Available online at www.sciencedirect.com

ScienceDirect

Current Opinion in Environmental Sustainability

Valuing nature's contributions to people: the IPBES approach

Unai Pascual[1,2,3], Patricia Balvanera[4], Sandra Díaz[5,6], György Pataki[7], Eva Roth[8], Marie Stenseke[9], Robert T Watson[10], Esra Başak Dessane[11], Mine Islar[12], Eszter Kelemen[13,14], Virginie Maris[15], Martin Quaas[16], Suneetha M Subramanian[17], Heidi Wittmer[18], Asia Adlan[19], SoEun Ahn[20], Yousef S Al-Hafedh[21], Edward Amankwah[22], Stanley T Asah[23], Pam Berry[24], Adem Bilgin[25], Sara J Breslow[26], Craig Bullock[27], Daniel Cáceres[28,29], Hamed Daly-Hassen[30], Eugenio Figueroa[31], Christopher D Golden[32], Erik Gómez-Baggethun[24,33,34], David González-Jiménez[4,35], Joël Houdet[36], Hans Keune[37,57], Ritesh Kumar[38], Keping Ma[39], Peter H May[40], Aroha Mead[41], Patrick O'Farrell[42], Ram Pandit[43], Walter Pengue[44], Ramón Pichis-Madruga[45], Florin Popa[46], Susan Preston[47], Diego Pacheco-Balanza[48], Heli Saarikoski[49], Bernardo B Strassburg[50,51,52], Marjan van den Belt[53], Madhu Verma[54], Fern Wickson[55] and Noboyuki Yagi[56]

Nature is perceived and valued in starkly different and often conflicting ways. This paper presents the rationale for the inclusive valuation of nature's contributions to people (NCP) in decision making, as well as broad methodological steps for doing so. While developed within the context of the Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES), this approach is more widely applicable to initiatives at the knowledge–policy interface, which require a pluralistic approach to recognizing the diversity of values. We argue that transformative practices aiming at sustainable futures would benefit from embracing such diversity, which require recognizing and addressing power relationships across stakeholder groups that hold different values on human nature-relations and NCP.

Addresses
[1] Basque Centre for Climate Change, Sede Building 1, 1st floor, Scientific Campus of the University of the Basque Country (UPV-EHU), Leioa 48940, Bilbao, Spain
[2] Ikerbasque, Basque Foundation for Science, María Díaz Haro, 3, 48013 Bilbao, Spain
[3] University of Cambridge, Department of Land Economy, 16-21 Silver St., Cambridge CB3 9EP, UK
[4] Instituto de Investigaciones en Ecosistemas y Sustentabilidad—IIES, Universidad Nacional Autónoma de México, Antigua Carretera a Pátzcuaro No. 8701, Morelia, Mexico
[5] Instituto Multidisciplinario de Biología Vegetal (IMBIV-CONICET), Córdoba, Argentina
[6] FCEFyN, Universidad Nacional de Córdoba, CC 495, 5000 Córdoba, Argentina
[7] Department of Decision Sciences Corvinus Business School, Corvinus University of Budapest & Environmental Social Science Research Group—ESSRG, Budapest, Fővám tér 8 1093, Hungary
[8] Department of Environmental and Business Economics, University of Southern Denmark, Niels Bohrs Vej 9-10, DK-6700 Esbjerg, Denmark
[9] Department of Economy and Society, University of Gothenburg, Box 625, 405 30 Gothenburg, Sweden
[10] Tyndall Center Department of Environmental Sciences, University of East Anglia, UK
[11] Project House, Moda Caddesi Borucu Han no: 20/204 Kadıköy, Istanbul, Turkey
[12] Centre for Sustainability Studies, Lund University, Box 170, 221 00 Lund, Sweden
[13] Environmental Social Science Research Group—ESSRG Ltd., Rómer Flóris u. 38, Budapest, Hungary
[14] Department of Decision Sciences, Corvinus University of Budapest. 1093 Budapest, Fővám tér 8, Hungary
[15] Centre d'Ecologie Fonctionnelle et Evolutive—CNRS, 1919 Route de Mende, Montpellier, France
[16] Department of Economics, Kiel University, Wilhelm-Seelig-Platz 1, Kiel, Germany
[17] International Institute of Global Health & Institute for the Advanced Study of Sustainability, United Nations University, UNU-IAS, Jingu mae, Shibuya ku, Tokyo, Japan
[18] Department of Environmental Politics, Helmholtz-Centre for Environmental Research—UFZ, Permoserstraße 15 04318, Leipzig, Germany
[19] Institute of Environmental Studies, University of Khartoum, B.O. Box 321, Ghamhoria Street, Khartoum, Sudan
[20] Korea Environment Institute, 613-2 Bulgwang-dong Eunpyeong-gu, Seoul 122-706, South Korea

[21] Center of Excellence for Wildlife Research, King Abdulaziz City for Science & Technology, P.O. Box 6086, Riyadh, Saudi Arabia
[22] Center for Environmental Governance, P.O. Box LG 376, Legon, Accra, Ghana
[23] School of Environmental and Forest Sciences, University of Washington, College of the Environment, 352100, Seattle, WA 98195, USA
[24] Environmental Change Institute, University of Oxford, Dyson Perrins Building, South Parks Road, Oxford OX1 3QY, UK
[25] Ministry of Forestry and Water Affairs of Turkey, 06560 Ankara, Turkey
[26] Centre for Creative Conservation, University of Washington, Box 355674, Seattle, WA 98195, USA
[27] School of Architecture, Planning and Environmental Policy, University College Dublin, UCD, Belfield, Dublin 4, Ireland
[28] Consejo Nacional de Investigaciones Científicas y Tecnológicas (CONICET) Córdoba, Argentina
[29] Department of Rural Development,Universidad Nacional de Córdoba—UNC, Av. Valparaíso s/n, Ciudad Universitaria, Córdoba, Argentina
[30] National Institute for Agricultural Research of Tunisia (INRAT), University of Carthage, Rue Hedi Karray, 2080 Ariana, Tunisia
[31] Department of Economics, University of Chile, Diagonoal Paraguay 257 Of. 1501, Santiago 833015, Chile
[32] Department of Environmental Health, Harvard T.H. Chan School of Public Health, 677 Huntington Ave., Boston, MA 02215 USA
[33] Department of International Environment and Development Studies, Norwegian University of Life Sciences—NMBU, P.O. Box 5003, N-1432 Ås, Norway
[34] Norwegian Institute for Nature Research—NINA, Gaustadalléen 21, 0349 Oslo, Norway
[35] Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmBH, Av. Insurgentes Sur 813 piso 4, C.P. 03840 Ciudad de México, Mexico
[36] The Albert Luthuli Centre for Responsible Leadership, Faculty of Economic and Management Sciences, University of Pretoria, Corner of Lynnwood Road and Roper Street, Hatfield, 0083 Pretoria, South Africa
[37] Belgian Biodiversity Platform & Research Institute for Nature and Forest (INBO), Kliniekstraat 25, 1070 Brussels, Belgium
[38] Wetlands International, A-25, Defence Colony, New Delhi 110024, India
[39] State Key Laboratory of Vegetation and Environmental Change, Institute of Botany, Chinese Academy of Sciences, 20 Nanxincum, Xiangshan, Haidian District, Beijing 100093, China
[40] Programa de Pós-Graduação de Ciências Sociais em Desenvolvimento, Agricultura e Sociedade—Universidade Federal Rural do Rio de Janeiro, Rodovia BR 465, Km 07, Seropédica, RJ 23890-000, Brazil
[41] Commission on Environmental, Economic and Social Policy, IUCN, Wellington, New Zealand
[42] Biodiversity and Ecosystem Services, Natural Resources and the Environment Research Groups, Council for Scientific and Industrial Research—CSIR, P.O. Box 320, Stellenbosch 7599, South Africa
[43] School of Agricultural and Resource Economics, The University of Western Australia, 35 Stirling Highway, Crawley, Western Australia 6009, Australia
[44] Area de Ecología—Instituto del Conurbano, Universidad Nacional de General Sarmiento, Juan María Gutiérrez 1150, 1613 Los Polvorines, Buenos Aires, Argentina
[45] Centro de Investigaciones de la Economía Mundial—CIEM, Calle 22, No. 309 entre 3ra y 5ta Avenida, Miramar, Habana 13 C.P. 11300, Cuba
[46] DG Regional and Urban Policy, European Commission, Avenue de Beaulieu 5, B-1049 Brussels, Belgium
[47] National Biodiversity Policy, Government of Canada, Canada
[48] Deputy Minister of Planning for Development, Plurinational State of Bolivia, La Paz, Bolivia
[49] Environmental Policy Centre, Finnish Environment Institute, Mechelininkatu 34A, Helsinki, Finland
[50] Rio Conservation and Sustainability Science Centre—CSRio, Department of Geography and the Environment, Pontifícia Universidade Católica, Rua Marquês de São Vicente, 225, Gávea, Rio de Janeiro, Brazil
[51] International Institute for Sustainability, Estrada Dona Castorina 124, Rio de Janeiro, Brazil
[52] Department of Biological Sciences, Federal University of Rio de Janeiro, Av. Pedro Calmon. n° 550, Cidade Universitária, Rio de Janeiro, Brazil
[53] Victoria University of Wellington, New Zealand
[54] Indian Institute of Forest Management, Box 357, Nehru Nagar, Bhopal, India
[55] Society, Ecology and Ethics Department, GenØk Centre for Biosafety, Siva innovasjonssenter, P.O. Box 6418, 9294 Tromsø, Norway
[56] Graduate School of Agricultural and Life Sciences, The University of Tokyo, 1-1-1 Yayoi Bunkyo-ku Tokyo, Japan
[57] Faculty of Medicine and Health Sciences, Belgium University of Antwerp. Drie Eiken – gebouw R R.3.07, Universiteitsplein 1, 2610 Wilrijk, Belgium

Corresponding author: Pascual, Unai (unai.pascual@bc3research.org)

Current Opinion in Environmental Sustainability 2017, **26–27**:7–16

This review comes from a themed issue on **Open issue, part II**

Edited by **Eduardo Brondizio**, **Rik Leemans** and **William Solecki**

For a complete overview see the Issue and the Editorial

Available online 23rd February 2017

Received 20 July 2016; Revised 22 November 2016; Accepted 10 December 2016

http://dx.doi.org/10.1016/j.cosust.2016.12.006

Introduction

Nature and its contributions to a good quality of life are often perceived and valued by people in starkly different and often conflicting ways [1,2]. People perceive and judge reality, truth, and knowledge in ways that may differ from the mainstream scientific lens [3]. Hence, it is critical to acknowledge that the diversity of values of nature and its contributions to people's good quality of life are associated with different cultural and institutional contexts [4] and are hard to compare on the same yardstick [5,6]. Conflicts over values often affect decision making as well as the way sustainability is conceived [7•]. Further, such value conflicts interfere with effective and equitable decisions about nature and its contributions to people.

The conceptual framework of the Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES) identifies three inclusive elements in the interaction between human societies and the non-human world, among others: nature, nature's benefits to people, and a good quality of life [8••,9]. This paper zooms into

the values ascribed to *nature's contributions to people* (hereafter NCP), given that they are the conduit between nature and a good quality of life.[1] The IPBES category of NCP, is defined here as all the positive contributions, or benefits, *and* occasionally negative contributions, losses or detriments, that people obtain from nature. It resonates with the original use of the term ecosystem services in the MA [10], and goes further by explicitly embracing concepts associated with other worldviews on human–nature relations and knowledge systems (*e.g.* 'nature's gifts' in many indigenous cultures) [8••].

Emphasis in the consideration of diverse values of NCP to inform policies and everyday practices can be placed, for example on food and feed; on protecting the evolutionary processes of biodiversity and the continued functioning of ecosystems; or on honouring the Earth as a sacred living being or on maintaining harmonic relationships between people and nature [11••]. Farmers may value the food they produce in different ways, for example by considering it to be a pure market commodity, which produces a financial benefit, or as an integral part of their continued cultural identity and self-determination. Further, the same farmers may also hold conflicting and evolving values about the food they produce. Hence, the ways in which values are understood, acknowledged, and addressed in practice are complex and have impact on decisions that may affect both present and future outcomes.

The interplay of different worldviews and values associated with NCP produces equally diverse perspectives on aspects pertaining to for instance conservation, equity, resilience and ways of achieving sustainable development goals. However, this wide spectrum of values through which people attribute meaning and importance to NCP is rarely recognized or explicitly taken into account in decision making. Identifying such diversity of values of individuals and social groups is often challenging. But not doing so can undermine the very objectives of those decisions and produce unsustainable outcomes [12]. Better understanding and recognition of the suite of values associated with NCP is thus crucial in sustainability science [7•].

In order to recognize and make visible the diversity of values of NCP and incorporate this diversity into decision making processes, IPBES has developed a guide [13••]. Here, we present the rationale for an inclusive incorporation of the diversity of values of NCP in decision making, as well as a (non-prescriptive) set of methodological steps for doing so. While developed within the context of the IPBES, this approach is more widely applicable to initiatives at the knowledge–policy interface that require a pluralistic approach to the diversity of values underpinning nature–human relationships.

Unpacking the value of 'nature's contributions to people' (NCP)

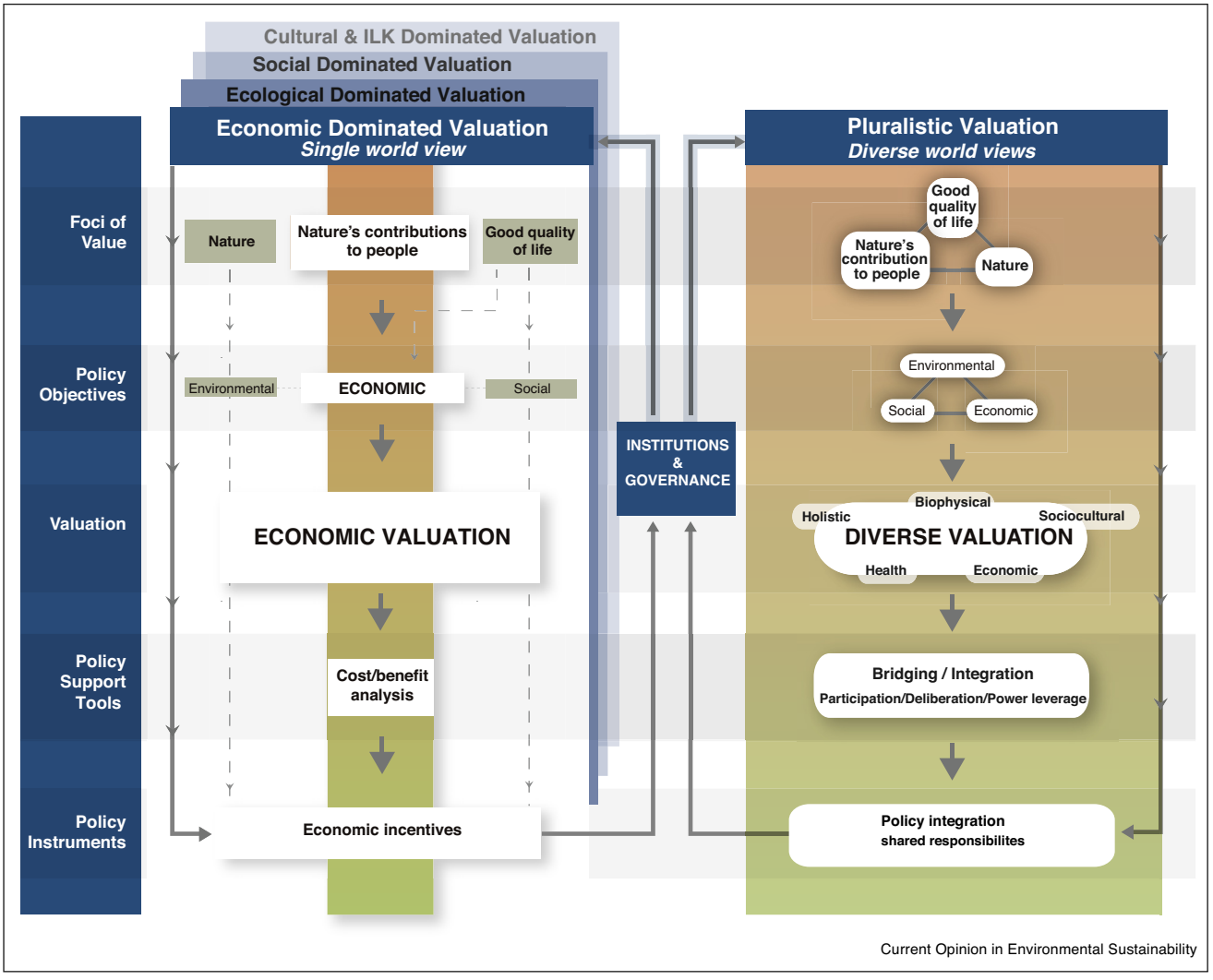
The word 'value' can refer to a *principle* associated with a given worldview or cultural context, a *preference* someone has for a particular state of the world, the *importance* of something for itself or for others, or simply a *measure*. These different meanings of 'value' can be linked, for example when ethical *principles* lead one to assign *importance* to different aspects of NCPs, and to have a *preference* for a specific course of action, which in turn can be *measured* by an appropriate valuation tool. It is important not to conflate these meanings. For example, the biophysical *measure* of how much tropical forest provides habitat to wildlife is only one proxy for the *importance* of forest in terms of its potential for habitat creation from an ecological viewpoint. In the same way, from an economic perspective, individuals' demand (*e.g.* willingness to pay) for the survival of wildlife is just one way to capture people's *preference* orderings where protecting wildlife yields NCP that can be associated, with for instance, inspiration and cultural identity connections, often related to non-use (existence and bequest) values [14].

While ways to integrate these unidimensional values are actively being developed and reported in the literature (*e.g.* [14,15]), this is seldom explicitly reflected in the sustainability science-policy arena. The dominant discourses and approaches tend to emphasize the dichotomy between instrumental (*i.e.* values of living entities as means to achieve human ends, or satisfy human preferences), vs. intrinsic (*i.e.* values inherent to nature, independent of human judgement) dimensions of nature [11••,16]. Hence, much of the policy discourse on the need for valuation of NCP heavily relies on either a unidimensional value lens (*value-monism*) that derives from a utilitarian economic perspective or an environmental ethics stance of nature–human relationships, strengthening the instrumental vs. intrinsic dichotomy. Depending whether a unidimensional or a more diverse (*value pluralism*) lens is applied, policy objectives, as well as policy instruments will be determined differently through formal and informal institutions, which themselves co-evolve with such value systems.

Figure 1 illustrates the contrast between the use of unidimensional value framings, for example economic, socio-cultural, and ecological (left panel), with the application of a more integrated approach that aims at bridging different value dimensions (right panel), associated with value pluralism. Here, we use the example of utilitarian value ethics based on individual self-interested

[1] The IPBES conceptual framework as presented in Díaz *et al.* [8••] used the expression 'nature's benefits to people'. The word 'benefit' was later replaced with 'contribution' because it is more comprehensive and neutral (Díaz *et al.* submitted).

Figure 1

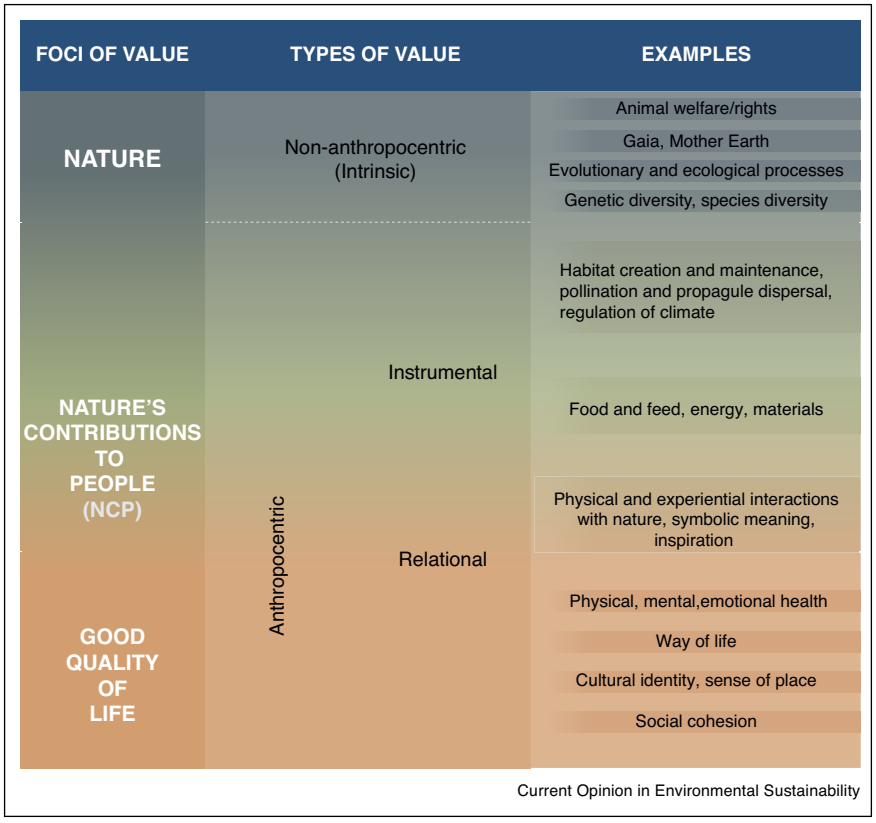


A stylized illustrative framework of contrasting approaches to the process of valuation. The right side panel emphasizes the importance of a pluralistic valuation approach, compared with value monism or unidimensional valuation approaches to human–nature relationships represented in the left side panel.

behaviour, often associated with a belief in material economic growth as the basis for a good quality of life, which should eventually result in protection and conservation of the environment [17], as well as in equity and poverty alleviation. This is often related to the view that economic growth trickles down to the disadvantaged and poor people, conflating the ideas of growth and development [18]. In such a worldview, either market-based valuation may be used disregarding negative externalities of economic growth policies or non-market valuation tools may be called upon to identify the relative importance of negative externalities associated with such pro-growth market-led governance [13••]; valuing environmental externalities is generally seen to better reflect the impact of policies on human wellbeing as the object to be sustained [15,19], and this is complemented with the development of indicators such as 'genuine or inclusive wealth' [20]. In turn, such normative valuation approach informs the composition of a policy toolbox aimed at internalising externalities, often at the jurisdictional scale [19], and thereby to include more beneficiaries in the distribution of wealth, for example through economic incentives such as Payments for Ecosystem Services, which may also have equity and poverty alleviation as co-objectives [21,22•].

By contrast, a value ethics that embraces value pluralism by acknowledging the diversity of worldviews and values (Figure 1 right panel) may lead to a different iterative approach regarding identification of policy objectives and instruments. Such an approach would take a social-ecological perspective, where nature, NCP and a good

Figure 2



Diverse values related to nature, nature's contributions to people (NCP) and a good quality of life. The grading in the colors indicate that both instrumental and relational values can be ascribed to the value of NCP, and to highlight that NCP are intertwined with nature and a good quality of life.

quality of life are seen as interdependent [8••]. Additionally this approach, would require activating deliberative approaches towards potential conflict resolution over values. It is associated with the need to leverage power relations through participatory negotiation among stakeholders holding incommensurable values over human–nature relations [23•]. Recognizing, making visible, and respecting the diverse values at stake and addressing power relations through which these are expressed, are all needed in order to effectively and equitably bridge different value systems, eventually allowing processes of social learning [24]. This integrative approach opens the opportunity to bridge NCP values in terms of biophysical, socio-cultural, economic, health, or holistic perspectives. This approach also calls for acknowledging the existence of different perceptions of what constitutes 'a good life' across social groups and cultures. Last but not least, it highlights the need to acknowledge the role of institutions, including social norms that underpin human–nature relations [25]. Policy cannot only support changes in social norms but also favour deliberative policy tools, which recognize the diversity of values as well as resolution approaches when value conflicts arise [26].

Conceptualising and visualizing the diversity of values

IPBES acknowledges that different types of values need to be promoted in decision making. While the intrinsic values of 'nature' are recognized as important for decision making, IPBES also acknowledges that decision making relies to a great extent on the instrumental values of NCP [11••,16,19]. In addition, NCP can embody symbolic relationships with natural entities to the extent that such relationships are inextricably linked to people's sense of identity and spirituality, to a meaningful life and to 'doing the right thing'. In this case NCP are associated with relational values, that is values that do not directly emanate from nature but are derivative of our relationships with it and our responsibilities towards it [11••].

Some of NCP are closely related to fundamental constituents of a 'good quality of life'; NCP can embody

symbolic relationships with natural entities to the extent that such relationships are part and parcel of how people's sense of identity and spirituality fulfil human life. In this case NCP are associated with relational values. Relational values reflect elements of cultural identity, social cohesion, social responsibility and moral responsibility towards nature [9]. This type of relationship with nature is also part of the set of NCP that impinge on people's good quality of life, such as those associated with learning and artistic inspiration, symbolic meanings, and cultural identity connections.

This kaleidoscopic view on values – intrinsic, instrumental and relational – permeates the ways we understand our relationship with nature. This makes it necessary to expand the way society recognizes the diversity of values and to embrace pluralistic valuation approaches. The IPBES approach to unravelling such diversity of values, presented here, is neither exhaustive nor prescriptive. Figure 2 maps the main types of values (intrinsic, instrumental and relational) with different foci of value related to nature, NCP and good quality of life. It emphasizes that NCP values are fluid and sometimes cannot be placed squarely into one category of value (*e.g.* instrumental or relational). This is illustrated by the colour gradient. The examples provided are not exhaustive and they indicate the objects which different types of values can be associated with. The definitions of the types of values used here and other key concepts are provided in the Annex.

A practical approach to pluralistic valuation and assessments

Once the diversity of values attributed to NCPs are recognized, a transparent way is required to capture and make available knowledge of such diversity to stakeholders. Here, we propose a five-step approach, illustrated in Figure 3 with the aim of facilitating comparability of valuation results, as well as transparency and accountability of the valuation process.[2]

(1) *Identifying the purpose* of the valuation or assessment of values is critical for providing relevant and context-specific understanding of the use of such values. The purpose of valuation may include multi-level decision making, whether at a community, landscape, bioregional or national level, as well as raising awareness, litigation, or using valuation as a conflict resolution instrument [28].

(2) *Scoping* means delineating the boundaries of the valuation approach with the aim of choosing the most appropriate procedures. Key issues to consider are: (i) which worldviews are at stake and which ones are actually recognized and reflected? (ii) Which foci of values are the most relevant (is it nature, NCP or dimensions of a good quality of life)? (iii) Which value types need to be elicited to capture the diversity of values? (iv) Which spatial, temporal and social organizational scales are targeted? (v) How do stakeholders engage to express values? (vi) How do different valuation methods shape the equitable relationships among stakeholders as regards value articulation? And (vii) how can practical requirements of valuation methods be fulfilled and improved?

(3) *Undertaking the assessment or valuation*, based on scoping. The plurality of worldviews leading to a diversity of values, heterogeneous valuation methods, and their integration across domains (biophysical, economic, health-based, holistic-indigenous and socio-cultural) should be considered. When identifying the diversity of values across different value foci, it will sometimes be the case that value trade-offs and incommensurability among values will be encountered and thus need to be acknowledged [29]. This would in turn require that the power relations among those holding conflicting and incommensurable values would need to be assessed.

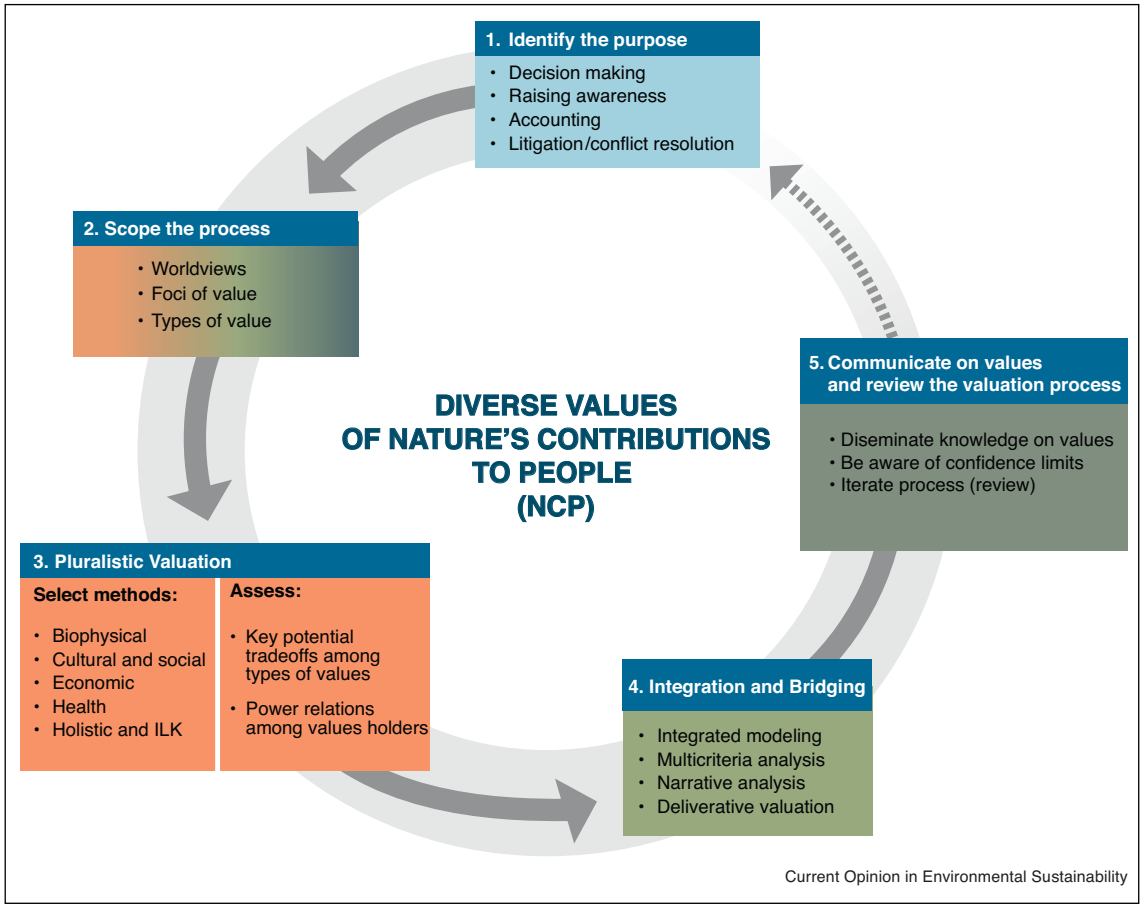
(4) *Integrating and bridging values.* A non-trivial question is how to synthesize the information or bridge among, sometimes, incommensurable value dimensions in a coherent and transparent way [30]. No matter what approach to bridging of values is chosen, it will include some elements of valuation itself, either by an implicit weighting of values, or explicitly through adopting a particular method rather than other. Hence, transparent participatory processes may be required to leverage power relations over diverse values, negotiate, and bridge upon incommensurable values. It is acknowledged though that deliberative processes, on their own, may not always lead to a shared understanding or consensus when an irreducible plurality of standpoints exists [31]. In this case, the reasons behind the challenge of bridging values ought to be identified. Various approaches for bridging and integrating values to support decision making can be used, such as integrated modelling approaches, multi-criteria analysis as well as deliberative and narrative approaches.

a) *Integrated modelling* reflects a multi- or inter-disciplinary effort. For example, when valuing changes in NCP the objective can be to simulate changes in elements of ecosystems across space and time [32]. Such modelling approaches may emphasize multiple dimensions including socio-economic and institutional system dynamics, and therefore a key challenge is the need to maintain coherence in their representation [33,34•].

b) *Multi-Criteria Decision Analysis* (MCDA) can be employed as a method to simultaneously embrace, combine, and structure a diversity of often incommensurable information (*e.g.* qualitative and quantitative data, as well

[2] There are similar approaches to assess environmental values in order to aid decision making (*e.g.* see Ref. [27]). The full detail of the valuation approach suggested here is explained in the guide on values [14].

Figure 3



The IPBES approach for assessing values and conducting valuation studies. Orange and green colours in step 2 indicate that the scoping applies to methods for both valuation and integrating/bridging diverse values (boxes 3 and 4).

as associated uncertainty), of opinions (also among experts), of actors' perspectives (and stakes), and of decision making criteria [34•,35,36].

c) *Narrative approaches* often prove to be a powerful communication tool that integrates knowledge and information based on the expertise within different cultural systems, such as scientific information and indigenous and local knowledge [37].

d) *Deliberative valuation* allows values to be discovered, constructed and reflected in a dialogue/negotiation among stakeholders [38,39]. It is useful to bridge values which are expressions of personal utility or motivated by other factors, such as moral or ethical considerations and thus different to be integrated through modelling [40]. MCDA can also inform deliberation and help to pave the way to decision making.

These approaches require different degrees of transdisciplinarity, where expert valuation is blended with social participatory processes to co-elicit stakeholders' diverse value perspectives. Deepening into transdisciplinary valuation approaches can also help achieving self-reflection and learning, prerequisites for a transformative vision about nature–human relationships where different worldviews are recognized and respected.

(5) *Communication with the public and decision makers*. Once values are identified and the results of the valuation attained, the information, knowledge gained and developed, can be shared through dialogue and dissemination activities. At this stage it is important to reflect on the confidence limits on the different types of values obtained from different data sources and the pluralistic valuation process. Communication is understood as process where stakeholders' views on the strengths and weaknesses of the pluralistic valuation approach chosen serves as the starting point for iterative and adaptive decision making.

IPBES principles on valuation and value assessments

Genuinely understanding the diversity of values of NCP entails two key principles. First, valuation and value assessments require the recognition of a broad range of worldviews and thus the need to express and respect the ways through which people ascribe meaning and importance to nature, NCP and different constituents of a good quality of life. When possible, promoting different conceptualizations of value and valuation approaches is more appropriate than a deeper focus on a subset of unidimensional values (*e.g.* economic, biophysical, social-cultural). This requires the ability to overcome paralysis in the face of value pluralism, to engage in bridging, and to mobilise transdisciplinary collaboration across a broad range of natural and social sciences as well as other knowledge systems. While a pluralistic valuation approach is likely to be more time and resource consuming than the application of approaches based on value-monism, it is likely to be more equitable, which is a prerequisite of any sustainable pathway.

Second, valuation requires learning that the incorporation of values and valuation methods into decision making processes are themselves value-laden [27,36]. The adopted approach to valuation depends on peoples' particular ways of thinking, their perspectives and the ways in which these influence their interaction with nature [41,42•]. These are all subject to manipulation from power relations and the politicization of such relations within a given socio-economic and institutional context [23•,43]. This implies the recognition that how to frame scoping questions, use methods, collect data, and interpret results, all involve a somewhat normative framework that, to some extent, can be difficult to subtract from purely technical aspects in valuation. The effectiveness of a science-policy body such as IPBES relies on society's perception of the need of a paradigm that recognizes and fully embraces the diversity of values as fundamental to achieving societal goals for sustainability.

Annex Glossary

Anthropocentric value: It means 'human-centred', so an anthropocentric value is a value that something has for human beings and human purposes.

Biophysical values: A biophysical value is a measure of the importance of components of nature (living being or non-living element), of the processes that are derived from the interactions among these components, or those of particular properties of those components and processes.

Economic values: Economists group values in terms of ' use' or 'non-use' value categories, each of which is associated with a selection of valuation methods. Use values can be both direct and indirect, and relate to the current or future (option) uses. Direct use values may be 'consumptive' (*e.g.* drinking water) or 'non-consumptive' (*e.g.* nature-based recreational activities). Indirect use values capture the ways that people benefit from something without necessarily directly seeking it out (*e.g.* flood protection). Non-use values are based on the preference for components of nature's existence without the valuer using or experiencing it, and are of three types: existence value, altruistic value, and bequest value.

Good quality of life: The achievement of a fulfilled human life, the criteria for which may vary greatly across different societies and groups within societies. It is a context-dependent state of individuals and human groups, comprising aspects such access to food, water, energy and livelihood security, and also health, good social relationships and equity, security, cultural identity, and freedom of choice and action. 'Living in harmony with nature', 'living-well in balance and harmony with Mother Earth' and 'human well-being' are examples of different perspectives on good quality of life.

Indigenous and local knowledge *(ILK)* system: A cumulative body of knowledge, practice and belief, evolving by adaptive processes and handed down through generations by cultural transmission, about the relationship of living beings (including humans) with one another and with their environment. It is also referred to by other terms such as, for example indigenous, local or traditional knowledge, traditional ecological/environmental knowledge (TEK), ethnoscience, indigenous science, and folk science.

Institutions: Encompass all formal and informal interactions among stakeholders and social structures that determine how decisions are taken and implemented, how power is exercised and how responsibilities are distributed.

Intrinsic value: This concept refers to inherent value, that is the value something has independent of any human experience or evaluation. Such a value is viewed as an inherent property of the entity (*e.g.* an organism) and not ascribed or generated by external valuing agents (such as human beings).

Instrumental value: An instrumental value is the value attributed to something as a means to achieve a particular end.

Integrated valuation: The process of collecting, synthesizing, and communicating knowledge about the ways in which people ascribe importance and meaning to NCP to humans, to facilitate deliberation and agreement for decision making and planning.

Knowledge system: A body of propositions that are adhered to, whether formally or informally, and are routinely used to claim truth.

Nature: The non-human world, including co-produced features. Within the context of science, it includes categories such as biodiversity, ecosystems, ecosystem functioning, evolution, the biosphere, humankind's shared evolutionary heritage, and biocultural diversity. Within the context of other knowledge systems, it includes categories such as Mother Earth and systems of life.

Nature's contributions to people (NCP): All the positive contributions or benefits, *and* occasionally negative contributions, losses or detriments, that people obtain from nature. It resonates with the use of the term ecosystem services, and goes further by explicitly embracing concepts associated with other worldviews on human–nature relations and knowledge systems (*e.g.* 'nature's gifts' in many indigenous cultures).

Non-anthropocentric value: A non-anthropocentric value is a value centered on something other than human beings. These values can be non-instrumental (*e.g.* a value ascribed to the existence of specific species for their own sake) or instrumental to non-human ends (*e.g.* the instrumental value a habitat has for the existence of a specific species).

Non-instrumental value: A non-instrumental value is the value attributed to something as an end in itself, regardless of its utility for other ends.

Policy instruments: Instruments used by governance bodies at all scales to implement their policies. Environmental policies, for example could be implemented through tools such as legislation, economic incentives or dis-incentives, including taxes and tax exemptions, or tradeable permits and fees.

Relational values: Values relative to the meaningfulness of relationships, including the relationships between individuals or societies and other animals and aspects of the lifeworld (all of whom may be understood as conscious persons), as well as those among individuals and articulated by formal and informal institutions. Another type of relational values, *eudaimonistic* values are associated with a good life, which include considerations of principles and virtues, and value the actions and habits that are conducive to a meaningful and satisfying life.

Shared values: Values shared by people in groups and/or those that inform shared identity of a particular group.

Value systems: Set of values according to which people, societies and organizations regulate their behaviour. Value systems can be identified in both individuals and social groups.

References and recommended reading

Papers of particular interest, published within the period of review, have been highlighted as:

- • of special interest
- •• of outstanding interest

1. Martinez-Alier J: *The Environmentalism of the Poor: A Study of Ecological Conflicts and Valuation*. Edward Elgar Publishing; 2003.

2. Daily GC, Söderqvist T, Aniyar S, Arrow K, Dasgupta P, Ehrlich PR, Folke C, Jansson A, Jansson B-O, Kautsky N *et al.*: **The value of nature and the nature of value**. *Science* 2000, **289**:395-396.

3. Tengö M, Brondizio ES, Elmqvist T, Malmer P, Spierenburg M: **Connecting diverse knowledge systems for enhanced ecosystem governance: the multiple evidence base approach**. *Ambio* 2014, **43**:579-591.

4. Brondizio ES, Ostrom E, Young OR: **Connectivity and the governance of multilevel social-ecological systems: the role of social capital**. *Annu Rev Environ Resour* 2009, **34**:253-278.

5. Martinez-Alier J, Munda G, O'Neill J: **Weak comparability of values as a foundation for ecological economics**. *Ecol Econ* 1998, **26**:277-286.

6. Gómez-Baggethun E, Barton D, Berry P, Dunford R, Harrison P: **Concepts and methods in ecosystem services valuation**. In *Routledge Handbook of Ecosystem Services.* Edited by Potschin M, Haines-Young R, Fish R, Turner RK. London and New York: Routledge; 2016. pp. 99–111.

7. • Bennett EM, Cramer W, Begossi A, Cundill G, Diaz S, Egoh E, Geijzendorffer IR, Krug CB, Lavorel S, Lazos E *et al.*: **Linking ecosystem services to human well-being: three challenges for designing research for sustainability**. *Curr Opin Environ Sustain* 2015, **14**:76-85.

Provides a social-ecological research agenda to answer key questions in ecosystem service science for decision making aiming at the the sustainable use of natural resources to improve human well-being.

8. •• Díaz S, Demissew S, Carabias J, Joly C, Lonsdale M, Ash N, Larigauderie A, Adhikari JA, Arico A, Báldi A *et al.*: **The IPBES conceptual frameworkíconnecting nature and people**. *Curr Opin Environ Sustain* 2015, **14**:1-16.

The conceptual framework of IPBES is developed as the first public output of the Platform. It recognizes that values of nature, nature's benefits to people and a good quality of life are associated with three broad types of values: intrinsic, instrumental and relational values.

9. UNEP: **IPBES-2/4: conceptual framework for the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services**. In Report of the Second Session of the Plenary of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services, 2014: http://www.ipbes.net/images/IPBES-2-17%20%20%20-%20%20Advance%20En.pdf.

10. Millennium Ecosystem Assessment: *Ecosystems and Human Well-Being: Synthesis*. Washington DC: Island Press; 2005.

11. •• Chan K, Balvanera P, Benessaiah K, Chapman M, Díaz S, Gómez-Baggethun E, Gould RK, Hannahs N, Jax K, Klain SC *et al.*: **Why protect nature? Rethinking values and the environment**. *Proc Natl Acad Sci U S A* 2016, **113**:1462-1465.

Reframes the discussion about environmental protection by defining relational values. It suggests that although intrinsic and instrumental values are critical to conservation, thinking only in these terms may miss a fundamental basis of concern for nature.

12. Martin A, Coolsaet B, Corbera E, Dawson NM, Fraser JA, Lehmann I, Rodriguez I: **Justice and conservation: the need to incorporate recognition**. *Biol Conserv* 2016, **197**:254-261.

13. •• UNEP: **IPBES/4/INF/1: preliminary guide regarding diverse conceptualization of multiple values of nature and its benefits, including biodiversity and ecosystem functions and services (deliverable 3(d))**. *Report of the Fourth Session of the Plenary of the Intergovernmental Science-Policy Platform on Biodiversity and*

Ecosystem Services 2015 In: *http://www.ipbes.net/sites/default/files/downloads/IPBES-4-INF-13_EN.pdf*.
It is the document on diverse conceptualization of values of nature and nature's benefits to people for a good quality of life approved by the 4th Plenary of IPBES, held in Kuala Lumpur in February 2016. It is the basis of the present paper.

14. Pascual U, Muradian R, Brander L, Gómez-Baggethun E, Martín-López B, Verma M, Armsworth P, Christie H, Eppink F, Farley J *et al.*: **The economics of valuing ecosystem services and biodiversity**. In *The Economics of Ecosystems and Biodiversity, Ecological and Economic Foundations.* Edited by Kumar P. London: Earthscan; 2010:183-255.

15. TEEB: In *The Economics of Ecosystems and Biodiversity: Ecological and Economic Foundations.* Edited by Kumar P. London: Earthscan; 2010.

16. Tallis H, Lubchenco J, Adams VM, Adams-Hosking C, Agostini VN, Kovács-Hostyánszki A: **Working together: a call for inclusive conservation**. *Nature* 2014, **515**:27-28.

17. Stern DI: **The rise and fall of the environmental Kuznets curve**. *World Dev* 2004, **32**:1419-1439.

18. Cannon T, Müller-Mahn D: **Vulnerability, resilience and development discourses in context of climate change**. *Nat Hazards* 2010, **55**:621-635.

19. Bateman IJ, Harwood AR, Mace GM, Watson RT, Abson DJ, Andrews B, Binner A, Crowe A, Day BH, Dugdale S *et al.*: **Bringing ecosystem services into economic decision making: land use in the UK**. *Science* 2013, **341**:45-50.

20. Duraiappah AK, Muñoz P: **Inclusive wealth: a tool for the United Nations**. *Environ Dev Econ* 2012, **17**:362-367.

21. Muradian R, Arsel M, Pellegrini L, Adaman F, Aguilar B, Agarwal B, Corbera E, Ezzine de Blas D, Farley J, Froger G *et al.*: **Payments for ecosystem services and the fatal attraction of win–win solutions**. *Conserv Lett* 2013, **6**:274-279.

22. • Pascual U, Phelps J, Garmendia E, Brown K, Corbera E, Martin A, Gomez-Baggethun E: **Social equity matters in payments for ecosystem services**. *Bioscience* 2014, **64**:1027-1036.
It illustrates how subjective notions of social equity and fairness affect the perception of the value of protecting nature's benefits to people through economic incentive mechanisms such as Payments for Ecosystem Services.

23. • Berbés-Blázquez M, González JA, Pascual U: **Towards an ecosystem services approach that addresses social power relations**. *Curr Opin Environ Sustain* 2016, **19**:134-143.
Addresses the importance of historical co-evolution of power relations and environmental change in shaping biodiversity and ecosystem services values.

24. Cundill G, Rodela R: **A review of assertions about the processes and outcomes of social learning in natural resource management**. *J Environ Manage* 2012, **113**:7-14.

25. Nyborg K, Anderies JM, Dannenberg A, Lindahl T, Schill C, Schlüter M, Adger WN, Arrow KJ, Barrett S, Carpenter S *et al.*: **Social norms as solutions**. *Science* 2016, **354**:42-43.

26. Wittmer H, Rauschmayer F, Klauer B: **How to select instruments for the resolution of environmental conflicts?** *Land Use Policy* 2006, **23**:1-9.

27. Kelemen E, Barton D, Jacobs S, Martín-López B, Saarikoski H, Termansen M, Bela G, Braat L, Demeyer R, García-Llorente M: *Preliminary guidelines for integrated assessment and valuation of ecosystem services in specific policy contexts*. EU FP7 OpenNESS Project Deliverable 4.3., European Commission FP7; 2015.

28. Gomez-Baggethun E, Barton DN: **Classifying and valuing ecosystem services for urban planning**. *Ecol Econ* 2013, **86**:235-245.

29. Stirling A: **Analysis, participation and power. Justification and closure in participatory multi-criteria analysis**. *Land Use Policy* 2006, **23**:95-107.

30. Gomez-Baggethun E, de Groot R: **Natural capital and ecosystem services: the ecological foundation of human society**. In *Ecosystem Services*, vol. 30. Edited by Jacobs S, Dendoncker N, Keune H. Elsevier; 2014 Global Issues, Local Practices.

31. Muro M, Jeffrey P: **A critical review of the theory and application of social learning in participatory natural resource management processes**. *J Environ Plann Manage* 2008, **51**:325-344.

32. Rincón-Ruíz A, Echeverry-Duque M, Piñeros AM, Tapia CH, David A, Arias-Arévalo P, Zuluaga PA: *Valoración integral de la biodiversidad y los servicios ecosistémicos: Aspectos conceptuales y metodológicos*. Bogotá, D.C., Colombia: Instituto de Investigación de Recursos Biológicos Alexander von Humboldt (IAvH); 2014, 151.

33. Giampietro M, Mayumi K: **Multiple-scale integrated assessments of societal metabolism integrating biophysical and economic representations across scales**. *Popul Environ* 2000, **22**:155-210.

34. • Etxano E, Garmendia E, Pascual U, Hoyos D, Díez MA, Cadiñanos JA, Lozano PJ: **A participatory integrated assessment approach for Natura 2000 network sites**. *Environ Plann C Gov Policy* 2015, **33**:1207-1232.
Provides an example of an integrated quantitative valuation aroach, based on a social multi-criteria assessment tool that incorporates information on both monetary and non-monetary values of ecosystem services as perceived by different stakeholders. It is applied in the context of a European Natura 2000 conservation site in the Basque Country.

35. Saarikoski H, Mustajoki J, Barton DN, Geneletti D, Langemeyer J, Gomez-Baggethun E, Marttunen E, Antunes P, Keune H, Santos R: **Multi-criteria decision analysis and cost-benefit analysis: comparing alternative frameworks for integrated valuation of ecosystem services**. *Ecosyst Serv* 2016, **22**:238-249 http://dx.doi.org/10.1016/j.ecoser.2016.10.014.

36. Vatn A: **An institutional analysis of methods for environmental appraisal**. *Ecol Econ* 2009, **68**:2207-2215.

37. Satterfield T: **In search of value literacy: suggestions for the elicitation of environmental values**. *Environ Values* 2001, **10**:331-359.

38. Wilson MA, Howarth RB: **Discourse-based valuation of ecosystem services establishing fair outcomes through group deliberation**. *Ecol Econ* 2002, **41**:431.

39. Spash CL: **Deliberative monetary valuation (DMV) issues in combining economic and political processes to value environmental change**. *Ecol Econ* 2007, **63**:690-699.

40. Wegner G, Pascual U: **Cost-benefit analysis in the context of ecosystem services for human well-being: a multidisciplinary critique**. *Glob Environ Change* 2011, **21**:492-504.

41. Brondízio ES, Gatzweiler FW, Zografos C, Kumar M, Jianchu X, McNeely J, Kadekodi GK, Martinez-Alier J: **Chapter 4. Socio-cultural context of ecosystem and biodiversity valuation**. In *The Economics of Ecosystems and Biodiversity.* Edited by Kumar P. London and Washington: Earthscan; 2010. pp. 149–182.

42. • Kenter JO, O'Brien L, Hockley N, Ravenscroft N, Fazey I, Irvine KN, Reed MS, Christie M, Brady E, Bryce R, Church A: **What are shared and social values of ecosystems?** *Ecol Econ* 2015, **111**:86-99.
Provides a conceptual framework about different dimensions of shared/social values and supports identifying shared values of ecosystem services to enhance legitimacy, effectiveness and transparency of valuation approaches which in turn would help decision making.

43. Cáceres DM, Felicitas S, Díaz S: **The rockypath from policy-relevant science to policy implementation—a case study from the South American Chaco**. *Curr Opin Environ Sustain* 2016, **19**:57-66.