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When we cannot have it all: Ecosystem services trade-offs in the context of spatial planning

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ABSTRACT

Spatial planning has to deal with trade-offs between various stakeholders' wishes and needs as part of planning and management of landscapes, natural resources and/or biodiversity. To make ecosystem services (ES) trade-off research more relevant for spatial planning, we propose an analytical framework, which puts stakeholders, their land-use/management choices, their impact on ES and responses at the centre. Based on 24 cases from around the world, we used this framing to analyse the appearance and diversity of real-world ES trade-offs. They cover a wide range of trade-offs related to ecosystem use,

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including: land-use change, management regimes, technical versus nature-based solutions, natural resource use, and management of species. The ES trade-offs studied featured a complexity that was far greater than what is often described in the ES literature. Influential users and context setters are at the core of the trade-off decision-making, but most of the impact is felt by non-influential users. Provisioning and cultural ES were the most targeted in the studied trade-offs, but regulating ES were the most impacted. Stakeholders' characteristics, such as influence, impact faced, and concerns can partially explain their position and response in relation to trade-offs. Based on the research findings, we formulate recommendations for spatial planning.

1. Introduction

Despite the popularity and desirability of so-called 'win–win solutions' in spatial planning, they seem to be rare in real-world situations, where managers need to cope with trade-offs and hard choices tend to be the rule (Vane-Wright et al., 1991; Kooiman and Jentoft, 2005; Tallis et al., 2008; McShane et al., 2011; Muradian et al., 2013). Spatial planners face the challenge of finding ways to organize landscapes, land-use, natural resources, wildlife and other issues in such a way that they can better fulfil the diverse requirements of society, such as needs of local residents, viability of local economic activities, requirements of visiting tourists, maintaining environmental quality, safeguarding biodiversity. The ecosystem services (ES) concept is considered useful for addressing this challenge, as it is a broad and inclusive concept that stimulates reflection upon landscape multifunctionality (Grêt-Regamey et al., 2008; Niemelä et al., 2010; Wu, 2013). Many ES assessments at the local scale provide an overview of potential delivery, actual delivery and/or values of ES for a certain area. In many cases, such assessments have limited value for planning, as they are not very 'actionable' for planners and decision-makers (Eigenbrod et al., 2010; Laurans et al. 2013; Ruckelshaus et al., 2015). One problem is that lists of ES give the impression that provisioning, regulating and cultural ES can be met at the same time, while in most situations it is impossible to manage ecosystems in such a way that all these ES are simultaneously utilized at desired levels (Swallow et al., 2009; Raudsepp-Hearne et al., 2010).

The term 'trade-off' has become very popular in the ES literature to deal with ES interactions, but it has predominantly been used to point to a negative correlation between spatial (or temporal) co-occurrences of ES supplies (e.g. Rodriguez et al., 2006; Nelson et al., 2009; Mouchet et al., 2014; Castro et al., 2014, 2015). To operationalize trade-offs for spatial planning purposes, we propose to return to its original meaning as applied in economics, where trade-offs are usually explained in terms of society's production-possibility frontier. Trade-offs arise due to "*the basic economic fact that limitation of the total resources capable of producing different commodities necessitates a choice between relatively scarce commodities*" (Samuelson 1970, p. 17). Key elements of this definition are: (1) there is only a finite amount of human and natural resources, (2) humans need to make choices about how to utilise resources, and (3) choices involve a 'sacrifice' represented by the foregone production of goods and services each choice entails.

In the context of spatial planning and ES, trade-offs can be translated as 'land-use or management choices that increase the delivery of one (or more) ecosystem service(s) at the expense of the delivery of other ecosystem services' (derived from TEEB (2010), UKNEA (2011) and Felipe-Lucia et al. (2015)). This definition corresponds with similar approaches, such as 'beneficiaries trade-offs' (TEEB, 2010) and 'demand-demand associations' (Mouchet et al., 2014). In practice, this relates for example to situations where co-use seems to be impossible (e.g. housing development vs. nature conservation), when two or more desired ES either cannot be delivered at the desired magnitude or strongly inhibit each other (e.g. agriculture vs. flood control), or when the burdens and benefits of ES are unequally distributed over different stakeholders (e.g. maintaining traditional landscapes vs. rural tourism) (Quintas-Soriano et al., 2016). ES trade-offs often reflect rivalry between well-being components (Iniesta-Arandia et al., 2014) or value dimensions (Martín-López et al., 2014).

This way of framing of ES trade-offs puts stakeholders (with their different values, interests, needs, power and choices) and their actual use of ecosystems at the centre of the ES trade-off analysis. This is justified if we consider that stakeholders are not only the prime actors that cause ES trade-offs (Hicks et al., 2013; McShane et al., 2011), but are also the key players in finding solutions to alleviate these trade-offs. When ES trade-offs result in 'winners' and 'losers' (Daw et al., 2011; Howe et al., 2014), they can become a source of friction between stakeholders. If not dealt with appropriately, they can even lead to conflicts (TEEB, 2010; Gómez-Baggethun et al., 2013; Kandziora et al., 2013; Kovács et al., 2015).

The choices stakeholders make when they deal with ES trade-offs are influenced by social, economic, institutional, and ecological factors, which often are highly context-specific. Knowledge about ES trade-offs is therefore difficult to generalize or transfer from one location to another. Place-based studies that focus on the local specificities of trade-off mechanisms, involving local knowledge, are often the most efficient and reliable way to study these ES trade-offs. As such studies are rare, it is not surprising that knowledge is lacking on when and where to expect trade-offs, the mechanisms that cause them, or how to deal with specific trade-offs (Bennett et al., 2009; Ostrom, 2009; Howe et al., 2014). There is an immediate need to bring ES trade-off analysis closer to the real-world problems and practice of spatial planners and decision-makers. Several authors suggested that better understanding of the underlying causes and mechanisms for trade-offs can be beneficial for planning and managing ES, because it can help to: predict where and when trade-offs might take place; encourage honest dialogue, learning and trust between concerned stakeholder groups; potentially lead to more effective, efficient and credible management decisions; and help to obtain more equitable and fair outcomes by taking into account distributive impacts of ES trade-offs (derived from: Rodriguez et al., 2006, Bennett et al., 2009; Nelson et al., 2009; Hirsch et al., 2010; Raudsepp-Hearne et al., 2010; Elmqvist et al., 2011; McShane et al., 2011; Phelps et al., 2012; Hicks et al., 2013).

The goal of this research is to make ecosystem services (ES) trade-off research more relevant for spatial planning and to obtain a better insight into how ES trade-offs express themselves in the real-world. Therefore we propose an analytical framework, which puts stakeholders, their land-use/management choices and their impact on ES at the centre. Based on 24 cases from around the world, we used this framing to assess the appearance and diversity of real-world ES trade-offs. Although we realize that the sample size is limited, the comparative analysis can shed some light on the following issues: