



Mathematisch-Naturwissenschaftliche Fakultät

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Suggested citation referring to the original publication:
Regional Environmental Change 16 (2016) 1985–1987
DOI <https://doi.org/10.1007/s10113-016-1028-x>
ISSN (print) 1436-3798
ISSN (online) 1436-378X

Postprint archived at the Institutional Repository of the Potsdam University in:
Postprints der Universität Potsdam
Mathematisch-Naturwissenschaftliche Reihe ; 917
ISSN 1866-8372
<https://nbn-resolving.org/urn:nbn:de:kobv:517-opus4-442031>
DOI <https://doi.org/10.25932/publishup-44203>

Social valuation of ecosystem services in mountain regions

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Received: 3 July 2016 / Accepted: 9 July 2016 / Published online: 8 September 2016
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Mountain areas worldwide are considered critical regions for ecosystem services provision (Grêt-Regamey et al. 2012). The diverse mountain landscapes support a large variety of ecosystem services, such as energy, water, food, protection from natural hazards, and multiple cultural ecosystem services (Huber et al. 2013; Crouzat et al. 2015). They provide these services to people living in the mountain regions themselves and their neighbouring lowlands, as well as to people coming into the mountains, in particular to enjoy cultural ecosystem services, and generating income through tourism there. To sustainably manage mountain regions and their natural resources, the value of ecosystem services to the diverse beneficiaries needs to be understood and accounted for.

Non-monetary social valuation has been considered a powerful approach to elicit the importance of ecosystem services to diverse beneficiaries in a non-market value elicitation context (De Groot et al. 2010). Such social valuation can be valuable in particular to understand beneficiaries' perception of ecosystem service (Lamarque et al. 2011), their demands and preferences (Martín-López et al. 2014) as well as potential conflicts between groups of beneficiaries (Castro et al. 2011). All three aspects are considered crucial to achieve sustainable, self-organising

socio-ecological systems in the long run (Ostrom 2009). Besides deliberative qualitative social valuation techniques (e.g. Wilson and Howarth 2002; Chan et al. 2012) and crowd-sourcing (Tenerelli et al. 2016), questionnaire and interview-based methods have proven appropriate means to elicit social values, as they compromise between the number of people included and the generation of specific knowledge through tailor-made questions (e.g. Oteros-Rozas et al. 2014; Martín-López et al. 2012).

In this special issue on ecosystem services in mountain regions, we bring together four studies that apply such social valuation methods in the European Alps and the Rocky Mountains. Interviewees were asked to identify main ecosystem services, and to rank and value them according to their personal perspective. Zoderer et al. (2015) and Bagstad et al. (2015) focus on the value for the greater public of mountain ecosystem services, whereas Sarkki et al. (2015) and Haida et al. (2015) explore expert opinions. They all build on empirical data based on questionnaire surveys or well-structured face-to-face interviews and aim to elicit society's perception and value of mountain landscapes at a regional level.

Zoderer et al. (2015) interviewed more than 500 tourists to value ecosystem services that are provided by three different landscapes in Southern Tyrol, Italy. The overall result shows different values assigned to the three landscape types, with regulating services valued on average highest in all three landscapes. The highest values in cultural services were assigned to the open woodlands provided by traditional larch meadows. Differences in the attributed values could be explained mainly by the origin of the tourists as well as their self-stated environmental knowledge.

Bagstad et al. (2015) compared the spatially modelled social value of visitors to a National Forest in the Southern

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Rocky Mountains (by SolVES) with the outcome of biophysical modelling of the same ecosystem services (by ARIES), including aesthetic value, biodiversity, soil erosion and water provisioning. Their results show that the areas highly valued by the public do not necessarily overlap with the areas that show the greatest biophysical capacity to provide these services. They identified shortcomings in the user perception-based supply mapping of ecologically more complex services and emphasise the complementarity of information sources in ecosystem service assessment. Finally, they highlight the added-value of public opinion to advance regionally feasible solutions in ecosystem services-based resource management.

Sarkki et al. (2015) evaluated expert opinions on key ecosystem services supplied by treeline ecosystems in fifteen European countries, related benefits and threats as well as governance instruments. The results from the expert panel revealed that altitudinal treelines within cultural landscapes provide more ecosystem services than polar treelines. Main beneficiaries from treeline ecosystem services include science and education, nature conservation and tourism. Depending on their impact on the treeline ecosystems, Sarkki et al. (2015) introduce a topology of beneficiaries, including “green key players”, the “harmless crowd”, “occasional stressors” and “risky users”. Finally, governance instruments were found to be well established, in particular for the altitudinal treelines.

Haida et al. (2015) investigated the perception and ranking of ecosystem services of a range of experts for three mountain regions in Austria and Italy. Their results indicate the strong relevance of water provisioning, habitat, energy supply, food provisioning and regulating natural hazards for these regions. They further show the high variability within the experts' opinions, which could not be attributed to differences between the regions or in the expertise of the interview partners, and finally highlight research gaps by comparing the identified ranking with the scientific literature.

All four articles demonstrate the potential and importance of including social values in ecosystem services assessments. In line with Chan et al. (2016), all studies reveal important insights into the appreciation of cultural ecosystem services, with partly surprisingly results (e.g. the high value for larch meadows, Zoderer et al. 2015, versus the relative low ranking in Haida et al. 2015). This ability to account for cultural ecosystem services is a strong advantage for many mountain regions, as they play an important role in touristic and traditional cultural mountain landscapes.

Furthermore, all four studies indicate the strong overall perception and appreciation of mountain regions as wildlife habitats, and the mountain ecosystems' role in regulating material and water flows. Depending on the

region, also food and water provisioning were highly ranked. However, they also indicate how strongly values differ between mountain regions and beneficiaries and that transferring results from one study to the other might not be an adequate procedure to elicit the specifics of a mountain region (Haida et al. 2015; Zoderer et al. 2015).

They further illustrate a range of purposes that social valuation studies can serve from quantifying social value of ecosystem services for different locations and between ecosystems (Bagstad et al. 2015; Zoderer et al. 2015); exploring perception and knowledge on the regional socio-ecological system (Sarkki et al. 2015; Bagstad et al. 2015); and identifying differing priorities between beneficiaries (Haida et al. 2015; Zoderer et al. 2015). Further, social valuation is seen highly complementary to biophysical modelling of ecosystem services with a great potential to identify feasible, potentially synergetic solutions in natural resource management (Bagstad et al. 2015).

Moreover, the four articles give useful methodological insights on choices of techniques and addressees beyond the regional case studies. For example, they indicate that concrete examples and location can strongly support social valuation in highly heterogeneous mountain landscapes (Zoderer et al. 2015; Bagstad et al. 2015).

Finally, they show limitations of questionnaire and interview-based valuation, for instance, in identifying and mapping ecosystem services, in particular when it comes to supply of regulative and supportive ecosystem services and less well-known areas (Bagstad et al. 2015).

This special issue was initiated at the workshop on “Qualities, Vulnerabilities, and Management of Ecosystem Services in Mountain Regions Worldwide”, which took place on 11–13 September 2012 in Möschberg, Switzerland, and was funded by the Mountain Research Initiative.

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