Katja Schmidt | René Sachse | Ariane Walz

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Review article

Current role of social benefits in ecosystem service assessments

Katja Schmidt[a,*], René Sachse[a], Ariane Walz[a]

[a] University of Potsdam, Landscape Management Group, Institute of Earth and Environmental Science, Karl-Liebknecht-Str. 24-25, 14476 Potsdam, Germany

HIGHLIGHTS

- Social benefits are linked to all ecosystem services.
- Social benefits link ecosystem services to human well-being more explicitly.
- Not all studies that assessed ecosystem services explicitly link them to benefits.
- Social benefits have been assessed with monetary and non-monetary techniques.
- Inclusion of stakeholder views favours the assessment of social benefits.

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ABSTRACT

Ecosystem services have a significant impact on human wellbeing. While ecosystem services are frequently represented by monetary values, social values and underlying social benefits remain underexplored. The purpose of this study is to assess whether and how social benefits have been explicitly addressed within socio-economic and socio-cultural ecosystem services research, ultimately allowing a better understanding between ecosystem services and human well-being. In this paper, we reviewed 115 international primary valuation studies and tested four hypotheses associated to the identification of social benefits of ecosystem services using logistic regressions. Tested hypotheses were that (1) social benefits are mostly derived in studies that assess cultural ecosystem services as opposed to other ecosystem service types, (2) there is a pattern of social benefits and certain cultural ecosystem services assessed simultaneously, (3) monetary valuation techniques go beyond expressing monetary values and convey social benefits, and (4) directly addressing stakeholderís views the consideration of social benefits in ecosystem service assessments. Our analysis revealed that (1) a variety of social benefits are valued in studies that assess either of the four ecosystem service types, (2) certain social benefits are likely to co-occur in combination with certain cultural ecosystem services, (3) of the studies that employed monetary valuation techniques, simulated market approaches overlapped most frequently with the assessment of social benefits and (4) studies that directly incorporate stakeholder's views were more likely to also assess social benefits.

Contents

* Corresponding author at: University of Potsdam, Institute of Earth and Environmental Science, Landscape Management Group, Karl-Liebknecht-Str. 24-25, 14476 Potsdam, Germany.
E-mail addresses: Schmikat@uni-potsdam.de (K. Schmidt), resachse@uni-potsdam.de (R. Sachse), ariane.walz@uni-potsdam.de (A. Walz).

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1. Introduction

The ecosystem services approach has initially been established to recognize the central role that ecological processes and natural capital play in supporting human well-being and to integrate their values into decision-making (Daily et al., 2009; MA, 2005). Assessments of ecosystem services aim to evaluate the impact of policy decisions and identify benefits as well as trade-offs within environmental management (de Groot, Alkemade, Braat, Hein, & Willemen, 2010; Hauck, Görg, Varjopuro, Ratamäki, & Jax, 2013). Ecosystem service assessments have been found useful in communicating benefits of environmental conservation among stakeholder groups and particularly effective in extending biodiversity conservation beyond its extent of protected areas (Hauck et al., 2013). They could potentially contribute largely to environmental planning and management (von Haaren & Albert, 2011).

The valuation of these benefits bears various challenges and to date remains controversial within the research community. Though the Millennium Ecosystem Assessment (2003) proclaims very broad terms of ecosystem service value as "the contribution of an action or object to user-specified goals, objectives, or conditions", allowing for ecological, economic or social interpretations (de Groot et al., 2010, Chapter 1; Gomez-Baggethun & Groot, 2010), the ecological and economic value domains prevail over social implications in ecosystem services valuation applications (Nieto-Romero, Oteros-Rozas, González, & Martín-López, 2014; Sherrouse, Semmens, & Clement, 2014; Vihervaara, Rönkä, & Walls, 2010).

The monetary valuation of ecosystem services, often referred to as "economic valuation", is found to be limited due to methodological uncertainties. Not all services provided by ecological systems are marketable goods that directly imply a monetary value. Non-utilitarian benefits (mostly provided by regulating and cultural services) are often assessed with indirect valuation approaches (Chan et al., 2012). These methods are commonly applied where there are no explicit markets for services (de Groot, Wilson, & Boumans, 2002). Methods of indirect revealed preferences often fail to reveal the full value of ecosystem services or provide only lower bound value indications respectively, especially if the service lacks an adequate proxy (cf. Daily et al., 2000). Also the validity of stated preference methods (Hausman, 2012; Kahneman & Knetsch, 1992), incommensurability, and the dynamics of people's values (Satz et al., 2013) are discussed critically. Several authors point out the limitations of monetary valuation of ecosystem services and suggest to explore different valuation methods to match the broad diversity of values (Baveye, Baveye, & Gowdy, 2013; Chan, Satterfield, & Goldstein, 2012; Kumar & Kumar, 2008; Martin-Lopez et al., 2012; Quintas-Soriano et al., 2016).

Though it may not be the focus of the better part of valuation endeavors, the consideration of social benefits of ecosystem services is subject to a variety of studies. Chan et al. (2012) propose a framework that allows for the valuation of ecosystem services in general and that is particularly attentive to complications originating from cultural values and benefits, e.g. the intangibility of values, ecological and social change, etc. Other studies confirm the correspondence of social benefits and cultural ecosystem services (Daniel et al., 2012; Sherrouse et al., 2014). Bryan, Raymond, Crossman, and Macdonald, (2010) conduct a study on environmental management and identify areas with social values for ecosystem services of high abundance, diversity, rarity and risk. Furthermore, Sherrouse, Clement, and Semmens (2011) provide a GIS-based tool, i.e. Social Values for Ecosystem Services (SolVES), to assess, map, and quantify the perceived social values of ecosystem services by deriving a non-monetary Value Index from responses to a public attitude and preference survey. Scholte, van Teeffelen, and Verburg (2015) provide an overview of methods which assess socio-cultural values of ecosystem services in recent studies. Other research directly addresses current policy implementation, such as the European Landscape Convention, where the social valuation of residents largely contributes to the landscape character assessment (Baas, Groenewoudt, & Raap, 2011). Terminology of ecosystem benefits and values has previously been applied inconsistently, using the terms "cultural values and benefits", "social values", and "cultural ecosystem services".

In this study, we aim to provide very clear definitions and interpretations of benefits, values, social valuation, and human well-being. Benefits, here also referred to as social benefits, represent the final outputs from ecosystems that directly affect human well-being (Haines-Young & Potschin, 2013b), see Chapter 4.1. Values can either refer to cultural ideas about what are desirable goals and appropriate standards for judging actions (held values) or to the relative importance that people assign to objects (in this study: to benefits provided by ecosystem services) by rating or ranking them (assigned values) (Brown, 2002; Rokeach, 1973). In this study, we refer to ecosystem service values in terms of the latter interpretation, namely the relative importance that people assign to benefits provided by ecosystem services, typically in monetary units, rating or ranking schemes. Social valuation describes the act of the valuation by people as opposed to using extant proxies, such as market values or costs. Benefits and values of ecosystem services are the key focus of the study. Human well-being is generated by access to the basic materials of a good life required to sustain livelihoods, sufficient food, shelter and access to goods, as well as health, good social relations and freedom of choice and action (MA, 2003), all of which social benefits of ecosystem services contribute to. Thus, benefits link ecosystem services closely to human well-being, because they specify in what ways humans benefit from ecosystem services (e.g. therapeutic benefits, economic benefits, see Table 2). In the next step, which has commonly been conducted in ecosystem service research without necessarily referring to individual benefits, the value assigned to these benefits is quantified. These

Table 1
List of variables considered in this research and the corresponding codes.

Variables	Description	Codes (binary)
Year of Publication	Year that study was published	
Study area	Continent and country that the study area was located in	
Ecosystem services categories	Ecosystem services were derived from the reviewed studies and subsequently divided into the ES categories (MA, 2003)	Provisioning services, regulating services, supporting services, cultural services
Cultural ecosystem services	To examine the correlation between social benefits and the assessment of cultural ecosystem services (TEEB, 2010)	Recreation and tourism, spiritual experience, aesthetic appreciation, inspiration, cultural heritage, sense of place
Valuation techniques	Valuation methods contain monetary and non-monetary methods (Christie et al., 2012)	Market price, cost-based methods, hedonic pricing, travel cost analysis, contingent valuation methods (CVM), choice experiments, deliberative methods, social ranking, social rating
Social benefit types	Social benefits, the final outputs from ecosystems that directly affect the well-being of people, were derived from the reviewed studies (see Section 4.1 for a closer description).	Therapeutic, economic opportunities, amenity, heritage, spiritual, existence, option, bequest benefits
Involvement of stakeholders	We distinguish between studies that engage the public or stakeholders in their valuation (e.g. surveys, workshops) and studies that rely on existing data (e.g. market prices, costs)	stakeholders, experts, land managers, decision-makers, users, affected public

values are described in either monetary (e.g. costs, willingness to pay (WTP), market prices) or non-monetary (e.g. rating, ranking) measures of relative importance to individuals or society. Identification of benefits as well as the quantification of their value is frequently referred to as the process of valuation in ecosystem service research, with benefits often only indirectly addressed. We aim to contribute to a better link between ecosystem services and human well-being that essentially will lead to an equal integration of economic, ecological and social issues within environmental management and planning.

In order to tie the benefits of ecosystem services better to human-wellbeing, this study explores how social benefits have been addressed in ecosystem service valuation studies published since the release of the Millennium Ecosystem Assessment in 2005. What typical benefits have been identified for ecosystem services? Have these been explicitly addressed in valuation studies? What ecosystem services, valuation techniques and research designs are they usually associated with? To this effect, we develop a typology for ecosystem service benefits adapted from conceptual ecosystem services literature that we found to cover all social benefits derived from the subsequently reviewed primary valuation studies. Further, we develop hypotheses on the relationship between social benefits and the assessment practice of ecosystem services based on conceptual and empirical ecosystem service literature. These hypotheses are then tested based on the coded evaluation of 115 valuation studies published between 2005 and 2014. To do so, we phrased four hypotheses that arise from current research opinions and their implications for social benefits in ecosystem service valuation (Section 2). We lay out our methods (Section 3) to establish a clear link between ecosystem services and human well-being. We tested how social benefits are linked to ecosystem service types, cultural ecosystem services, valuation techniques and directly addressing stakeholders (Section 4). Finally, the results of the analysis, together with implications of the used method and conclusions for further research are drawn (Section 5).

2. Hypotheses

Considering conceptual and empirical insights from recent ecosystem service research, we put forward four hypotheses regarding the relationship between social values, ecosystem service types, particularly cultural ecosystem services, valuation techniques and directly approaching stakeholders.

H 1. Social benefits (see Section 4.1) are mostly considered in studies that assess cultural ecosystem services, as opposed to provisioning, supporting or regulating ecosystem services.

Whereas social constructs by definition underlie all ecosystem services, it is argued that cultural ecosystem services rely on them to a greater degree (Daniel et al., 2012). Moreover, non-marketed cultural ecosystem services are associated with intangibility, incommensurability and scaling issues (Chan, Satterfield et al., 2012; Satz et al., 2013) and are considered less susceptible for economic indicators (Carpenter et al., 2009; Martín-López, Gómez-Baggethun, Lomas, & Montes, 2009). These studies are bound to employ alternative valuation approaches in order to assess cultural ecosystem services that leave more room for the assessment of social benefits. It is thus assumed that studies are more likely to value social benefits when cultural ecosystem services are assessed than when provisioning, regulating or supporting services are reviewed.

H 2. There is a typical pattern of social benefits and cultural ecosystem services explored in combination (see Section 4).

It is further observed, that cultural ecosystem services, which essentially assemble cultural values, benefits and services in numerous classifications, frequently overlap with social and cultural benefits, e.g. aesthetics contribute to recreational leisure experiences, recreation and tourism can trigger physical exercise and intellectual stimulation, both contributors to health (Chan, Satterfield et al., 2012; Daniel et al., 2012). Referring to Haines-Young and Potschin (2013b), we support the distinction between cultural ecosystem services and social benefits with cultural services "covering all non-material outputs of ecosystems that affect physical and mental states of people" whereas social benefits relate to "things that people create or derive from final ecosystem services (e.g. products, experiences)". Hence, we argue that the assessment of social benefits co-occur in studies that derive non-material, cultural ecosystem services, in this study based on the TEEB typology (2010). We expect to identify pairs of cultural ecosystem services and social benefits that frequently appear together.

H 3. Monetary valuation techniques go beyond expressing monetary values and also convey social benefits.

Recent ecosystem service research emphasizes that the valuation of ecosystem services is heavily dependent upon the valuation method employed and that ecosystem service value is not a robust figure (Spangenberg & Settele, 2010). Valuation approaches, including monetary techniques, reflect "perceived realities, worldviews,

mind sets and belief systems" and thus are thought to be heavily dependent on social, cultural and economic contexts (Kumar et al., 2013). Some authors find the results of monetary assessments (i.e. willingness to pay) to a bigger extent resemble attitudes or social preferences than economic preferences (Castro et al., 2011). We assume that monetary values derived by monetary valuation methods, such as contingent valuation, choice experiments, replacement costs and even hedonic prices and market prices have potential to go beyond expressing monetary measures and also convey social benefits expressed in monetary terms.

H 4. Directly incorporating the view of stakeholders supports the consideration of social benefits in ecosystem service assessments

Ecosystem service assessments typically rely on stakeholder engagement to inform on critical management decisions, to develop scenarios to estimate future change or to derive stakeholder preferences and values (Daily et al., 2009). It is assumed that representative individuals as well as small groups of citizens can pass informed judgments about public goods and services not merely in terms of personal utility, but representing widely held social values (Wilson & Howarth, 2002). In this study, we distinguish between studies that address stakeholders within case study regions to assess their (stated) values (e.g. surveys, workshops, interviews), and studies that rely on extant data (e.g. market prices, costs) as a proxy for social value. In the following, we subsume experts, land managers, decision-makers, sensu stricto stakeholders, users and the affected public under the term "stakeholders". Thus, we hypothesize that the assessment of social benefits correlates with directly addressing stakeholders to elicit their views.

3. Methods

3.1. Development of an integrated classification for social benefits of ecosystem services

Human well-being has been found to be linked to five key components: the necessary material for a good life, health, good social relations, security and freedom and choice (MA, 2003). Whereas good social relations (social cohesion, mutual respect, good family relations, etc.) and freedom and choice (having control over what happens, etc.) are less attributable to social benefits provided by ecosystems, material for a good life, health and security are dimensions that generate multiple benefits supplied by ecosystems and their services.

Building on current classifications of benefits of ecosystem services (Brown, 2005; Brown and Reed, 2000; De Groot, Van der Perk, Chiesura, & van Vliet, 2003; Kahneman and Knetsch, 1992; Turner et al., 2003), we developed a typology of benefits to describe how ecosystem services improve human well-being. We reviewed the range of benefits covered by the existing classifications, each of them with their specific foci, and combined them to an integrated typology of social benefits of ecosystem services. Brown and Reed (2000) and Brown (2005), for instance, classify forest values to assess preferences and attitutes towards forest management, clearly associating a social benefit with each value type. Then, De Groot et al. (2003) classify social criteria to measure the criticality of natural capital while largely overlapping with Brown's forest values, while Turner et al. (2003) and Kahneman & Knetsch (1992) provide insight into mostly economic concepts of existence value.

While these classification schemes frequently refer to the term social "values", we adapt and use them for our classification of social benefits of ecosystem services. As explained above, we refer to the term "value" as an assigned measure of relative importance (monetary, rating, ranking) of a benefit rather than to the effect on human well-being itself. Merging the existing classification schemes allowed us to broaden the scope of benefits to be identified.

3.2. Case survey method

We make use of the case survey method, which combines qualitative and quantitative techniques and has been employed for meta-analyses in policy research for several years (Larsson & Finkelstein, 1999; Newig & Fritsch, 2009; Yin & Heald, 1975). The method is used to review primary research and its significant findings and is thought to work well when the research consist of a heterogenous collection of case studies (Yin & Heald, 1975). As case survey method allows to aggregate individual case studies' characteristics with scientific rigour, without necessarily comprising their conclusions, it provides a suitable approach to review which characteristics of ecosystem service valuation studies determine the comprehension of social benefits.

The case survey method draws on existing published case studies according to following procedure (Larsson, 1993): first, a group of existing case studies relevant to previously determined research questions is selected (Section 3.3). Next, a coding-scheme for the systematic recording of case study variables is designed (Section 3.4) which is then applied to the group of selected studies. Whereas Larsson (1993) suggests to measure interrater reliability of multiple raters, we had two raters discuss discordant cases. The coded information was subsequently statistically analysed in regard to the research questions (Section 3.5). As case surveys review several individual case studies, they are thought to combine advantages of both case-based and cross-based research (Newig & Fritsch, 2009).

3.3. Selection of studies

To evaluate the consideration of social benefits within ecosystem service valuation research, we conducted a literature search using Thomson Reuters' search engine Web of Knowledge mid May 2014 (cut-off date 13 May, 2014). Keywords were defined to select studies regarding the valuation of ecosystem services (topic: "ecosystem service*" AND "valuation"). In total; 1089 publications were retrieved from the Web of Knowledge database published between 2005 and 13 May 2014. These studies were qualitatively reviewed in terms of their content; selecting empirical; primary studies in which the authors performed an assessment of ecosystem services for further review. Studies using value proxies derived by meta-analysis or benefit/value transfer as well as conceptual contributions and reviews were discarded. Duplicates; grey literature and non-English studies were also omitted from the review. Ecosystem services of the reviewed studies had to roughly comply with the classifications of the MA; TEEB or CICES classification of ecosystem services (Haines-Young & Potschin, 2013a; MA, 2003; TEEB, 2010). The valuation of ecosystem services did not have to be the main focus of the study. As a result; of the initially retrieved studies; 115 studies were found to contain a self-consistent primary valuation of ecosystem services and were therefore selected for the detailed analysis (see Appendix).

3.4. Coding scheme to evaluate primary studies

Information was extracted from these 115 papers. They were screened individually in terms of basic information on the year of publication, the study area and several features that relate to our hypotheses (ecosystem service categories, cultural ecosystem services, valuation approaches, consideration of social benefits, involvement of stakeholders; see Table 1).

Table 2
Social benefit types considered in this study.

Social benefit type	Description	Examples	Literature
Therapeutic	The provision of medicines, clean air, water and soil, space for recreation and outdoor sports and general therapeutic effects of nature on people's mental and physical well-being	- Health services - Restorative and regenerative effects on people - Socio-economic benefits from reduced health costs and conditions	De Groot et al. (2003); Brown (2005); Turner et al., (2003)
Economic opportunities	to provide a work place, income, economic opportunities	- Provision of work place, income, economic opportunities	Brown and Reed (2000)
Amenity	Importance of nature for cognitive development, mental relaxation, artistic inspiration, aesthetic enjoyment and recreational benefits	- Aesthetic quality of landscapes - Recreational use - Artistic use	De Groot et al. (2003); Brown and Reed (2000)
Heritage	Importance of nature as reference to personal or collective history and cultural identity, also for educational purposes	- Historic sites and features - Role in cultural landscapes - Cultural traditions and knowledge - Education	De Groot et al. (2003); Brown and Reed (2000)
Spiritual	Importance of nature in symbols and elements with sacred and religious significance	- Sacred sites and features - Role of nature in religious ceremonies and sacred texts	De Groot et al. (2003); Brown and Reed (2000)
Existence	Importance people because they obtain moral satisfaction by conservation of biodiversity (intrinsic value)	- Expressed (through donations, voluntary work, etc.) or stated preference for nature protection - Moral satisfaction through conservation and the "warm glow effect"	De Groot et al. (2003); Brown and Reed (2000) Turner et al. (2003) Kahneman & Knetsch (1992)
Option	Importance people attach to having the option to use ecosystem services in the future, within their own lifetime	- Comfort of having the option to use ecosystem services at a later time in their lives	de Groot, Alkemade et al.(2010)
Bequest	Importance people attach to nature for inter-generational equity	- Comfort of knowing ecosystem services will be available for future generations	Brown and Reed (2000)

3.5. Data analysis

In our analysis, one study corresponds to one dataset. One dataset may therefore assess multiple ecosystem services, value multiple benefits and use numerous valuation techniques.

In order to test the hypotheses and to explore the likeliness that social benefit types were determined in the studies, four types of general linear models (GLM) were fitted to the data using the R environment for statistical computing (Team, 2013). The models aimed at predicting the conditional probability for each of the social benefit types that have been investigated in the studies in dependency of (i) the ecosystem service types, (ii) the cultural ecosystem services, (iii) the used monetary and non-monetary valuation techniques and (iv) whether or not stakeholders had been directly addressed in the studies.

Since all dependent variables and explanatory variables were binary (present or not present in the study) the GLMs were calculated with binomial error distribution and a logit link function resulting in multiple logistic regressions for the first three models and logistic regression for the investigation of directly addressing stakeholders. Relevant predictors which should be included in the models were identified by applying stepwise backward model selection according to Venables and Ripley (2002), choosing the models with the smallest AIC as best model. Peng, Lee, and Ingersoll (2002) found logistic regressions appropriate for testing hypotheses about relationships between a categorical outcome variable and one or more categorical or continuous predictor variables. Since the logit is calculated as the logarithm of the odds: $\log it(p) = \log\left(p/1-p\right)$, the logistic regression models calculate the log-odds: $\log\left(p_i/1-p_i\right) = \beta_0 + \beta_1 x_{i1} + \ldots + \beta_n x_{in}$. For easier interpretation of the regression coefficients (β_i) the equation has been exponentiated to retrieve odds ratios: $p_i/1-p_i = e^{\beta_0} e^{\beta_1 x_{i1}} \ldots e^{\beta_n x_{in}}$. The exponentiated coefficients (the odds ratios) can be read as how much the odds of the social benefit types increased multiplicatively with the presence of the predictor variables (x_i) compared to their absence.

4. Results

4.1. Integrated classification of social benefits of ecosystem services

Our classification of social benefits includes 8 benefit types that have previously been discussed in literature (Brown, 2005; Brown and Reed, 2000; De Groot et al., 2003; Kahneman & Knetsch, 1992; Turner et al., 2003) and extracted from the reviewed valuation studies according to Table 2. The included benefits are thought to specify in what ways the ecosystem services improve human well-being. Knowledge about these effects therefore strengthens the understanding of the link between human-wellbeing and ecosystems. They range from palpable effects like therapeutic (e.g. health through outdoor activities) and economic benefits (e.g. sustaining one's livelihood by providing an income through fishing) to less tangible benefits like amenity (e.g. mental relaxation through a hike), heritage (e.g. cultural identity by passing along knowledge and traditions), spiritual (e.g. religious awareness through sacred sites), existence (e.g. moral satisfaction people obtain from conserving a local ecosystem they themselves may never experience) to rather abstract categories like bequest and option benefits. The latter three are often referred to as values rather than benefits. As they describe

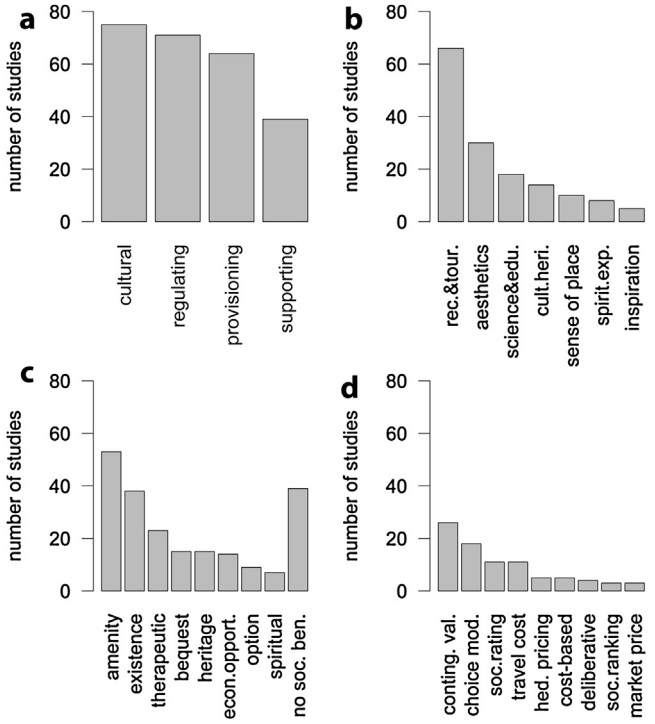

Fig. 1. Number of studies (a) per ecosystem service types, (b) per cultural ecosystem services, (c) per social benefits and (d) per valuation techniques to derive social benefits.

the moral satisfaction derived from knowing that ecological systems or species are existent (existence), will be available for future generations (bequest) and possibly available for people to experience in the future (option), we include them in our typology of benefits.

Social benefits in the reviewed valuation studies have been assessed through a wide range of monetary and non-monetary methods, i.e. market prices, cost-based methods, hedonic pricing method, travel cost analysis, contingent valuation, choice experiments as well as deliberative, social ranking and social rating approaches.

4.2. Overview over primary valuation studies

The number of the selected valuation studies rose exponentially after 2005 with 2 articles published in 2005 and 28 articles in 2013. Three quarters of the reviewed case studies originate in Europe (37%), Asia (24%) and North America (17%). While Africa accounted for 8%, Australia, New Zealand and the Pacific Islands for 7% and South America for 6%. One study was a global assessment. In terms of study areas, most case studies were conducted in the USA (15%) and China (14%), followed by Spain (10%).

Of the reviewed studies, cultural ecosystem services were assessed most frequently (65%), followed by regulating (62%), and provisioning services (56%). Supporting services were assessed by roughly one third (34%) of the studies (Fig. 1a). Studies that explored cultural, provisioning and regulating services had increased significantly since 2009 and 2010, the number of studies that assessed supporting services was on the rise since 2012. The majority of studies conducted an assessment of more than one ecosystem service type (63%). If a study focused on only one type of ecosystem service, they most frequently focused on cultural ecosystem services (17%), followed by regulating (11%), provisioning (6%) and supporting (2%) services. 13% of the reviewed articles accounted for all four ecosystem services types and 12% assess provisioning, regulating and cultural ecosystem services in their case studies.

The selected studies valued a broad range of cultural ecosystem services (Fig. 1b). More than half of the studies assessed values for recreation and tourism services (57%) while one quarter assessed values for the aesthetic appreciation of landscapes (26%). Less often assessed were science and education services (16%), cultural heritage (12%), sense of place (9%), spiritual experience (7%) and inspiration (4%).

Regardless of the ecosystem service type assessed, 76 of the selected studies (66%) explicitly refer to social benefits (Fig. 1c). The remaining 34% of the studies assessed values for ecosystem services without associating them in the wider context of human-wellbeing, thus without specifically addressing social benefits. Almost one half of the 115 reviewed studies derived amenity benefits (46%) and nearly one third evaluated existence benefits (29%). Therapeutic benefits (20%), heritage benefits and bequest benefits (both 13%) as well as the benefit of economic opportunities (12%) were evaluated less often. Option values (8%) and spiritual benefits (6%) were assessed in less than 10 articles each. Most articles derived only one social benefit in their case studies, the most frequent combination of social benefits derived being amenity and existence benefits that were explored in seven of the reviewed studies.

To derive values for these social benefits, 79% the social benefit deriving studies used monetary approaches, only 16% made use of non-monetary social approaches, 5% mixed monetary and non-monetary methods. When taking a closer look at the types of valuation methods (Fig. 1d), contingent valuation methods (willingness to pay, willingness to invest, etc.) were employed most frequently (34%), followed by choice experiments (24%), social rating approaches (14%) and travel cost analysis (14%). Methods that were less often employed were hedonic pricing (7%), cost-based approaches (7%), deliberative approaches (5%), social ranking (4%) and market price approaches (4%).

4.3. Case-survey of the integration of social benefits

Hypothesis 1. Social benefits are mostly considered in studies that assess cultural ecosystem services, as opposed to provisioning, supporting or regulating ecosystem services.

In an attempt to explore the link of ecosystem service types and the valuation of social benefits, we found that social benefits are abundant across provisioning, regulating, supporting and cultural ecosystem services, yet vary under the ecosystem service type assessed (Fig. 2). This remains true when studies that (also) assess cultural ecosystem services are disregarded in the computation (see cross-hatched bars). All benefits except for spiritual benefits and option values are assessed across the three remaining ecosystem service types. The results suggest that social benefits were mainly assessed within studies that value cultural ecosystem services, particularly amenity benefits. Spiritual benefits are inextricably linked to the valuation of cultural ecosystem services, as they only appear in studies that also examine cultural ecosystem services. The number of studies that assess social benefits is altogether lower in studies that do not assess cultural ecosystem services.

Similarly the logistic regression shows (Table 3) that four social benefits types are significantly related to the assessment of cultural ecosystem services. Studies addressing supporting and provisioning services show significant results for two types of benefits each. Chances that therapeutic benefits were derived were 3.3 times higher when supporting services were valued ($p < 0.05$) and additionally 6 times higher when also provisioning and regulating services were valued (Table 3). The odds to assess heritage benefits were just over 9 times higher for studies when cultural ecosystem

Table 3
Odds ratios of the best logisitic regression models of social benefits and ecosystem service types after stepwise backward model selection. Each line represents a model for the social benefit type in the first column. The following columns represent the predictors. Empty cells indicate that the predictor was not included in the best model. Coefficients in bold font were significant with p < 0.05.

Ecosystem service types	Cultural	Provisioning	Supporting	Regulating	Intercept	AIC
Social benefit types	Odds ratios	Odds ratios	Odds ratios	Odds ratios	Odds ratios	
Therapeutic		2,68	**3,32**	2,24	**0,04**	108,35
Heritage	**9,35**	**3,88**			**0,01**	82,96
Amenity	**24,67**				**0,08**	120,79
Spiritual	3,2E+07				3,2E-03	50,53
Existence	**5,80**	**3,05**	**11,06**		**0,03**	108,60
Economic opportunities	**12,74**				**0,02**	78,45
Option	4,66				**0,03**	64,28
Bequest	3,85		2,45		**0,04**	88,59

The model with maximal possible number of predictors was: logit (social benif it type) = β_1 cultural + β_2 provisioning + β_3 Supporting + β_4 regulating + β_0.

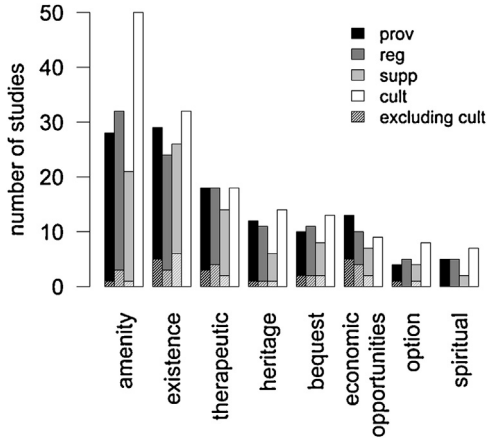

Fig. 2. Number of studies that assess social benefits according to ecosystem service type. Bars with cross-hatching represent a subset of the studies that do not include the assessment of cultural ecosystem services (excluding cult).

services were explored and collectively 36.3 times higher when also provisioning services were assessed ($p \leq 0.05$). Results further indicate that the assessment of amenity benefits were more likely with the valuation of only cultural ecosystem services (odds ratio = 24.7, $p < 0.05$). Chances to derive existence values increase with simultaneous consideration of cultural, provisioning and supporting ecosystem services, altogether odds = 195 ($p < 0{,}05$). Our findings further suggest a significant link between the assessment of economic opportunities and cultural ecosystem services (odds ratio = 12.7, $p < 0.05$). For instance, Butler, Radford, Riddington, and Laughton, (2009) estimate the economic impact of recreational rod fisheries for four salmon and trout species in north-east Scotland. In our analysis, we found no significant influence between ecosystem service type and spiritual, option and bequest benefits.

Our results provide evidence that social benefits are linked to the assessment of cultural ecosystem services to a greater degree than to provisioning, supporting or regulating services. Significant influence was found for 4 of the 8 social benefit types analysed. However, significant correlations could also be found in respectively two combinations of social benefit types and provisioning and supporting ecosystem services. These findings indicate that the assessment of social benefits is not only significantly linked to cultural ecosystem services but that social benefits are abundant across three ecosystem service types. Only the valuation of regulating services revealed no significant link to the elicitation of social benefits. Furthermore, high odds to derive social benefits when only one or two ecosystem service types were assessed suggest that certain social values are linked to the assessment of certain ecosystem services. This will be further explored within the next section.

Hypothesis 2. There is a typical pattern of social benefits and cultural ecosystem services explored in combination.

We analysed whether studies that contained individual cultural ecosystem services show a higher probability to consider certain social benefits than others. We included recreation/tourism, spiritual experience, aesthetics, science and education, inspiration, cultural heritage and sense of place as cultural ecosystem services according to TEEB (2010).

In our analysis, we found that a number of social benefit types are more often investigated when the reviewed studies also assessed cultural ecosystem services (Table 4). The assessment of amenity benefits was found 6 times more likely if aesthetic appreciation was valued and collectively even 25 times more likely if also recreation and tourism were valued. Sherrouse et al. (2011) for instance derived amenity benefits for the aesthetic appreciation of an area by having survey respondents first allocate points and then map areas where they see these provided. Liu, Crossman, Nolan, and Ghirmay (2013) performed a social rating exercise estimating the amenity benefits of recreation and tourism, sense of place as well as aesthetic appreciation in a sub-catchment of the Murray–Darling Basin in Australia.

Therapeutic benefits co-occured in studies that assessed science/education (odds ratio = 4) and inspiration (odds ratio 16.7; both $p < 0.05$). Larson, Stoeckl, Neil, and Welters (2013) for instance used a mail-out survey to assess therapeutic benefits of the provision of drinking water next to teaching/learning benefits and inspiration benefits of the Australian tropical rivers. Another study conducted a valuation of therapeutic benefits (flood prevention, enhanced water quality and pest control) provided by home gardens in the Catalan Pyrenees, while also assessing the social benefits of inspiration for culture, art and design and the maintenance of traditional ecological knowledge (Calvet-Mir, Gómez-Baggethun, & Reyes-García, 2012).

Our results suggest, that existence values are 3 times more likely to be derived when recreation and tourism is being assessed ($p = 0.05$). Wakita et al. (2014) for instance measured the indispensability of marine ecosystem services by assessing existence values ("Because the sea exists, life continues and nature is sustained") next to amenity values for recreation ("Without recreational opportunities such as swimming, diving, and surfing, our recreation opportunities would be far less interesting").

We found that the assessment of spiritual benefits is more likely when science and education, inspiration ($p < 0.05$) and cultural heritage ($p < 0.05$) are valued as ecosystem services. As an example, one study assessed spiritual benefits for spiritual services and sense of place provided by the water resources of the Murray-Darling basin in Australia, while also assessing aesthetic appreciation and cultural inspiration (Liu et al., 2013).

Table 4
Odds ratios of the best logisitic regression models of social benefits and cultural ecosystem services (after TEEB, 2010) after stepwise backward model selection. Each line represents a model for the social benefit type in column one. The following columns represent the predictors. Empty cells indicate that the predictor was not included in the best model. Coefficients in bold font were significant with $p < 0.05$.

Cultural ecosystem services	Recreation/Tourism	Spiritual experience	Aesthetics	Science/Education	Inspiration	Cultural heritage	Sense of place	Intercept	AIC
Social benefit types	Odds ratios	Odds ratios	Odds ratios	Odds ratios	Odds ratios	Odds ratios	Odds ratios	Odds ratios	
Therapeutic				**3,98**	**16,67**			**0,16**	106,96
Heritage			10,94			8,3E+09	1,2E-02	**0,007**	28,973
Amenity	**4,08**		**6,23**				3,87	**0,22**	133,51
Spiritual				7,8	**60**	**29,11**		**0,003**	27,76
Existence	**3,25**						2,77	**0,21**	141,1
ec. Opportunities						3,64		**0,11**	85,98
Option	4,87					**10,18**	2,2E-02	**0,02**	57
Bequest						**7,67**		**0,1**	83,82

The model with maximal possible number of predictors was: logit (socialbenefitty pe) = $\beta_1$recr + $\beta_2$spirit + $\beta_3$aest + $\beta_4$science + $\beta_5$insp + $\beta_6$cult + $\beta_7$place + β_0.

Further we found that the odds to assess bequest and option benefits rose within the valuation of cultural heritage. Zander and Straton (2010) for instance used the condition of waterholes and their importance to aboriginal people as a proxy to assess the existence and bequest value of Australia's tropical rivers for urban Australians. We were unable to identify any of the tested cultural ecosystem services as significant predictors for the elicitation of heritage benefits and the benefit of deriving economic opportunities.

Hypothesis 3. Monetary valuation techniques go beyond expressing monetary values and also convey social benefits.

Next, we tested the co-occurrence of social benefits and the employment of monetary valuation techniques. Monetary valuation techniques include market prices, cost-based approaches, hedonic pricing, travel cost analysis, contingent valuation and choice experiments if they include monetary measures. Non-monetary valuation techniques comprise deliberative techniques next to social rating and social ranking approaches.

In our analysis we found that simulated market approaches such as contingent valuation and choice experiments correlate significantly with a wide range of social benefits (see Table 5). Contingent valuation derives indirect monetary values (passive use values) of environmental services by estimating people's willingness to pay, or the cost of actions they are willing to accept, to avoid the unfavourable effects that would occur if these services were suspended. Studies that employed contingent valuation frequently derived existence values, e.g. for marine biodiversity and species conservation (Chen, Chuang, Jan, Liu, & Jan, 2013), to improve coral reef quality (Madani, Ahmadian, KhaliliAraghi, & Rahbar, 2012), for the protection of a special protected area (Cruz, Benedicto, & Gil, 2011). Other studies assessed therapeutic benefits, e.g. by eliciting people's WTP for health benefits provided by a project that prevents a local lake from further degradation and enhancement of basic environmental infrastructure (Wang, Shi, Kim, & Kamata, 2013), amenity benefits, e.g. by determining the values people place on the management of semi-natural and natural habitats maintained by the UK Biodiversity Action Plan via a choice experiment (Colombo, Christie, & Hanley, 2013), or economic opportunities, e.g. by measuring the value of an area of agricultural land change required to keep agricultural provision as a basic industry in the Kushiro watershed in Japan (Shoyama, Managi, & Yamagata, 2013).

In our analysis, market-based (market price, cost-based methods) as well as surrogate market approaches (travel cost analysis, hedonic pricing) did not or without significant frequency occur in studies that address social benefits. In contrast, we found that all of the 16 studies that used non-monetary approaches also assessed social benefits, social rating being the method connected with highest odds ratios to the most social benefit types.

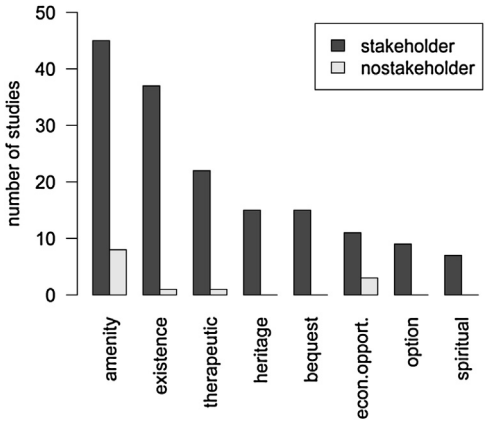

Fig. 3. Number of studies that assess social benefits based on stakeholder participation.

Hypothesis 4. Directly incorporating the view of stakeholders supports the consideration of social benefits in ecosystem service assessments.

In order to determine whether methods that include public engagement lead to a more frequent consideration of social values in ecosystem service assessments, we compared studies that directly addressed stakeholders or the public in their study design and studies that used proxy-based methods.

We found that social benefits were assessed in studies that included stakeholders a lot more frequently than in studies that applied proxy-based methdos (e.g. market based and hedonic pricing methods) (Fig. 3). Of the 66% of the studies that assessed social benefits, 84% addressed the views of stakeholders directly in their valuation by employing travel cost analysis, deliberative methods, contingent valuation and choice experiments and social ranking and rating approaches. Heritage and spiritual benefits and bequest values have been derived only in studies that directly approached stakeholders. In contrast, therapeutic, amenity, existence and option values as well as economic opportunities were also assessed in studies that did not address them directly. For instance, Chen, Li, and Wang (2009) estimated amenity values by conducting a combination of GIS-based accessibility and viewshed (visibility) analysis, forgoing public participation. Similarly, Morri, Pruscini, Scolozzi, and Santolini (2014) estimated therapeutic values of drinking water supply by forests of a river basin by multiplying the forests' water retention capacity and market prices.

Further analysis showed that studies that address stakeholdersí values directly are significantly more likely to assess therapeutic, amenity and existence values (Table 6). Particularly existence values were more likely to be derived when the public or stakeholders were integrated in the study, e.g. by estimating WTP towards the

Table 5
Odds ratios of the best logisitic regression models of social benefits and monetary and non-monetary valuation techniques after stepwise backward model selection. Each line represents a model for the social benefit type in column one. The following columns represent the predictors. Empty cells indicate that the predictor was not included in the best model. Coefficients in bold font were significant with $p < 0.05$.

Valuation techniques	Market-based approaches		Surrogate market approaches		Simulated market approaches		Non-monetary approaches			Intercept	AIC
	Market price	Cost based	Hedonic pricing	Travel cost analysis	Contingent valuation	Choice experiment	Deliberative	Social rating	Social ranking	Odds ratios	
Social benefit types	Odds ratios	Odds ratios	Odds ratios	Odds ratios	Odds ratios	Odds ratios	Odds ratios	Odds ratios	Odds ratios		
Therapeutic					**11,06**	**12,44**		**343,16**	11,65	**0,03**	78,89
Heritage	6,1E-02	16,02			**24,48**	**27,61**		**370,93**	38,98	**5,4E-03**	65,31
Amenity	9,6E-11		6,6E+09	5,4E+09	**27,32**	**21,07**	1,1E+09	3,8E+09		**0,05**	85,92
Spiritual					1,1E+08			4,9E+08		1,2E-03	39,02
Existence	2,1E-02	18,71			**125,09**	**130,84**		**108,85**	9,2E-03	**0,02**	88,83
ec. Opportunities	3,8E+09	20,17			**14,13**	**29,08**		**184,75**		**0,0054**	60,51
Option					4,76	**5,91**			9,27	**0,03**	63,51
Bequest					**18,23**	**22,69**		**40,21**		**0,01**	76,55

preservation of a threatened area (Mmopelwa & Blignaut, 2006; Wang et al., 2013), by deriving the perceived importance of preserving an ecosystem with social rating (Larson et al., 2013; Wakita et al., 2014) or choice experiments (Cerda, Ponce, & Zappi, 2013; Zander, Parkes, Straton, & Garnett, 2013). Amenity values were assessed for instance through a mix of ranking and rating of different stakeholder groups (Hicks, Graham, & Cinner, 2013) or the wider public (Liu et al., 2013) and the WTP of tourists for the provision of recreational opportunities (Chen et al., 2013). Therapeutic values were mostly assessed using contingent valuation (García-Llorente, Martín-López, Díaz, & Montes, 2011; Kaplowitz, Lupi, & Arreola, 2012), social rating (Hicks et al., 2013; Wakita et al., 2014) or choice experiments (e.g. Colombo et al., 2013; Drake, Smart, Termansen, & Hubacek, 2013).

Taken together, these results indicate a correlation between the assessment of social benefits and the public/stakeholder participation in the reviewed valuation studies. Our results suggest that within the reviewed body of literature, particular social benefit types, e.g. heritage, spiritual, bequest benefits, have not been assessed without the engagement of stakeholders. Also existence, therapeutic and amenity benefits have been assessed more frequently when the valuation methods were used which directly elicit the stakeholdersí views.

5. Discussion

5.1. The current role of social benefits in ecosystem service assessments

Our review underlines that social benefits are frequently subject to the valuation of ecosystem services. While we confirmed that certain social benefits co-occur with a row of cultural ecosystem services (Hypothesis 2), we also showed that they are abundant across studies that assess either of the four ecosystem service types (Hypothesis 1). Furthermore, simulated market valuation techniques such as contingent valuation approaches and choice experiments were found to explicitly mention social benefits next to deriving monetary values (Hypothesis 3). Lastly, we found that studies that directly address stakeholders, had an increased likelihood of the assessment of social benefits (Hypothesis 4).

This study does not support the assumption that social benefits strictly correlate to the assessment of cultural ecosystem services (Hypothesis 1). In contrast to other recent literature reviews on ecosystem services (Hernandez-Morcillo, Plieninger, & Bieling, 2013; Milcu, Hanspach, bson, & Fischer, 2013), we include studies that assess provisioning, regulating and supporting services next to cultural ecosystem services in our analysis. We found that social benefits are assessed across all ecosystem service types and significantly overlap with cultural, provisioning and supporting services. Our analysis further suggests a strong link between both provisioning and supporting services and social benefits, indicating the awareness of social implications regarding both provisioning and supporting services. Studies explore existence benefits of the nutrient cycling and habitat function of marine ecosystems (Jobstvogt, Hanley, Hynes, Kenter, & Witte, 2014; Wakita et al., 2014) as well as the awareness of personal benefits of photosynthesis, soil formation and nutrient cycling (Shoyama et al., 2013). As the awareness for personal benefits for supporting services in the latter study was rather high, results indicate a general understanding of ecological processes and their relevance for society. In contrast, studies that assessed regulating services frequently focused on ecosystem functions and processes and did not explicitly link their analysis to social benefits and human-wellbeing (Colloff, Lindsay, & Cook, 2013; Stanley, Gunning, & Stout, 2013; Watanabe & Ortega, 2014).

Table 6
Odds ratios of the logisitic regression models of social benefits and stakeholder/public participation. Each line represents a model for the social benefit type with stakeholder/public participation as only predictor. Coefficients in bold font were significant with $p < 0.05$.

Social benefit types	Stakeholder/public participation Odds ratios	Intercept Odds ratios	AIC
Therapeutic	**4,9**	**0,07**	99,68
Heritage	9,22E+07	3,17E-03	74,75
Amenity	**3,7**	**0,22**	141,7
Spiritual	1,18E+08	1,17E-03	52,75
Existence	**45,2**	**0,02**	105,2
Economic opportunities	4,7	**0,04**	80,19
Option	7,6	**0,02**	66,34
Bequest	9,22E+07	3,17E-03	74,75

log it (social benefit type) = β_1 participation + β_0

Though our results suggest numerous relations of social benefits and cultural ecosystem services in the reviewed studies (Hypothesis 2), the aforementioned examples show that this link is not always of direct nature but instead may be caused by the plurality of cultural ecosystem services assessed. Social benefits were found to co-occur in studies that assessed cultural ecosystem services, namely therapeutic benefits and science/education and inspiration, amenity benefits and recreation/tourism and aesthetic appreciation, spiritual benefits and inspiration and cultural heritage, existence benefits and recreation/tourism, option benefits and cultural heritage as well as bequest benefits and cultural heritage. Whereas amenity benefits have been derived directly from recreation/tourism and/or aesthetic appreciation in several studies (Aretano, Petrosillo, Zaccarelli, Semeraro, & Zurlini, 2013; Karjalainen, Marttunen, Sarkki, & Rytkonen, 2013; Liu et al., 2013; Ruiz-Frau, Hinz, Edwards-Jones, & Kaiser, 2013; Sherrouse et al., 2011), therapeutic benefits in contrast were found to be assessed in the same studies that valued science/education or inspiration services without direct causal link (Calvet-Mir et al., 2012; Larson et al., 2013). This finding suggests an inaccuracy resulting from the use of data sets that include multiple services and benefits (see Implications of the Methodology), while also pointing to a correlation between said cultural ecosystem services and cultural benefits as they have been the simultaneous objects of interest in a number of studies. On the other hand, several expected correlations could not be substantiated by our analysis, for instance between spiritual benefits and the assessment of spiritual experience as a cultural service or heritage benefits and cultural heritage. Other benefit-service pairs were noted but not further examined as they were not immediate subject to our study, e.g. therapeutic values and regulating services by Kaplowitz et al. (2012) or existence values and supporting services by Yao et al. (2014). Further research is required to establish which social benefit types relate to which provisioning, regulating, supporting or cultural ecosystem services.

Similar to what Milcu et al. (2013) find in their review of valuation studies of cultural ecosystem services, our analysis across all ecosystem service types found that monetary methods prevail over non-monetary methods in the assessment of social benefits. A large part of the reviewed studies particularly used simulated market approaches in which values are derived by stated preference techniques such as contingent valuation or choice experiments to value social benefits of ecosystem services. Market-based and surrogate market valuation approaches on the other hand, could surprisingly not be associated with the valuation of specific social benefits. This can partially be explained by the low number of studies that use market-based or surrogate market methods. Whereas simulated market approaches were found suitable to derive monetary values while explicitly assessing social benefits, studies that employed non-monetary techniques such as social ranking, deliberative approaches and social rating indicated a large overlap with the assessment social benefits by a small numbers of studies. Similar to what Wilson and Howarth (2002) found over a decade ago regarding discourse-based methods, we found that non-monetary social valuation methods have yet to be thoroughly applied in the practice of ecosystem service valuation. One of the few examples that use non-monetary techniques is by Agbenyega, Burgess, Cook and Morris, (2009), who conduct a survey with residents that includes a non-monetary rating of various ecosystem services provided by community woodlands, acknowledging therapeutic, amenity and heritage values. As demonstrated by our study, social benefits can generally appear as value constructs that underlie monetary values, i.e. in simulated market approaches, or they can well be valued directly in social valuation exercises, such as rating, ranking or deliberative methods. We suggest concentrating further research on the employment of non-monetary valuation techniques to enhance knowledge on the social benefits provided by ecosystem services.

Moreover, directly addressing stakeholders appears to have a positive effect on the consideration of a number of social benefit types, as they were derived then significantly more frequently. This finding is closely related to the choice of valuation methodology of course. Directly eliciting stakeholdersí views and the necessary interaction with individuals or stakeholder groups, however, often also has implications for the research processes and setting. It can trigger learning processes (Reed et al., 2010) and can support the inclusion of relevant stakeholders in decision-making (Reed, 2008), with deliberative methods such as participatory mapping (e.g. Klain & Chan, 2012) being predestinated for highly discursive stakeholder engagement. Both have proven effective in enhancing the acceptance and compliance of results for decision-making (Menzel & Teng, 2010). Few of the reviewed studies assess social benefits without addressing stakeholders directly. Related techniques are mostly found in modelling-based studies, which allow for first estimates. One example is the InVEST Recreation Model that assesses amenity benefits by modelling visitation rates using geotagged photographs posted to the website flickr (Sharp et al., 2014). We see a need to further investigate the validity of such models.

5.1.1. *Multidisciplinary approaches*

As the exclusive use of monetary valuation methods remains contested, a couple of authors suggest the notion of multi-dimensional value domains, e.g. multi-criteria evaluation to overcome issues of incommensurability and incompatibility across value types (; Gomez-Baggethun & Groot, 2010) and methodological pluralism (Kumar & Kumar, 2008; Quintas-Soriano et al., 2016). De Groot et al. (2002) have discussed the multi-dimensional facets of total value (ecological, socio-cultural, and economic) of ecosystem goods and services at an early stage of the implementation of the ecosystem services concept. This notion was later adapted by the TEEB conceptual framework (de Groot et al., 2010, Chapter 1), yet has not been incorporated by the better part of studies conducting ecosystem service assessments. Chan, Satterfield et al. (2012) advocate a multi-method and multi-metric approach to ultimately improve the validity and legitimacy of

ecosystem service research. In practice, as demonstrated by our analysis, very few of the studies reviewed in this analysis use a mix of monetary and non-monetary approaches when valuing social benefits. Further research is required to test multi-method and multi-metric approaches to examine the multi-dimensional link between ecosystem services and human well-being and ultimately strengthen the ecosystem services concept.

5.1.2. Implications of the methodology

The case survey method allowed for a systematic analysis of ecosystem service valuation studies by combining qualitative and quantitative techniques. One shortcoming of the current study is the limited selection of reviewed studies. This could have been enhanced by including broader search terms from outside the ecosystem service research community, such as landscape service, environmental goods, etc. Another limitation is the partial inaccuracy of the collected data. Whereas we elicited social benefits and the service types/methods used per reviewed paper, we did not explicitly assign every social benefit to the ecosystem service analysed/method employed. Whereas our analysis suggests numerous dependencies of social benefits from cultural ecosystem services in the reviewed studies, a closer look at the case studies reveals that the link is not always of direct nature (see Hypothesis 2 and discussion above). A number of studies include multiple service types or techniques to derive values (Joshi & Negi, 2011; Martín-López, García-Llorente, Palomo, & Montes, 2011). In these instances, our results may suggest a tendency of variables appearing in the same studies but must be interpreted with caution. Likewise, our results do not allow us to conclude on the suitability of valuation techniques or stakeholder involvement to derive values for social benefits. However, the case survey method and its way of qualitatively reviewing existing case-study literature allowed for a critical interpretation of the ecosystem service types and particulary cultural services assessed, methods used and direct incorporation of stake holdersí views and thus proved a suitable method for our research objectives.

6. Conclusions

The practice of ecosystem service assessments displays different approaches of taking into account the effect of ecosystem services on human well-being. Our analysis revealed that (1) a variety of social benefits are valued in studies that assess either of the four ecosystem service types, (2) certain social benefits are likely to co-occur in combination with certain cultural ecosystem services, (3) of the studies that employed monetary valuation techniques, simulated market approaches overlapped most frequently with the assessment of social benefits and (4) studies directly addressing stakeholders were more likely to also assess social benefits. Though there appears to be a general understanding of social benefits provided by ecosystem services in the reviewed ecosystem service assessments, there is no common understanding on which ecosystem services potentially provide which particular social benefits. Moreover, the definition of benefits and values (held/assigned) varies significantly in the reviewed case studies as well as classifications and conceptual contributions. To acknowledge the effect of environmental management on human-wellbeing, we advocate a consistent integration of social benefits in ecosystem service assessments. This requires a common classification of social benefits of ecosystem services.

Particularly with the explicit attention to social benefits and values also in practical policy implementation such as the European Landscape Convention (Jones & Stenseke, 2011), the field of social benefits and values of ecosystem services bears great potential. We suggest further research on the employment of non-monetary and monetary valuation techniques, and the implications of valuation methods and forms of addressing and involving stakeholder for social benefits in ecosystem service assessments. Further experimental investigations are needed to explore the potential of multi-dimensional value assessments of ecosystem services to equally accommodate economic, ecological and social values in environmental management and decision-making.

Appendix A. : List of reviewed papers

1. Wakita, K., Shen, Z., Oishi, T., Yagi, N., Kurokura, H., Furuya, K., 2014, Ḧuman utility of marine ecosystem services and behavioural intentions for marine conservation in Japan, *Marine Policy*, 46, 53–60.
2. Feagin, R. A., Williams, A. M., Martínez, M. L., Pérez-Maqueo, O., 2014, Ḧow does the social benefit and economic expenditures generated by a rural beach compare with its sediment replacement cost?, *Ocean & Coastal Management*, 89, 79–87.
3. Yao, R. T., Scarpa, R., Turner, J. A., Barnard, T. D., Rose, J. M., Palma, J. H. N., et al., 2014, V̈aluing biodiversity enhancement in New Zealand's planted forests: socioeconomic and spatial determinants of willingness-to-pay, *Ecological Economics*, 98, 90-101.
4. Morri, E., Pruscini, F., Scolozzi, R., Santolini, R., 2014, Ä forest ecosystem services evaluation at the river basin scale: Supply and demand between coastal areas and upstream lands (Italy), *Ecological Indicators*, 37, Part A 210–219.
5. van Berkel, D. B., Verburg, P. H., 2014, S̈patial quantification and valuation of cultural ecosystem services in an agricultural landscape, *Ecological Indicators*, 37, Part A 163–174.
6. Czajkowski, M., Giergiczny, M., Kronenberg, J., Tryjanowski, P., 2014, T̈he economic recreational value of a white stork nesting colony: A case of 'stork village' in Poland, *Tourism Management*, 40, 352–360.
7. Beaumont, N. J., Jones, L., Garbutt, A., Hansom, J. D., Toberman, M., 2014, T̈he value of carbon sequestration and storage in coastal habitats, *Estuarine, Coastal and Shelf Science*, 137, 32–40,
8. Watanabe, M. D. B., Ortega, E., 2014, D̈ynamic emergy accounting of water and carbon ecosystem services: a model to simulate the impacts of land-use change, *Ecological Modelling*, 271, 113–131.
9. Yoo, J., Simonit, S., Connors, J. P., Kinzig, A. P., Perrings, C., 2014, T̈he valuation of off-site ecosystem service flows: deforestation, erosion and the amenity value of lakes in Prescott, Arizona, *Ecological Economics*, 97, 74–83.
10. Jobstvogt, N., Hanley, N., Hynes, S., Kenter, J., Witte, U., 2014, T̈wenty thousand sterling under the sea: estimating the value of protecting deep-sea biodiversity, *Ecological Economics*, 97, 10–19.
11. Chen, J.-L., Chuang, C.-T., Jan, R.-Q., Liu, L.-C., Jan, M.-S., 2013, R̈ecreational Benefits of Ecosystem Services on and around Artificial Reefs: A Case Study in Penghu, Taiwan, *Ocean & Coastal Management*, 85, Part A 58–64.
12. Hicks, C. C., Graham, N. A. J., Cinner, J. E., 2013, S̈ynergies and tradeoffs in how managers, scientists, and fishers value coral reef ecosystem services, *Global Environmental Change*, 23, 1444–1453.
13. Colombo, S., Christie, M., Hanley, N., 2013, Ẅhat are the consequences of ignoring attributes in choice experiments? Implicationsforecosystemservicevaluation, *Ecological Economics*, 96, 25–35.
14. Stanley, D., Gunning, D., Stout, J., 2013, P̈ollinators and pollination of oilseed rape crops (*Brassica napus* L.) in Ireland:

ecological and economic incentives for pollinator conservation, *Journal of Insect Conservation*, 17, 1181–1189.
15. Liu, S., Crossman, N. D., Nolan, M., Ghirmay, H., 2013, Bringing ecosystem services into integrated water resources management, *Journal of Environmental Management*, 129 92–102.
16. Casado-Arzuaga, I., Madariaga, I., Onaindia, M., 2013, Perception, demand and user contribution to ecosystem services in the Bilbao Metropolitan Greenbelt, *Journal of Environmental Management*, 129, 33–43.
17. Colloff, M. J., Lindsay, E. A., Cook, D. C., 2013, Natural pest control in citrus as an ecosystem service: Integrating ecology, economics and management at the farm scale, *Biological Control*, 67, 170–177.
18. Jianjun, J. I. N., Chong, J., Lun, L. I., 2013, The economic valuation of cultivated land protection: A contingent valuation study in Wenling City, China, *Landscape and Urban Planning*, 119, 158–164.
19. Wang, H., Shi, Y., Kim, Y., Kamata, T., 2013, Valuing water quality improvement in China: a case study of Lake Puzhehei in Yunnan Province, *Ecological Economics*, 94, 56–65.
20. Larson, S., Stoeckl, N., Neil, B., Welters, R., 2013, Using resident perceptions of values associated with the Australian Tropical Rivers to identify policy and management priorities, *Ecological Economics*, 94, 9–18.
21. Shoyama, K., Managi, S., Yamagata, Y., 2013, Public preferences for biodiversity conservation and climate-change mitigation: a choice experiment using ecosystem services indicators, *Land Use Policy*, 34, 282–293.
22. de Lange, W. J., Veldtman, R., Allsopp, M. H., 2013. Valuation of pollinator forage services provided by Eucalyptus cladocalyx, *Journal of Environmental Management*, 125, 12–18.
23. Silvestri, S., Zaibet, L., Said, M. Y., Kifugo, S. C., 2013. Valuing ecosystem services for conservation and development purposes: a case study from Kenya, *Environmental Science & Policy*, 31, 23–33.
24. Zhao, J., Liu, Q., Lin, L., Lv, H., Wang, Y., 2013. Assessing the comprehensive restoration of an urban river: an integrated application of contingent valuation in Shanghai, China, *Science of The Total Environment*, 458–460, 517–526.
25. Drake, B., Smart, J. R., Termansen, M., Hubacek, K., 2013. Public preferences for production of local and global ecosystem services, *Regional Environmental Change*, 13, 649–659.
26. Cerda, C., Ponce, A., Zappi, M., 2013. Using choice experiments to understand public demand for the conservation of nature: a case study in a protected area of Chile, *Journal for Nature Conservation*, 21, 143–153.
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28. Zander, K. K., Parkes, R., Straton, A., Garnett, S. T., 2013. Water ecosystem services in Northern Australia—how much are they worth and who should pay for their provision?, *PLoS One*, 8, e64411.
29. Ibarra, A. A., Zambrano, L., Valiente, E. L., Ramos-Bueno, A., 2013. Enhancing the potential value of environmental services in urban wetlands: an agro-ecosystem approach, *Cities*, 31, 438–443.
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