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Bringing ecosystem services indicators into spatial planning practice: Lessons from collaborative development of a web-based visualization platform

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ABSTRACT

Considerable efforts are made to integrate ecosystem services (ES) indicators into spatial planning practice. Although a lot of decision support systems already provide helpful functionalities, they are not yet integrated into everyday decision-making, mainly because they do not readily fit into planning processes in practice. There is an increasing awareness that the development should foster collaboration between interdisciplinary researchers and the end users of the tools to secure their suitability for such planning processes. Hence, user-oriented research and experimenting is seen as the appropriate approach for getting the tools ready for practice. Guidelines for conducting such processes are yet missing. Here, we contribute to the development of such guidelines by means of a practical case study. The focus is placed on how transdisciplinary (TD) research on spatial decision support systems should be designed for the integration of ES indicators into planning practice. In a TD project, a web-based visualization platform with indicators of relevant ES was developed to support municipalities of the Canton of Zurich, Switzerland, in assigning adequate watercourse corridors according to the revised Swiss Waters Protection Act. A preliminary as well as an enhanced version of the platform prototype were demonstrated to different actors for evaluating the platform's readiness for practice. We assessed the process design and the quality of the product in a discursive manner. Thereby, we implemented a set of assessment criteria derived from literature and adapted them to the case study at hand for the analysis of empirical material (participant lists, project schedule, meeting minutes and observation protocols). Finally, we discussed the lessons learned on developing significant ES indicators and their visualization and the conclusions drawn with respect to ensuring the quality of the platform development process. The results show that conceptualizing the ES indicators in strong collaboration with practice representatives increased their relevance to the actors' needs and therefore their legitimacy. Providing interfaces for collaboratively translating practical approaches into scientific models is, thus, crucial for the development of significant indicators. Furthermore, specifying the purpose of the visualization platform in planning processes requires prototyping and iterative conceptualization, because practice actors need concrete examples to express their specific demands. This also requires that the concept of developing the ES indicators and the spatial decision support systems should be treated rather as an open working paper than as a final document agreed on in the first collaboration phase. Hence, time scheduling and occupying skilled project managers for this iterative process should be taken seriously.

1. Introduction

The growing attention of science and practice to ecosystem services (ES) has led to an increased interest in both the public and private sectors for approaches to develop and apply ES indicators in real-world decision-making (Daily et al., 2009; Ruckelshaus et al., 2013). ES are defined as goods and services provided by ecosystems,

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which contribute to human well-being, ranging from provisioning (e.g., food, fresh water) and regulating (e.g., water regulation) to cultural (e.g., recreational experiences) and supporting services (e.g., habitat for plant and animal species) (MA, 2005; de Groot et al., 2010). Several decision support systems are evolving for integrating ES into planning processes (Bagstad et al., 2013), i.e., interactive, computer-based tools, which help decision makers to visualize, compare, and consider trade-offs among many ecological, social, and economic values (Labiosa et al., 2013). Although a lot of these systems already provide helpful functionalities, they are not yet integrated into everyday decision-making, because they do not readily fit into existing planning processes (de Groot et al., 2010; Bagstad et al., 2013).

In order to transform current landscape patterns into more sustainable ones, the collaboration of science and a variety of public and private stakeholders is seen as key (Healey, 2007; Scholz, 2011; Steinitz, 2012). Thereby, the transfer of the relevant information to all stakeholders in a credible and comprehensible manner is the essential prerequisite for successful collaboration processes (Wissen et al., 2008). In participatory workshop settings, particularly GIS-based landscape visualizations have proved to be valuable communication and information media for different planning tasks (Salter et al., 2009; Schroth et al., 2011; Wissen Hayek, 2011). Furthermore, besides a sufficiently large set of GIS-tools that can support planning and design, GIS-tools are increasingly offered as participatory web platforms, and designing solutions is becoming more and more a rather collaborative effort than an expert task (Batty, 2013). Most recently, different frameworks and prototypes of web-based visualization platforms were presented which should facilitate the collaboration of heterogeneous stakeholder groups by providing information on possible impacts of certain demands for ES on the fulfillment of other demands (e.g., Klein et al., 2013; Grêt-Regamey et al., 2013). However, the development of such web-based platforms should not only foster the collaboration between GIS-modelers and interdisciplinary researchers but also with the end users of the tools to secure that the platforms actually provide helpful decision support for planning processes (Cook and Spray, 2012; Bagstad et al., 2013).

User-oriented research and experimenting is seen as the appropriate approach for getting the tools ready for practice (Daily et al., 2009). Yet, there are only few studies that assess the application of tools for quantifying biodiversity and ES in real-world decision-making and provide preliminary guidelines as basis for accelerating the development of effective tools (e.g. Ruckelshaus et al., 2013). Thereby, the quality of the system or platform development process is at least as important as the (technical) decision support system itself (Cash et al., 2003).

Approaches which are aiming at a co-production of practical outcomes that can be applied in a social or environmental context for problem solving, can be attributed to transdisciplinary (TD) research (Wickson et al., 2006; Pohl, 2008). However, the boundaries between applied and TD research types are gradual with regards to the distinguishing characteristics and the methodology (Hirsch Hadorn et al., 2006). There is neither a common definition nor methodology of TD research, but patterns of common characteristics can be identified (Jahn et al., 2012; Thompson Klein, 2013). According to Pohl (2005, 2011), important distinguishing characteristics of TD research are, that the researchers have to frame, analyze, and process a societal problem in a manner that (1) its complexity is grasped, (2) the diverse perspectives of science and society are addressed, and (3) that it links abstract and case-specific knowledge in order to (4) produce practically relevant knowledge according to the stakeholders' value systems. A collaboration of academic as well as non-academic stakeholders and a process of mutual learning are necessary to tackle the four issues (Wickson et al., 2006; Pohl, 2005, 2011; Hirsch Hadorn et al., 2006). Since the process is characterized by science-practice collaboration and mutual learning, the usability of results of this process should be evaluated in a recurrent manner (Pohl, 2005; Hirsch Hadorn et al., 2006). Yet the development of guidelines for designing and evaluating TD research are still in its infancy (Carew and Wickson, 2010; Lang et al., 2012). Important sources for principles and concepts for design and quality evaluation of TD research processes and products are primarily case studies (Klein, 2008; Thompson Klein, 2013; Pohl, 2011; Seppelt et al., 2012; Stauffacher et al., 2012).

Here, we contribute to the development of guidelines by means of a practical case study. The focus is placed on designing and evaluating the TD research on a web-based visualization platform for the integration of ES into everyday decision-making. We analyze a TD process where the planning task of an on-going collaborative planning process – the designation of watercourse corridors in the Canton of Zurich, Switzerland – was the starting point for collaborations between academic researchers and diverse actors from practice. The TD research aimed at the development of a web-based visualization platform for taking ES indicators of riparian areas and other indicators of socio-economic demands into account in the design of watercourse corridors at the local level. The intended purpose of the platform was to support discussion and balance diverse actors' conflicting interests in solution development. A preliminary as well as an enhanced version of a prototype were demonstrated to different actor groups for evaluation of the readiness of the platform for practice purposes. Here, we analyze empirical material of this case study, implementing a set of assessment criteria derived from literature. We discuss the lessons learned on how to develop significant ES indicators and to ensure the quality of the platform development process as well as the platform's decision support function in practice. We conclude by reflecting on requirements and implications of the development of spatial decision support systems integrating ES indicators into planning practice by implementing TD approaches.

2. Methods

2.1. Case study: Collaborative development of a web-based visualization platform

Riparian areas serve as habitat for plants and animals, as space for recreation and identification for the people, they provide fresh water and protect against floodwater or are economic production areas (Hauser et al., 2011). These services of the riparian areas contribute to human wellbeing (Millennium Ecosystem Assessment, 2005). Since physical modification of rivers through human activities has degraded the provision of these services significantly all over the world, there are increasing political activities considering river rehabilitation (Gilvear et al., 2013). In Switzerland, about 42% of the watercourses do not provide the services sufficiently (Zeh Weissmann et al., 2009), and the recent revision of the Waters Protection Act (GSchG, 2014) from the 1st of January 2011 obligates the cantons, therefore, to define adequate corridors for watercourses. These corridors shall provide an area for enhancing or restoring the supply of the ES. The process of their designation should be characterized by an informed trade-off decision-making of different actors' economic, ecological, and social demands (Oberle, 2011).

The Canton of Zurich started a collaborative process for the implementation of the Waters Protection Act. The goal of this broad-based participatory process was to define principles, approaches, and responsibilities for designating the watercourse corridors at municipality level. Furthermore, the canton wanted to provide the municipalities with spatial decision support tools. Particular tools were needed for effectively communicating and deliberating the spatial priorities of the provision of certain ES of