Biodivers Conserv
DOI 10.1007/s10531-014-0796-1

COMMENTARY

# How (not) to perform ecosystem service valuations: *pricing gorillas in the mist*

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Received: 27 May 2014 / Revised: 27 August 2014 / Accepted: 3 September 2014
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**Abstract** Monetary valuation of ecosystem services (ES) is gaining growing interest in scientific papers, policies and awareness-raising documents for its potential as a communication tool illustrating the societal importance of biodiversity. However, simultaneously, its limitations are increasingly discussed in the literature. In this paper we argue that monetary valuation of ES should be seen as representing only one component of ES valuations. We provide basic standards to ensure integrated approaches to ES valuation that can effectively contribute to preserving cultural and biological diversity by acknowledging boundaries to resource exploitation and by building on the various interests and socio-cultural values of involved stakeholders. We base our discussion on a recent study that assesses the economic value of the world-famous Virunga National Park in the Democratic Republic of Congo, home to some of the last mountain gorillas (*Gorilla beringei beringei*). We alert against some ES monetary valuation that narrowly frames

Communicated by David Hawksworth.

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Published online: 11 October 2014

biodiversity conservation in terms of economic calculus and argue that subjugating conservation efforts to profit logics downplays the importance of intrinsic, symbolic and other non-economic values of biodiversity. We conclude by providing principles and methodological guidelines to enhance ES valuation as a tool to promote awareness rising for biodiversity conservation through the understanding the overall importance of biodiversity for human societies.

**Keywords** Biodiversity conservation · Ecosystem services · Biocultural diversity · Natural resource management · Integrated valuation · Value pluralism

## Introduction

Facing current challenges of increasing pressure on ecosystems and natural resources, the valuation of ecosystem services (ES) is suggested as a tool to shift from our development paradigm towards a more sustainable resource use that allows to meet the needs of present and future generations (De Groot et al. 2002; Dendoncker et al. 2013; Jacobs et al. 2014). It is nowadays a widely applied approach in sustainable development and biodiversity conservation (Bateman et al. 2013; Baveye et al. 2013; Abson et al. 2014). Particularly, *monetary* valuation of ES increasingly abounds in scientific papers (de Groot et al. 2012; Boerema et al. 2014), policy documents (TEEB 2010; European Commission et al. 2013) and NGO awareness-raising texts (Pinfold 2011; WWF-Dalberg 2013), including much grey literature (Adger et al. 1994; Tangerini and Soguel 2004; Brander and van Beukering 2013). In parallel to this rise, a growing body of scientific literature addresses the technical and ethical concerns with regard to valuation approaches restrained to monetary units (McCauley 2006; Spangenberg and Settele 2010; Luck et al. 2012; Kallis et al. 2013; Jax et al. 2013). Such reactions evidence a growing demand for better defining standards that secure the scientific quality and social legitimacy of environmental valuation exercises.

This paper aims to serve this purpose using as a concrete illustration the recently published World Wildlife Fund (WWF) report written by the Dalberg Global Development Advisor which assesses—as its name suggests—'The Economic Value of Virunga National Park' (WWF-Dalberg 2013). The Virunga Park, located in the Democratic Republic of Congo, is known for its rich biodiversity—among which a quarter of the population of endangered mountain gorillas—and is recognized as UNESCO (United Nations Educational, Scientific and Cultural Organization) World Heritage. According to this assessment (referred to as 'Dalberg's study' hereafter), the economic value of the park currently reaches US$50 million/year but would potentially extent to US$1.1 billion/year under a sustainable development scenario. This estimation relies on the 'total economic value' (TEV) approach, frequently used to measure in economic terms the use and non-use values related to ES (Liekens et al. 2013). According to the TEV typology, a use value arises from the actual use of an ecosystem service (ES), as with the ES of crop provision or water regulation, while non-use values reflect the importance of the pure existence of biodiversity and ES and the knowledge that they provide benefits to others and future generations (Liekens et al. 2013; Davidson 2013). WWF uses monetary valuation for the honourable cause to provide arguments and raise awareness against SOCO petrol concession in the area. Whereas SOCO has recently given up its plans to not further drill or explore UNESCO sites under the pressure of the British Government, UNESCO and some high-profile individuals, (SOCO International 2014; Vidal 2014), we believe that Dalberg's report is a useful case to illustrate the limits and risks associated with narrow monetary

valuations of biodiversity and ES, specially in contexts where their non-economic values can justify conservation efforts from a societal view point.

With the aim of avoiding such risks, this article advances principles and methodological guidelines to align ES valuation with standards of ecological viability, social justice, and long term economic sustainability, defines conditions under which valuation could be best applied, and suggests ways of making progress towards the integration of different methods and metrics for ES valuation.

## Standards for an integrated valuation of ecosystem services

The technical challenges and ethical risks of narrow approaches monetizing ES are widely acknowledged in the literature (Gómez-Baggethun and Ruiz-Pérez 2011; Kallis et al. 2013; Jax et al. 2013). Table 1 summarizes ES valuation standards found in recent literature.

Before engaging in any ES assessment, the *policy and socio-economic contexts* need to be identified (Christie et al. 2012; de Groot et al. 2012) as well as the decision making context the valuation aims to inform (Gomez-Baggethun et al. 2014). This is key to understand potential conflicts between economic and non-economic values local people attribute to nature (Gómez-Baggethun and Ruiz-Pérez 2011; Kallis et al. 2013) and to allow for the consideration of social disparities in access to ES (Jax et al. 2013). Within the complex conflict area of Democratic Republic of Congo, Dalberg's valuation assumes that '*stability and security are guaranteed*' and that '*an effective law system protects the integrity of the ecosystem*', likely missing critically important features with regard to the local institutional and governance context.

When applying ES valuation, *transparency* in the goals, calculations and underlying assumptions is essential (de Groot et al. 2012; Jax et al. 2013). A closer reading of Dalberg's non-use values estimation reveals that relying on a previous study (Hatfield and Malleret-King 2007), they misuse value definitions and misuse original data. Such misuse in definitions misled the authors to double the existence value estimated in the initial study (US$1865 million/year) using the argument that permit prices for access to gorilla areas will double, thereby overseeing that permit prices reflect a recreational *use value* uncoupled from the *non-use value* attributed to their *existence*. Moreover, this original estimation of non-use values refers to the whole mountain gorilla population (Hatfield and Malleret-King 2007) and as Virunga only hosts a third of the whole population, this amount ought to be adapted proportionately. A better transparency in calculations and definitions would have helped the authors avoiding this confusion.

Next to analytical flaws, consideration of *multiple languages of valuation* (Martinez-Alier 2003; Gomez-Baggethun et al. 2014) can be critical to address the wider societal value of ES. Throughout Dalberg's study, only monetary values are mentioned, it being for fish, tourism or gorillas' existence value, this way poorly representing cultural, spiritual, aesthetic and symbolic values related to the complex socio-cultural and ecological system studied. The three pillars of sustainability and their subsequent values are generally identified as required when valuing ES: ecological value, social value and economic value (Daily et al. 2000; Martín-López et al. 2014; Jacobs et al. 2014) (Fig. 1—circles). These values are embedded into each other: economy and society are dependent upon the environment and bound to operate within safe ecological boundaries (Cato 2009; Rockström et al. 2009; United Nations 2012). This calls for the complementarity of ES monetary valuations with other types of valuations addressing the full range of values related to ES.

**Table 1** Standards for ES valuation from the perspective of value pluralism

| Valuation of ecosystem services | | | |
|---|---|---|---|
| General | Define policy and socio-economic context | | |
| | Make transparent assumptions and calculations | | |
| | Consider multiple values | | |
| Values | Ecological | Social | Economic |
| Aim | Safeguard resilience and ecological integrity | Improve well-being of present and future generations | Secure economic efficiency and long-term viability |
| How | Quantify biophysical properties and safety boundaries of ES | Take broad socio-cultural context into consideration | Clarify aim and scope |
| | Assess ecological thresholds and ecosystem non-linear response to changes | Identify sociocultural values held by stakeholders and users | Focus on value change from one situation to another and include scenario comparison |
| | Consider temporal and geographical scales | Apply participative approaches that involve affected stakeholders | Avoid commodification by restricting monetization to real costs of ES loss |
| Integration | Multicriteria analysis | | |

Derived from recommendations in a.o. Baveye et al. (2013), Christie et al. (2012), Daily et al. (2000), Gomez-Baggethun et al.(2014), Jacobs et al. (2014), Jax et al. (2013), Kallis et al. (2013), Martín-López et al. (2014), Spangenberg and Settele (2010), Seppelt et al. (2011), TEEB (2010)

## Ecological values

*Ecological values* are fundamental to assess biophysical processes underlying ES, in order to understand which ecological processes are critical for long-term ES maintenance (Seppelt et al. 2011; Admiraal et al. 2013). These aspects include trade-offs among services (e.g. how enhanced supply of provisioning services can result in decreased supply of habitat and regulating services) and recognition of ecological thresholds that are relevant for ES supply (Gómez-Baggethun et al. 2011). When systems are close to thresholds, ES valuation needs to switch from choosing among alternatives to securing the avoidance of ecosystem collapse by defining safe-minimum standards (Limburg et al. 2002; Rockström et al. 2009; Palmer and Febria 2012). Ideally, such investigations should moreover take into consideration temporal and geographical scales (de Groot et al. 2012).

Suggesting to triple fish extraction, implement hydropower plants and quadruple tourism as well as pharmaceutical prospection with no reference to data about ecological thresholds and ecological capacity, Dalberg's study risks encouraging already well-known local overfishing issues (WWF-Dalberg 2013), conflicts of fluvial alteration with local resource use (Erlewein 2013) and impacts of tourism expansion on environmental degradation (Lo et al. 2013). Consideration of ecological thresholds and of the ecological functions and process underlying the production of ES should be a fundamental component in integrated assessment and valuation of ES in order to avoid the valuation to become an incentive for unsustainable exploitation (Limburg et al. 2002; Pascual et al. 2010; Gomez-Baggethun et al. 2014).

## Social values

*Social values* should be included as much as possible into ES valuation exercises to encompass stakeholders' point of views and socio-cultural contexts (Justus et al. 2009; Seppelt et al. 2011; Daniel et al. 2012) and in order to ensure equitable improvement of human wellbeing (Martinez-Alier 2003; Brondízio et al. 2010). Social values are specifically important when assessing non-use values of ES (Mace et al. 2012). Hence, the evaluation of non-use values through the sole use of money metrics following the TEV approach, as done in Dalberg's study, is likely to be misleading by failing to capture their socio-cultural importance (Chan et al. 2012). Instead, deliberative methods are proposed (Kenter et al. 2011) to include cultural and spiritual values, which can improve the accuracy and procedural quality of the assessment (Brondízio et al. 2010; Kenter et al. 2011; Chan et al. 2012) and can foster critical sense, responsibilities, and capacity building of local communities. The performance of such methods however depends upon many factors such as the procedural quality used in the choice of stakeholders and in the questions used in interviews and focus groups (Seppelt et al. 2011). For instance, as many studies that focus narrowly on monetary aspects of ES, Dalberg's study neglects indigenous views and the perception of local inhabitants when assessing non-use values—and bases the estimation on interviews to 27 affluent international tourists that generally are largely ignorant of local cultural and socioeconomic realities. Consequently, the final estimation of US$700 million for the non-use values (corresponding to more than 60 % of the TEV of the park) represents the value in the eyes of wealthy people and not '*the potential direct income to local communities'* as pretended.

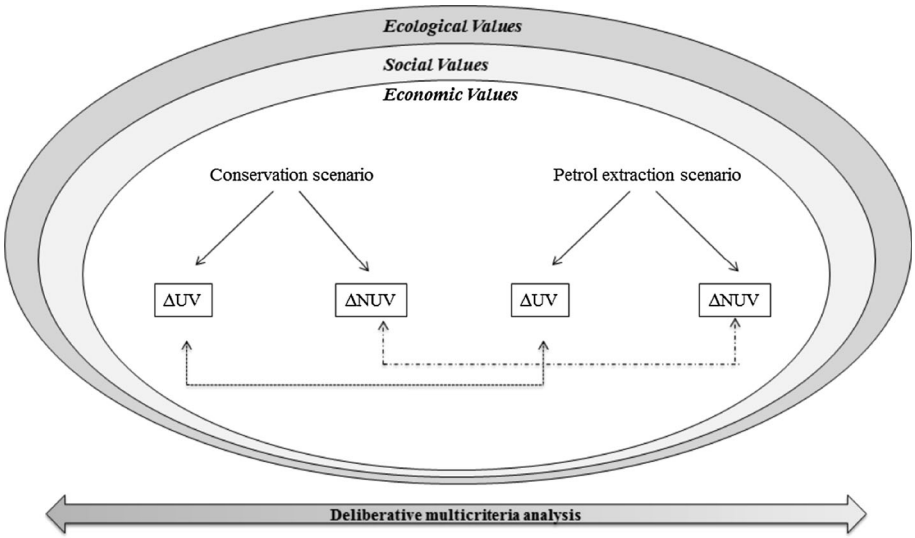


**Fig. 1** ES valuation framework using the TEV typology of use and non-use value. Unlike classical TEV, use values (UV) and non-use values (NUV) are not summed up. ES valuation compares use value difference between T0 and T1 (ΔUV) of the first scenario with the ΔUV of the second scenario (*regular dotted arrow*). Separately, the same comparison is carried out between non-use value differences (ΔNUV) of the two scenarios (*irregular dotted arrow*). Integrated ES valuation account for the fact that economy is a subset of society and that both are constrained by the environment boundaries by including ecological and social values in addition to economic ones. Deliberative MCA structures the valuation while accounting for stakeholders' viewpoint

## Economic value

*Monetary valuations* can be carried out for distinct purposes, ranging from awareness raising (Liu et al. 2010; Jacobs et al. 2014) to priority setting in decision making or to creating economic incentives for conservation (de Groot et al. 2012). Specifying the aim and policy context of the valuation exercise is thus crucial to avoid misuses of the valuation outcomes (Liu et al. 2010; Jax et al. 2013; Gomez-Baggethun et al. 2014). While Dalberg's study specifies to aim for awareness raising, its findings based on monetary estimates are stretched to strong political recommendations: '*Based on the findings (...), WWF urges governments, oil companies and non-governmental organizations (...) to take immediate steps to protect the park (...) and encourages all stakeholders to work together to unlock Virunga's potential as a sustainable source of direct income (...)*'. Coming right after the monetary assessment of potential increased resource use (e.g. fishing could be tripled and tourism quadrupled), the assessment risks being interpreted as a 'licence for exploitation' without considering any ecological or cultural boundaries in terms of resource depletion or local perceptions on tourism congestion.

Following economic theory, monetization that aims to inform policy processes should assess value change rather than the total value of ecosystems, and more specifically, marginal change. This means that scenarios cannot be so different that the price per unit changes (e.g. a scenario leading to extreme scarcity of gorillas could rocket prices of access permits) (Daily et al. 2000). Moreover, when informing priority settings in policy decisions, values should ideally be compared between decision options (TEEB 2010; Seppelt

et al. 2011). For instance, for Dalberg's case, a sustainable development scenario could have been compared to a petrol extraction scenario. In addition, comparisons between scenarios can only be accomplished within commensurable value categories (Martín-López et al. 2014) (Fig. 1—dotted arrows). Therefore, the TEV approach, and its application in the Dalberg's study, are scientifically unsound by suggesting a summation of the incommensurable non-use and use values.

It must also be kept in mind that attributing monetary values to non-market ecosystem components that are not intended for sale opens the door to undesirable commodification of ES, i.e. the further inclusion of ecosystem goods into market exchanges (Gómez-Baggethun and Ruiz-Pérez 2011). Commodification can increase social inequity (Liu and Yang 2013), crowd out non-economic motivations (Bowles 2008; Sandel 2012) and increase economic pressure on natural resources (McCauley 2006; Kallis et al. 2013). Cultural impacts of commodification can be especially high in the context of developing countries, where many local communities often manage resources through non-market norms (Gómez-Baggethun et al. 2010; Christie et al. 2012). Hence, monetary valuations should be directed to ES having (in)direct commercial value or which loss bears real economic costs, but should be avoided for ES not intended for sale and which are expected to be governed by non-market norms. As much of the literature on ES valuation based on stated preferences techniques through the simulation of hypothetical markets, Dalberg's study makes thus a risky move to measure the gorillas' non-use value of existence by means of monetary metrics. Translating existence value, or any non-use value, into money is moreover highly debatable for ethical reasons (Luck et al. 2012; Jax et al. 2013; Davidson 2013) as it advances the notion that monetary equivalences for gorillas are actually feasible.

## The challenge of integrating value plurality

Dalberg's failure to address what may be seen as the most critical values associated to the preservation of gorilla populations illustrates a prevailing gap in scientific knowledge: whereas many publications in the ES literature acknowledge the importance of value pluralism and integration, few provide hints on *how* to actually integrate values to inform decision making processes (Gomez-Baggethun et al. 2014; Martín-López et al. 2014). In this context, several ES valuation frameworks have been developed, such as the Ecosystem Properties, Potentials, and Services (EPPS) framework (Bastian et al. 2013) and the assessment of ecological and economic benefits of environmental water in the Murray–Darling Basin (Jackson et al. 2010).

One approach that is gaining interest and which has already shown encouraging outcomes for integrated ES valuations is multicriteria analysis (MCA) (Justus et al. 2009; Spangenberg and Settele 2010) (Fig. 1—bottom arrow). By integrating multiple qualitative and quantitative criteria and indicators, MCA can accommodate value pluralism and incommensurability in environmental assessment (Martinez-Alier et al. 1998), and help to structure deliberative methods as mentioned above (Munda 2004; Koschke et al. 2012). MCA can also be used as decision support tools that acknowledge complexity, uncertainty and various points of view (Fontana et al. 2013). Rather than providing a one-size-fit-all solution, social MCA provide insights on the possible compromise solutions (Munda 2004; Fontana et al. 2013; Keune and Dendoncker 2014).

In such social MCA, decision support criteria, different alternatives and their respective priorities are first defined in a deliberative phase with various stakeholders. These

alternatives and the criteria are then analyzed through a MCA based on a desk research and expert elicitation. These results are then discussed in a stakeholder deliberation.

By acknowledging non-use values associated to the habitats of gorilla populations through an analytical deliberative MCA, elicited values may outweigh conservation scenarios against non-conservation ones. Narrow monetary valuation of ES can show that conservation is economically rational in some cases, but is unlikely to outcompete lucrative extraction activities such as oil drilling and mining.

## Conclusions

Monetary valuations of ES are increasingly endorsed on the grounds of making a pragmatic case for biodiversity conservation. We are sympathetic to well-intended economic exercises by environmentalist NGO's aimed at raising awareness about the societal importance of biodiversity and we acknowledge that monetization can be a powerful communication instrument in this respect: it can provide insights and promote informed debate concerning trade-offs between economic growth and environmental quality which are currently not endorsed by traditional economic accounting systems and prosperity measures. Yet, we contend that valuation exercises that fail to capture ecological and socio-cultural values of biodiversity can easily backfire by serving the interest of third parties which agendas have little to do with the conservation of nature. Used outside their appropriate domain and as an ultimate decision tool, monetary valuations risk being abused at the expense of the poor, future generations and—in the case of Dalberg's study—some of the last mountain gorillas. Furthermore, monetary valuations of dubious methodological quality that use loose terminology and methodologies play against the legitimacy and long term credibility of valuation tools that otherwise can be an important component on the toolkit for ES assessments and biodiversity conservation. ES valuation should consider the lessons drawn from over 50 years of application and be mastered holistically applying standards of sound socio-economic analysis, procedural quality and value pluralism where economic, ecological and social values are seen primarily as complements and not as substitutes. We hope our contribution will trigger a constructive debate among fellow scientific communities and NGOs with shared interest of preserving the world's biological and cultural diversity.

**Acknowledgments** We acknowledge the work done by our World Wildlife Fund fellows regarding biodiversity conservation and we hope our paper will support them in their fight against the destruction of the Virunga Park and its mountain gorillas. Additionally, we thank our colleagues in our respective research departments for helpful discussions and the insightful recommendations of two anonymous referees. We moreover acknowledge the contribution of colleagues present on site who answered our questions on local conditions.

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