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Editorial

Exploring the Role of Science in Sustainable Landscape Management. An Introduction to the Special Issue

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Abstract: In this special issue, landscapes are conceptualized as social-ecological systems resulting from the interaction between societal and natural processes. Landscapes produce services and values to stakeholders that share a particular geographical area. In view of landscape sustainability, these stakeholders have common responsibilities to retain the functioning of landscapes to service future generations. Also, because demands for landscape services overlap and require landscape wide management, users and owners of the landscape have common interests in creating added value and organizing landscape wide coordination of interventions. This interdependency calls for collaborative management, but is also a cause of conflicts. From the point of view of scientific support, there is a need for interdisciplinary and solution-oriented approaches that foster collaboration. This special issue presents innovative interdisciplinary approaches that illustrate the main challenges for science to support community-based landscape governance.

Keywords: landscape sustainability; science-practice interface; collaborative research; landscape governance; landscape services

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1. Landscapes as Social-Ecological Systems

In this special issue, landscapes are considered as spatially-heterogeneous social-ecological systems that develop in a geographically limited area through the interaction of landscape-ecological processes and interventions by the community of land-owners and users. These interventions are responses to growing needs to benefit more or in another way from the services that landscapes can offer to society, or to safeguard those benefits in the light of (regional or global) economic and environmental changes, for example, a world-wide transition to non-fossil energy or to increasing weather extremes associated with climate change. These responses include a reframing of benefits and values provided by the landscape and a physical adaptation to change the functioning of the landscape to better provide the future demands, including those of generations to come. However, landscape users vary in their perception of desired value, and do not necessarily agree on what would be the best adaptation measure to take and where would be the best location to implement it. Therefore, sustainable landscape management is characterized by innovation, social learning, and negotiation in a community-based process. In this context, landscape management is sustainable if it promotes social and economic benefits from landscape services as a result of a community-wide decision-making about a desired balance of values.

2. Challenges in Landscape Sustainability Science

In this introduction to the special issue, I will first give an overview of the main challenges and then reflect on how the contributions of this special issue contribute to pushing sustainability science towards a more effective role in society.

Recent reflections on progress in sustainability research have provided insight into how science contributes to transitions towards sustainability [1–4]. Applied to landscape management, Opdam et al. [5] translated these insights into the following key points.

1. A sustainable landscape is a normative concept: the term means different things to different people and is connected to their beliefs, values, and preferences. Decisions aiming at making a landscape more sustainable depend on the world view of owners and users of the landscape and of the resources they have available. Therefore, sustainability aims and solutions are being defined in a societal process, not in a scientific discourse. Sustainability science requires an understanding of how environmental, social, and economic mechanisms are interdependent [6].
2. Any decision to adapt the use of a local landscape to achieve sustainability may have consequences for landscapes elsewhere in the world [7]. Therefore, science should give insight about how local decisions are connected to regional and global drivers and effects [8].
3. The relation between humans and landscapes has often been the subject of analytical and impact assessment studies, but generating landscape solutions has not received much attention in sustainability science [9,10]. For achieving sustainable landscapes, understanding the problem should be followed by creating interventions for adapting the landscape. This activity requires a design approach [11].
4. Landscape sustainability often requires fundamental societal transformations [12,13]. Collaborative forms of governance, which are adaptive and iterative (rather than rule-based and linear), are known to support such transformations [14]. Such governance requires knowledge exchange and complex forms of learning in social networks [15]. This calls for scientists to engage with society in a way that fosters both motivation and capacity for societal change [4,12].

These points emphasize a need for landscape sustainability science to be based on collaborative approaches (in which scientists engage with society), social-ecological systems thinking, and scientific approaches for creating solutions. This special issue seeks to illustrate these insights with innovative interdisciplinary research. The novelty of this focus can be illustrated by the fact that (in spite of the explicit emphasis on cooperation between science and practice in the description of the theme) the majority of manuscripts that were offered to this special issue were conventional assessments of land use changes and ecosystem services rather than studies in which solutions were generated in cooperation with local communities.

3. Contribution of the Special Issue to Landscape Sustainability

3.1. Social-Ecological Systems

The concept of social-ecological systems connects ecological and social systems by two feedbacks: the perception within the community of benefits from landscapes and, secondly, the interventions in the landscape that are taken to ensure that better value is obtained from these benefits. Landscape services (a specification of ecosystem services appropriate for use in landscape governance, [16]) play a central role in several of the contributions to this special issue. García-Llorente et al. [17] consider landscape services as provided by social farming, including food production, agrobiodiversity, the preservation of local varieties, and aspects of human health. Berkowitz and Medley [18] express the values that home gardeners experience as services, for example, in terms of enjoying species, inspirational, and health benefits. Opdam and Steingrover [19] show how companies may gain corporate benefits by including landscape services in their food chains and social strategies. Karrasch et al. [20] use landscape services in relation to the values achieved by adapting coastal landscapes to climate change, and they use them in a spatially explicit way by linking them to landscape elements. Burgi et al. [21] use them as the connection between landscape functioning and the societal demands for landscape values as perceived by people. The main advantages of using landscape services in sustainable landscape management are that: (1) the concept links values to the ecological and physical functioning of the landscape; (2) by using the concept, a demand for future values by groups of stakeholders is stimulated (facilitating negotiations between land owners or managers and users); and (3) the concept facilitates social learning and collaboration among stakeholders with different interests and values [22].

3.2. Landscape Governance

There is extensive literature suggesting that transformations in socio-ecological systems are more likely when key actors feel ownership of their future environment [14]. Collaborative and participatory approaches allow a better use of local knowledge, more effective social learning, and more responsibility during implementation. Several types of collaborative forms of landscape governance have been proposed [6,23]. In the context of this special issue, landscape governance is based on the shared perception of common interests and benefits provided to stakeholders by the future landscape, in relation to their private interests, to legislation and the distribution of power in society. This is nicely illustrated in this special issue by the analysis of Riggs et al. [24] for forest governance in Indonesia. They propose an institutional solution to unsustainable practices in forest management by suggesting that national and provincial governments, NGO's, and research groups form a coordinating and stimulating body that cooperates with local communities. This clearly illustrates the need for multi-scale governance. Opdam and Steingrover [19] discuss how and why companies may get involved in governance networks in their region, thus extending the formal and non-formal types of governing with a market-based mechanism. Also, Garcia-Llorente et al. [17] observed that governance networks for social farming were partly based on market-based mechanisms. What the special issue illustrates is that sustainable landscape management requires innovations in the type of governance in which the traditional top-down steering by the government (based on rules and legislation) is (partly) replaced by a diversity of governance networks, with new partners and mixed governance mechanisms. Additionally, information provided by scientists can be a mechanism in governance [25]. For example, Opdam et al. [26] discussed how information about the common benefits of landscapes and about the interdependence of land owners in a landscape area to create these benefits could facilitate collaborative landscape governance.

3.3. Creating Solutions

A landscape can be unsustainable because the current land use is too much focussed on one or a few landscape services, to the detriment of other services for which there is a demand. For example, in many modern industrialized farming systems, food production is so dominant that most other services (such as pollination, human health, scenic beauty) are suppressed. Also, a landscape may be perceived as unsustainable if the demanded services cannot be produced due to insufficient eco-physical conditions. For example, the green infrastructure of the landscape may not be robust enough to provide adequate pollination services for a region with many orchards. If the current landscape is perceived as being unsustainable, the next step would be to adapt the landscape to bend its functioning towards more sustainable conditions. Adjusting the eco-physical structure of a landscape or its use is a complex societal process in which a common vision on the future landscape is translated into a new landscape pattern which is better in balance with the required functioning. The outcome of this process is often in the form of a map and pictures of the future landscape. The recognition that social learning and knowledge sharing is crucial in finding a sustainable solution for a landscape area is the basis for the cyclic process scheme proposed by Burgi et al. [21]. Here, design is the third step, following assessments of alternative future scenarios and a choice for one of them, and preceding implementation of adaptation measures. Following such an iterative process, Karrasch et al. [20] used alternative narratives for future landscape and art-based illustrations, showing translation of the narratives into a landscape picture that people can understand. These are important tools to support a common learning process of the local community. Riggs et al. [24] also apply a design process, but they start with the design of a governance network that is supposed to work towards an improved use of the landscape for timber production. As these studies show, design is a creative and innovative process in which "dreamed" values are joined with environmental and economic realities in a collaborative effort by practitioners and scientists [11,27].

3.4. The Role of Scientists

Over the years, landscape scientists have reflected on the gap between science and practice, e.g., [28]. Often, the suggested improvements were limited to the need of better communication and connecting to policy makers. Here, we propose that a better understanding of how scientific information interacts with social processes is fundamental to bridging the gap between science and practice. It means that we should ask questions based on scientific theory and answer them with scientific methods. For example, Opdam et al. [26] recently reviewed a number of studies on the interface between landscape ecology and social sciences, and found that multifunctional concepts like green infrastructure and landscape services can facilitate actors from different sectors to converge towards a common goal and also stimulate collaborative landscape management. This special issue contains one study that makes the interface between scientific information and practice as an object of scientific research. Suh et al. [29] investigated the role of knowledge and environmental perceptions in the willingness to buy smart irrigation systems among home-owners in three states in the USA. The factors they found to be of influence (including awareness of the urgency of the water problem and social network related factors such as what the neighbours do) can be understood by using the theory of planned behaviour [30] that is used by Opdam and Steingrover [19] to describe the willingness of companies to participate in sustainable landscape management.

Other studies in this special issue illustrate different ways of cooperating with practitioners in landscape management, ranging from individual gardeners [18], via social farms [17], to governance networks [24] and landscape transformations [20]. In these examples, scientists play different roles. They may (1) contribute to understanding the relation between landscape services and the response by users and owners of pieces of land [18], (2) provide information about landscape indicators for sustainability [20], or (3) organize the process and facilitate joined vision building and decision making about interventions [20,21]. The need for this role diversity can be understood with help of the analysis by Raquez and Lambin [31], who investigated 46 case studies to learn how scientific information had contributed to social-ecological transformations towards sustainability. The three key factors they identified were: (1) information about the need and possibility to change, (2) capacity of the society to organize change, and (3) motivation (willingness) of society to change. Understanding how roles played by scientists contribute to these factors is essential to further develop the effectiveness of science in the management of sustainable landscapes.

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