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Framing local outcomes of biodiversity conservation through ecosystem services: A case study from Ranomafana, Madagascar

Susanna Kari [a,*], Kaisa Korhonen-Kurki [b,c]

[a] Department of Environmental Sciences, P.O. Box 65, 00014 University of Helsinki, Finland
[b] Center for International Forestry Research (CIFOR), P.O. Box 0113 BOCBD, Bogor 16115, Indonesia
[c] Helsinki University Centre for Environment, P.O. Box 65, 00014 University of Helsinki, Finland

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ABSTRACT

Conservation can have both positive and negative effects on human well-being by causing changes in ecosystem service flows and reallocation of the distribution of benefits. This can lead to different, sometimes contradictory, outcomes of conservation. We studied local perceptions of ecosystem service flows in the Ranomafana National Park area of Madagascar to examine the local outcomes of conservation. The Ranomafana forest area provides a variety of benefits that contribute considerably to local inhabitants' livelihoods and well-being. Changes in ecosystem service flows alter the provision of many important ecosystem services at the local level, which is likely to affect local livelihoods negatively and increase local vulnerability and inequality. The findings indicate the presence of trade-offs between types of ecosystem services and between different societal goals, namely conservation and development. Benefit trade-offs also occur within and between beneficiary groups and across spatial and temporal scales. Although conservation might prove beneficial for local people in the long run, its immediate local costs are high. The findings reveal the importance of integrating local perceptions of ecosystem services into conservation planning. In addition, there is a need for further negotiations of the trade-offs between ecosystem services, conservation and development in Ranomafana.

1. Introduction

Ecosystems provide numerous resources and processes, collectively known as ecosystem services that contribute significantly to human well-being (Millennium Ecosystem Assessment, 2005). With growing recognition of the importance of biodiversity in providing these services (Mace et al., 2012), biodiversity conservation activities are often justified as being beneficial to people (e.g., Mooney (2010)). As a result, protected areas are increasingly being managed for conservation purposes to deliver continuous ecosystem service flows from ecosystems to beneficiaries (Egoh et al., 2007; Ten, 2011).

Ecosystems and their services are subject to diverse demands and meanings and thus are perceived and valued very differently from different perspectives and across different spatial and temporal scales (Hein et al., 2006; Rodríguez et al., 2006). Conservation activities can lead to changes in ecosystem service flows and reallocation of the benefits accrued from ecosystems (Daw et al., 2011; Roe and Walpole, 2010). Several researchers have criticized the poor performance of protected areas in distributing the costs and benefits of conservation fairly (e.g., Adams et al. (2010)). This is especially true in developing countries where the local livelihood costs of protected areas can be significant while the benefits tend to be accrued globally.

Applications of the concept of ecosystem services provide novel tools for studying the outcomes of conservation, including both the trade-offs and synergies, as well as a means of addressing the multiple interests and values of biodiversity and ecosystem services (e.g., Daw et al. (2011)). By making the outcomes of conservation explicit, we can address and balance multiple needs and values (Hein et al., 2006; Tallis et al., 2008) and pursue equity in and sustainability of service provision (Daw et al., 2011; Dawson et al., 2010). Accordingly, the concept of ecosystem services can be applied not only as a new way to justify conservation (Mooney, 2010) but also as a tool for delivering ecosystem service flows fairly (e.g., Tallis et al., 2008). Local communities often depend heavily on ecosystems and are directly affected by changes in the flows of ecosystem services (Millennium Ecosystem Assessment, 2005). Failure to properly address trade-offs and adequately interpret or define people's perceptions can likely lead to conflicts (Adams et al., 2003). Therefore, it is essential to understand ecosystem service flows from the local perspective.

Ranomafana National Park in southeastern Madagascar harbors forest biodiversity of global importance, but conservation-induced

* Corresponding author. Tel.: +35 8414300876.
E-mail addresses: susanna.kari@alumni.helsinki.fi (S. Kari).
k.korhonen-kurki@cgiar.org (K. Korhonen-Kurki).

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changes in ecosystem service flows are affecting the lives and livelihoods of local residents. Drawing on data from Ranomafana, we evaluate the importance of locally perceived ecosystem services in biodiversity conservation and answer the following questions: (1) What are the main ecosystem services that the forest provides to local communities in the peripheral zone of the national park in Ranomafana? (2) How have the ecosystem service flows changed over time? (3) Given the findings, what can be said about local conservation outcomes in the area?

2. Ecosystem service flows and conservation outcomes

Ecosystem services are provided via ecosystem service flows from ecosystems to beneficiaries (Chan et al., 2006; Millennium Ecosystem Assessment, 2003, 2005). Ecosystem services are the benefits people actually receive from ecosystems, as opposed to the stock of ecosystem services, or the ecosystems' capacity to deliver these services (Layke, 2009).

Applications related to ecosystem service flows can serve as powerful tools and include the following:

- understanding the ecosystem service flows from ecosystems, especially the ecological processes underlying these flows (e.g., Boyd and Banzhaf (2007), Chan et al. (2006), Guariguata and Balvanera (2009));
- understanding the feedback between social and ecological environments and their effects on service flows and human well-being (e.g., Díaz et al. (2011), Maass et al. (2005), Millennium Ecosystem Assessment (2005));
- understanding and managing the trade-offs and other outcomes of the natural resource decisions that affect ecosystem service flows, including how such changes are valued and perceived (e.g., Daw et al. (2011), Goldman et al. (2010), Hein et al. (2006), Rodríguez et al. (2006), Tallis et al. (2008), Turner et al. (2012)).

Socio-ecological dynamics mean that ecosystem service flows are influenced by both their ecological underpinnings and their socioeconomic context (Díaz et al., 2011; Guariguata and Balvanera, 2009; Kremen and Ostfeld, 2005; Rodríguez et al., 2006). Whatever an ecosystem's capacity to provide services (protected areas tend to contain rich stocks of ecosystem services), societal drivers, such as access, are often stronger than biophysical factors in changing ecosystem service flows (Chan et al., 2006). Ribot and Peluso (2003) define access as "the ability to derive benefits from things", which aptly describes one major driver affecting the flow of ecosystem services in the context of protected areas. Access includes not only one's rights and restrictions but also abilities, such as social relationships. Ecosystem service flows are depicted in Fig. 1.

Conservation, mainly implemented through protected areas, has been criticized for achieving its goals at the expense of local communities (Adams et al., 2010). Problematically, protected areas represent a form of land use that generally rules out all other land uses, thus leading to the physical, economic and cultural exclusion of local people (Agrawal and Redford, 2009). Protected areas are also highly political in nature, with inequalities between actors in terms of power and distribution of benefits (Adams and Hutton, 2007). To overcome these challenges, many researchers have argued that conservation needs to acknowledge both trade-offs and synergies, i.e., the mutual gains and losses arising from certain choices and actions (Hirsch et al., 2011; McShane et al., 2011). Outcomes are also good indicators of conservation success (Kapos et al., 2009). Trade-offs seem inevitable in conservation but choices are rarely recognized or debated,

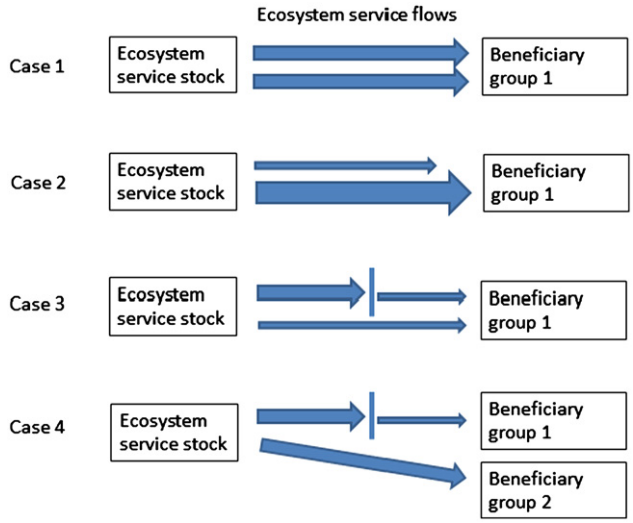

Fig. 1. Ecosystem service flows or the service provision from certain ecosystems to certain beneficiaries (cases 1–4). Multiple flows and different outcomes can occur simultaneously. Various direct and indirect drivers of change affect ecosystem service flows (case 3 and 4). Trade-offs occur between ecosystem services (case 2) and between beneficiary groups (case 4).

even though they often trigger obvious conflicts or have unfair consequences.

Despite the apparent importance of conservation in supporting the provision of ecosystem services in the long run (Turner et al., 2012), conservation goals can clash with the more immediate livelihood needs of local inhabitants, especially in developing countries (Fisher and Christopher, 2007; Roe and Walpole, 2010). As conservation measures often affect ecosystem service flows, conservation outcomes can be assessed by observing the resulting changes in service flows. Outcomes can be either intentional or unintentional, often take place over a long time and are likely evaluated differently depending on the social and cultural perspective and the time (Kapos et al., 2009; Skourtos et al., 2010). Trade-offs that are considered negative today may appear positive in the future. Similarly, beneficiary groups perceive changes in ecosystem service flows differently depending on what they have at stake. Furthermore, given coexisting objectives, different outcomes are likely to occur simultaneously (Persha et al., 2011; Rodríguez et al., 2006; Roe and Walpole, 2010; Tallis et al., 2008). Consequently, trade-offs in conservation take different forms and occur at multiple temporal and spatial scales. Following are three trade-offs relevant to our case study.

First, conservation of one service may take place at the expense of another (Fig. 1, case 2) (e.g., Fisher et al. (2009), Pereira et al. (2005), Rodríguez et al. (2006)). In particular, flows for provisioning services are often traded off against regulating services (Bennett et al., 2009; Fisher et al., 2011). Nevertheless, synergies also exist, as some services offer a means of delivering other services; for example, regulating and supporting services generally support provisioning or cultural services (Wallace, 2007). Second, there may be competition between resource use objectives or societal goals (Faith and Walker, 2002), most evidently between conservation and development (e.g., Campbell et al. (2010), Goldman et al. (2010), Kareiva et al. (2008)). Outcomes will thus be different in cases with such barriers to ecosystem service flows compared with cases without them (Fig. 1, case 3) (Daw et al., 2011). This is closely related to the third trade-off, where trade-offs occur between beneficiary groups—or individuals—when benefits are reallocated (Fig. 1, case 4). Roe and Walpole (2010) claim that this factor underlies the general conservation outcomes whereby production of global