and an interest to further explore the applicability in practice.

## **4.4 Recommendations for further research and practice**

### **4.4.1 Recommendations for further research**

Both the concept of ecosystem services and its integration in planning are new and vibrant fields of research. Based on the insights generated during the work on this thesis, a few dimensions can be identified that provide promising opportunities. The following summary of proposals for further research is structured according to the domains of landscape planning outlined in section 2.

In terms of theory, further research can focus on empirically investigating changes in the use of terms, statements and contexts in applications of the ecosystem services concept in landscape planning. An example of such research on discursive changes is provided by Leibenath (2017), focusing on the German TEEB process. In the context of theories of planning, more research can address how the use of the ecosystem services concept changes planning practices and procedures, for example based on case studies and expert interviews.

More research is needed on methods for assessing, evaluating and communicating ecosystem services (papers 9, 12, 13, cf. Bendor et al. 2017). Although much research has already focused on advancing methods for assessing and evaluating the (potential) supply and delivery of ecosystem service, still knowledge gaps exist concerning robust methods applicable at the landscape scale. Furthermore, methods are needed for services that have received little attention such as inspirational cultural ecosystem services and some regulating ecosystem services (Sutherland et al. 2017). For application in the field of landscape planning, methods for assessing ecosystem services need to provide robust decision-support on relevant service, even in situations with little data availability (paper 7). Hence, methods are needed that are robust enough to serve as the basis for decision support, but only as complex as necessary. The development of these methods can build upon existing approaches and does not need to start from scratch.

To allow for a broader uptake of ecosystem services assessment methods, a good documentation and guidelines for application need to be made available. At best, a toolbox of suitable methods with appropriate documentation should be provided. Developing standards for assessing and valuing ecosystem services in specific planning contexts and instruments would be a useful step for greater applicability. In order to enhance applicability in planning, the interests, decision-contexts and requirements of methods and outcomes need to be considered from the very outset of method development (paper 10). Identifying, quantifying and minimizing uncertainties in ecosystem services assess-

ments are another field that deserves greater attention (paper 7). Further innovative research could explore opportunities for using data generated by new technology such as social media, drones, digital sensors and high resolution satellite imagery in the assessment and valuation of ecosystem services.

Methods for assessing ecosystem services demand as well as methods to estimate the benefits of ecosystem services to human well-being are still scarce (paper 5). Diverse sources of information to be harnessed to develop such methods, from field research and interviews to social media. Investigating risks for ecosystem services provision is another promising field for further research. In this regard, existing approaches to assess sensitivities and human pressures in landscape planning (see paper 4) could be brought together with recent research in the field of risk assessments of ecosystem services (see e.g. Maron et al. 2017).

A major field for further innovation is to advance methods for assessing, illustrating and communicating ecosystem services trade-offs. The key challenge here is to develop ways for usefully comparing changes across different ecosystem services. Further studies can explore the relative advantages and disadvantages of using different kinds of scales (such as cardinal scales vs. ordinal scales) for comparison, and which methods and tools help to best illustrate these trade-offs to different audiences. Research can address the conditions under which scenario impacts should be assessed in terms of relative changes in ecosystem services delivery with respect to a reference year or to a target value, and in which cases economic estimates of respective costs and benefits are most useful (cf. papers 7 & 13).

An interesting field of research is the development of methods to establish target values for the provision of ecosystem services, also as reference values against which progress in intentional landscape change can be evaluated. Scholarship in this regard should consider and build upon the large body of studies on environmental quality targets (e.g. Fürst and Gustedt 1989). Another dimension of research can address the development of standard costs for impairments of ecosystem services from land use changes. Recent research in this area has identified the ranges of economic costs and benefits of such impairments from a review of existing studies (Förster et al. 2017). A next step will be linking these estimates better with biophysical assessments and the identification of areas with more or less similar cost and benefits estimates in order to decrease the diversity of potential values.

With the topic of ecosystem accounting being still high on the environmental policy agenda, further research can consider which contributions the field of landscape planning could provide. Research could explore if some of the established approaches, indicators and methods for the assessment and valuation of landscape functions and ecosystem services could be used in the development of methods for biophysical assessments at national levels. Research questions that are of more remote rele-



vance for landscape planning include those regarding the links between ecosystem condition and ecosystem service provision, and the links between biodiversity and ecosystem services.

Further research in landscape planning could explore new ways for communicating ecosystem services, for example through new planning strategies such as green infrastructure (cf. paper 5) and nature-based solutions (cf. European Commission 2015; Eggermont et al. 2015; Albert et al. 2017b). Paper 5 argued that more research was needed of how strategies for green infrastructure can be developed, and how they could be integrated in spatial planning frameworks.

Finally, further scientific inquiry can explore the potential impacts of using the ecosystem services concept in decision making. Such research could examine if information on ecosystem services will actually yield a better consideration of environmental aspects in planning processes, and evaluate this information actually influences preferences and decision-making of relevant audiences (paper 7) Investigating this issue can use methods such as transdisciplinary case studies, planning experiments and focus group discussions (paper 4 and 13). An inspiring example in this regard is provided by Rode et al. (2017) who evaluated the implications of providing different kinds of ecosystem services information to participants in a hypothetical decision context.

#### **4.4.2 Recommendations for practice**

The papers comprising this thesis demonstrate that the ecosystem services concept indeed holds remarkable promise to enhance the consideration of the importance and value of ecosystem services in landscape planning and decision-making. Landscape planning should make use of this opportunity wherever possible and appropriate. To decide if and how the ecosystem services concept should be integrated in landscape planning practice, I recommend considering the following aspects.

The first step should be to scope the context of the potential application. Important considerations concern the issue at stake, the relevant decision-makers, and important legislation and planning instruments. It needs to be clarified what decision-space exist for using information on ecosystem services, who would be responsible for funding and implementing land use changes, who would be potentially affected by the decision, what data is available and how many resources and what time is available for assessing ecosystem services.

Second, a decision concerning the intended strategic use of the ecosystem services concept needs to be made. Diverse options exist for using the ecosystem services concept in planning, ranging from fully integrating the concept in the formal planning process to simply adding some ecosystem services estimates to the regular planning procedure. In which way shall the ecosystem services concept be harnessed in the particular context at stake? Should the concept be fully integrated in one specific planning instrument? Or should it not be used at all? For example, a survey among planners (pa-

per 10) revealed that the perceived potential benefits from using the ecosystem services concept would strongly differ depending on context. Application contexts perceived as promising were project-oriented planning, public information, and regional development. In order to enhance transparency and compliance with legislation, the addressees of ecosystem services information and the decision-making space need to be clarified within which ecosystem services assessment and valuation results can be considered (paper 10). It should be critically evaluated if information on ecosystem services is really needed in addition to already existing environmental information in order to justify the additional resources required for the assessment (paper 10). Planners should not be too optimistic about the potential impact of ecosystem service information. In fact, environmental information in general remains just one of several aspects driving decision-making (paper 10). I recommend planners to consider what kind of information on ecosystem services would be useful, for what decision, and for whom. Furthermore, the requirements for information on ecosystem services need to be established, i.e. how robust must the information be to serve as the basis for land use decision-making. Given the often substantial constraints in data and resources available for landscape planning, planners need to ask themselves if the extra efforts for generating ecosystem services information in addition to already available information should and can be made. An important aspect to consider are the existing critical perspectives on the ecosystem services concept (paper 12). For example, some commentators have critiqued the concept of too strongly emphasizing economic values, potentially resulting in ignorance of other relevant values of ecosystem services (Morelli and Møller 2015). Regardless of what way of implementation chosen, I recommend building upon emerging insights, testing applications of ecosystem services in planning instruments, and critically evaluating the potential implications of using the concept before making a decision about formal integration.

Third, once the intended context and purpose of using the ecosystem services concept have been defined, decisions need to be made concerning which ecosystem services definition and concept to use, which aspects of ecosystem services to consider (capacity, flow, supply), and what ecosystem services categorization system to apply. Oftentimes, the definition, concept, and ecosystem services categories need to be adapted to the specifically context. The decision concerning which term to use for ecosystem services also needs to be made with regard to the context and intention for use. In some cases, it may be helpful to speak of ecosystem services to highlight the innovation it brings to planning, while in other cases using the term might be distracting. In such situations, it might be easier to refer simply to services derived from nature and landscape.

The definition of ecosystem services to use depends on the context and prior knowledge of participants. For the application in landscape planning, the more recent definition of ecosystem services as

'contributions' to human well-being as in TEEB (2010) or as nature's contributions to people (NCP) (Pascual et al. 2017) has conceptual advantages over the more vague definition of ecosystem services as benefits as proposed by the MA (2005). Using conceptual models such as PRESET (paper 3) and the ES-in-planning framework (paper 4) can help applying ecosystem services definitions and concepts within the planning context and existing planning frameworks. For example, those conceptual models can help to consider all ecosystem services regardless if they are currently used or not (cf. paper 3).

Which ecosystem services categorization system to apply again depends on the context. Numerous different categorization systems exist, including the ones proposed by the MA (2005) and TEEB (2010). The Common International Classification System (CICES, Haines-Young and Potschin 2013) is probably the most frequently used typology in Europe today and will continue to further evolve with emerging findings from applications in practice. A comparison and proposed translation of ecosystem services categories from CICES to a set of ecosystem services to be applied landscape planning in the German context is provided by Albert et al. (2015a). The decision of which categorization system to apply is not easy to make. It needs to be considered that each ecosystem services categorization system has its particular purpose and field of application. In other words, not all systems are useful in all contexts. For landscape planning, I suggest to select the existing categorization system that seems most useful, to adapt it as needed, and to focus on those ecosystem services of particular importance for the case study areas and for which data and appropriate assessment methods are available given the often limited resources (cf. paper 4).

The fourth step is to decide about the strategy to be applied for the assessment, valuation and communication of ecosystem services, including the role and degree of public and stakeholder participation. Depending on the specific purpose, context and available resources, different kinds of indicators and outputs will be helpful. Planners should explore which ways of communicating ecosystem services effects are best understood and most useful by the audiences. For example, survey results reported in paper 10 revealed that planning practitioners prefer using context-specific combinations of ecosystem services information formats. Using cardinal scales in ecosystem services assessments is often perceived as transparent and well understandable, but it makes it more difficult to compare the level of importance across different services as different units for assessment need to be employed. The appropriate level of stakeholder and public participation to implement in the assessment and valuation of ecosystem services needs to consider the specific context – in some cases, a systematic involvement of stakeholders and citizens may be advisable, whereas in other cases it is not necessary or even impossible. In any event, landscape planners need to ensure that the ecosystem services information is presented in a format that complies with existing data, planning instruments

and understandings of the audience, without overstressing the capacities and resources available (cf. paper 10).

As a fifth step, landscape planners should critically consider which indicators and methods to apply in assessments of ecosystem services. In general, the methods for assessments should be designed fit for purpose (paper 10). For application in planning, appropriate ecosystem services assessment methods deliver outputs that are as simple as possible but at the same time as robust and reliable as needed. In other words, assessing ecosystem services for planning does not require attaining the highest levels of detail possible, but should aim at providing information that is robust enough as a basis for decisions at stake. In cases of uncertain data, the design of targets and measures should account for uncertainty, for example by applying the precautionary principle. If possible, the increasing amount of data available on national and sub-national levels should be harnessed, but problems of scale and limitations of transferability need to be recognized. Scale issues are important to consider as data generated for decision-support at one level is often insufficient to provide guidance at a subordinate level with an appropriate level of accuracy (paper 8). Inherent uncertainties and complexities of ecosystem assessment methods need to be identified and appropriately communicated. In many case studies of landscape planning, it may be advisable to distinguish between public and private goods in order to clarify the respective addressees, and to account for spatial discrepancies between costs and benefits (paper 3). In addition, attention should be paid to democratically legitimized environmental objectives and the recognition of existing anthropogenic impacts (paper 4). Data availability clearly limits the level of sophistication of methods to be employed. In consequence, compromises and generalization will sometimes have to be accepted until better data is available (paper 8).

A further decision needs to concern the method of valuation of ecosystem services to be used. As outlined above, diverse methods for evaluating or valuing ecosystem services are available. Paper 4 provides an example of how ecosystem services can be evaluated with respect to targets derived from existing legislation and directives. This reference to existing targets is important to justify why the consideration of each ecosystem services is needed in decision-making, especially in cases where private interests are concerned or in situations of litigation and conflict resolution. In addition, landscape planners can use opportunities for highlighting the further benefits that ecosystem services provide to human well-being. If it is of perceived benefit for decision-support and in case resources allow, social and economic valuation techniques can be applied. Such valuation, however, should be framed within the specific legislative decision-space mentioned in the first step outline above. Monetary valuation in particular should be only applied where it is of perceived value for decision-support. However, such valuation should be used with caution, highlighting the legislative decision space and

recognizing the need to apply valuation methods that are accepted by audiences. For example, it seems that the replacement costs method is understood relatively well among stakeholders while willingness to pay approaches are often critiqued. However, the replacement cost method probably often severely underestimates the full range of economic benefits that may be lost. In addition, equity issues and power relations need to be taken into account and addressed, especially when social and economic valuation methods shall be used.

If targets and measures are developed based on outcomes of ecosystem services assessments, landscape planners need to account for the inherent uncertainties, for example by safeguarding for inaccurate assessment results as suggested by the precautionary principle. The development of implementation concepts for proposed targets and measures of landscape planning can finally benefit from references to ecosystem services. For instance, new forms of funding and cooperative implementation through instruments such as green bonds and payments for ecosystem services could be harnessed.

#### **4.5 Concluding remarks**

Looking across the possible changes of and recommendations for integrating the ecosystem services concept in landscape planning, the question remains of how to best move forward in practice. In this section, I lay out some considerations in this regard by focusing on the particular German context in which most of the research conducted for this thesis has been executed.

A full and formal integration of the ecosystem services concept within the existing system of landscape planning in Germany is unlikely (see papers 9 and 10). It currently seems unrealistic that substantial changes would be implemented in regulations and laws relevant for landscape planning as the regulations in place are often critiqued of being too complicated already and thus hindering development. Especially for landscape planning at community and county level, legislative change to integrate the ecosystem services concept is not feasible given the already limited resources. Furthermore, recent efforts to reform environmental legislation in Germany, for example to develop a coherent environmental code have failed, making new initiatives for substantial revisions unlikely. Furthermore, financial and temporal resources are lacking within the given context of funding landscape planning processes because the fee structure imposed for architects and engineers (HOAI) provides only limited funding that in most cases will not suffice for considerations of ecosystem services beyond the established standards for assessing landscape functions or natural assets. Finally, understanding the diverging concepts and methods for ecosystem services assessment and valuation is challenging and applicable guidelines for simple and robust ecosystem services methods in landscape planning are so far lacking.

Against this background, I recommend a pragmatic approach of developing and testing options for complementing existing landscape planning processes with considerations of ecosystem services instead of aiming for a comprehensive integration. Such a pragmatic approach could make use of the new kinds of quantitative and eventually economic information generated by, and the communicative power associated with, applications of the ecosystem services concept as a way to provide complementary arguments for the conservation and sustainable use of nature and landscapes. These new arguments are likely to resonate well with decision-makers, stakeholders, and citizens (cf. paper 9).

Given the resource constraints, one promising procedure for complementing landscape planning at the community or county level with the ecosystem services concept could be the following: first, a regular process of landscape planning would take place and result in the development of a conventional landscape plan or landscape framework plan that spatially identifies targets and measures for implementation. Second, relevant decision makers, stakeholders and the responsible landscape planners could identify a small set of priority strategies for implementation, for example the preservation of important open spaces within the urban fabric, the restoration and enhancement of river and floodplain corridors, and the conservation and restoration of moorlands. Once these key strategies are identified, landscape planners could partner with communication experts to develop storylines of the expected added value of implementing these strategies. These storylines could pick up the idea of ecosystem services – eventually with different terms such as landscape services – and connect it with promising strategic spatial approaches such green infrastructure (cf. paper 5) and the more recent concept of nature-based solutions (cf. European Commission 2015; Eggermont et al. 2015; Albert et al. 2017b). Then, relevant ecosystem services could be identified for which a positive effect would be expected as a result of the implementation of the proposed strategies. The positive impacts that might occur could be assessed in terms of changes in the provision of these essential ecosystem services, and different ways of valuing and communicating the benefits and eventual trade-offs could be explored and implemented (for some promising examples of how these benefits of particular land use options can be described, see papers 7, 9 and 13). Finally, results of the assessments and valuation exercises should be synthesized and innovative ways for illustrating the complex information, for example through the use of infographics, 3D online map services, and augmented reality could be used.

To implement such a pragmatic approach, landscape planning research should focus on developing relatively simple but robust methods for assessing, quantifying and eventually socially or economically valuing ecosystem services based on existing assessment and evaluation data generated by conventional landscape planning. Guidelines will need to be developed that explain how the assessment

and valuation can be realized. Finally, case studies need to be developed and evaluated to learn from experience and to identify useful procedures. Empirical investigations and planning experiments can enhance understanding of the implications of using different kinds of arguments for landscape planning proposals in decision-making. Last but not least, capacity building among landscape planning practitioners is needed to enhance the knowledge and skills necessary for assessing, valuing, and communicating the benefits of planning proposals better through the use of the ecosystem service concept. The next years will show if we can successfully advance this knowledge and capacity building process, and if the ecosystem services concept can fulfill its promise to assist landscape planning in its quest for supporting sustainable landscape development in practice.





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