

## **Widening the evaluative space for ecosystem services: A taxonomy of plural values and valuation methods**

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### **Abstract**

Researchers working in the field of ecosystem services have long acknowledged the importance of recognising multiple values in ecosystems and biodiversity. Yet the operationalisation of value pluralism in ecosystem service assessments remains largely elusive. The aim of this research is to present a taxonomy of values and valuation methods to widen the evaluative space for ecosystem services. First, we present our preanalytic positions in regards to values and valuation of ecosystem services. Second, we review different value definitions that we deem relevant for the discussion of ecosystem services valuation. Third, we propose a taxonomy of ecosystem service values based on different conceptions of human-nature relationships. Finally, we present a taxonomy of different methods that can be used to recognise plural values in ecosystem services. This taxonomy for a plural valuation of ecosystem services can help ES scientists and practitioners with the aim of representing people's multiple and context specific ways of valuing nature. The taxonomy can also serve to pay broader attention to ES values that are overlooked or misrepresented in assessments that restrict their focus to monetary valuations.

**Key words:** Ecosystem Services, Incommensurability, Monetary and Non-Monetary Valuation, Value Pluralism

## **Introduction**

The concept ecosystem services (ES) is used to refer to the benefits people obtain from ecosystems, such as; fresh water, food, climate regulation, recreation or aesthetic experiences (de Groot et al., 2002; MA, 2005; TEEB, 2011). The ES framework is concerned with the development of science-policy tools that are founded on the ES concept (see MA, 2005; Turner and Daly, 2008). Nowadays, the ES framework is increasingly used by diverse stakeholders, including scientists, policy-makers, NGO's and practitioners, for purposes that range from decision-making support to advocacy for biodiversity protection (Barnaud and Antona, 2014). The ES framework focuses on the importance of biodiversity and ecosystems for human well-being (MA, 2005), and hence from the outset has had a clear emphasis on nature's instrumental values (Reyers et al., 2012). Since instrumental values refer to the value an entity holds as a means to achieve specific ends, it implicitly assumes that the entities bearing such values may be replaced and compensated for, as long as their substitutes can perform the same functions (Muraca, 2011; Zimmerman, 2015). The emphasis on instrumental values suggests that two ES that provide the same impact on economic welfare, or human well-being, can be interchanged. This emphasis partially explains why the ES framework is often associated with the practice of monetary valuation and commodification (Gómez-Baggethun and Ruiz-Pérez, 2011; Abson et al., 2014; Nieto-Romero et al., 2014). Yet, using the ES framework does not necessarily entail the use of monetary valuations (Ruckelshaus et al., 2015) nor markets as the preferred governance mechanism (Schröter and Oudenhoven, 2016).

The influence of the ES framework on environmental and conservation policy has grown over recent years (Kull et al. 2015). This situation begs the question as to how non-instrumental value can be integrated into the ES framework (Jax et al., 2013). In fact, initial ES definitions

tended to stress that ecosystems and biodiversity sustain and fulfil the requirements for achieving human wellbeing, often in an attempt to confer nature a higher moral place beyond instrumental values (Deliège and Neuteleers, 2015). Furthermore, many influential contributions within the ES framework have advocated the need to integrate plural values of ecosystems and biodiversity. For example, the Millennium Ecosystems Assessment (MA, 2005) distinguished utilitarian monetary values of ES from other non-utilitarian values (i.e., ecological, socio-cultural and intrinsic values). Similarly, the initiative The Economics of Ecosystem Services and Biodiversity (TEEB) recognises that ES valuation involves dealing with conflicting valuation languages that can involve incommensurability (Pascual et al., 2010, p.193). Finally, the Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES) also recognises multiple value systems, including intrinsic, instrumental and relational values (Díaz et al., 2015, p.11).

Some scholars have endorsed the perspective of recognising multiple values in ES beyond instrumental ones (Costanza and Folke, 1997; de Groot et al., 2002; Farber et al., 2002; Polishchuk and Rauschmayer, 2012; Reyers et al., 2012). ES valuations within this perspective have integrated different disciplinary approaches as well as introduced diverse positions on how ‘value’ should be defined and expressed. Hence, ES valuations have spanned across different value domains (e.g., ecological, cultural and monetary) and levels of societal organisation (e.g., individual and shared values) (Chan et al., 2012; Martín-López et al., 2014; Kenter et al., 2015). Many influential contributions on ES valuation have grounds in ecological economics (e.g., Costanza and Folke, 1997; de Groot et al., 2002; MA, 2005; TEEB, 2011), a field where value pluralism and incommensurability are considered foundational principles for environmental valuation (Martínez-Alier et al., 1998; Martínez-Alier and Muradian, 2015; Gómez-Baggethun and Martín-López, 2015). Value pluralism is

based on the recognition of different and often conflicting value domains, that are neither reducible to each other, nor to some ultimate value (O'Neill et al., 2008; Chang, 2001; Mason, 2015). Furthermore, the principle of value incommensurability implies the recognition of plural values of nature and also that these values cannot be measured with a single value-indicator, such as money or energy (Neurath, 1973; Martínez-Alier et al., 1998).

Even if the recognition of plural values has been a mainstay in much conceptual literature on ES valuation, the operationalisation of value pluralism and value incommensurability in ES assessments has remained largely elusive. Monetisation still is the dominant valuation language (Christie et al., 2012; Abson et al., 2014; Nieto-Romero et al., 2014) and is often conceived as a pragmatic language to communicate with political and business institutions (Spash, 2013). However, scholars have called attention to the minimal use of monetary valuation of ES in decision-making (Kushner et al., 2012; Laurans et al., 2013), and have also noted that stakeholders, including policy makers, demand other valuation languages beyond the monetary (Ruckelshaus et al., 2015). Ecological economists, and their antecedents, have criticised the use of monetary valuations as an expression of nature's multiple values and noted that monetary valuations are often conducted without a critical perspective on its consequences (see Kapp, 1972; O'Neill, 1997; Martínez-Alier et al. 1998; Gustafsson & Frolova, 1998;; Farrell, 2007; O'Neill et al., 2008, Spash, 2006; 2013). Joining this position, scholars working on ES have also stressed the drawbacks and potentially negative consequences of an ES framework biased towards a monetary framing. For instance, monetary values of ES cannot account for limited degrees of substitutability, non-linearities and critical thresholds of ES and hence can guide decision-making towards the acceptance of ecological losses that cannot be substituted or compensated (Boeraeve et al., 2015).

Commensurability assumptions have raised ethical concerns regarding the way monetary

valuation masks non-instrumental ES values such as ecological and cultural values (Luck et al., 2012; Jax et al., 2013). Monetary valuation has been associated with a push towards ES commodification, i.e. the expansion of market trade to previously non-marketed ES (Gómez-Baggethun and Ruíz-Pérez, 2011). ES commodification has been criticised on the grounds that it can promote unequal access to resources (Pascual et al., 2014), erode intrinsic motivations for conservation (Rode et al., 2015) and some entities should not be for sale.

This paper presents a taxonomy of plural values and valuation methods that can serve to open up the evaluative space for recognising the plural values of ES. This aims to advance the dialogue regarding how to speak coherently about the ontological and epistemological complexities of ES values. First, we present our preanalytic positions regarding ES values and ES valuation. Second, we review different disciplinary approaches to the conceptualisation of ‘value’ that enter into the discussion of ES valuation. Third, based on multiple metaphors for human-nature relationships, we provide a taxonomy of ‘value domains’, and ‘articulated values’, relevant for ES valuations. Finally, we present a taxonomy of different methods for construing and constructing ES values (i.e., value articulating methods).

### **Premises regarding values and valuation of ES**

In this section, we state our premises regarding: 1) the object of valuation, 2) the objective and subjective nature of ES values and 3) the framing of ES values by social and political contexts. Before starting let us define our terminology. ‘ES values’ are taken to mean the multiple and incommensurable ways in which ES are important for people. ‘Ecosystem services valuation’ is defined as the process of analysing, assessing or understanding ES values and how these values are comparable in relation to coexistences, synergies or trade-offs (Gómez-Baggethun and Martín-López 2015). ‘Value domains’ refer to the different ways

in which ES are important for people affecting how they engage with nature (Centemeri, 2015). ‘Articulated values’ signifies the concrete expressions of value domains, stemming from valuation processes (Farrell, 2007).

The recognition of plural values in the ES framework involves the integration of plural and complex objects of valuation (Klain et al., 2014). People can refer to the importance of an ES (e.g., global climate regulation), but may also refer to the importance of nature as a broad concept, a particular ecosystem (e.g., a forest) or components of biodiversity (e.g., endemic species). While nature, ecosystems, biodiversity and ES are different concepts, both in science and policy these categories are increasingly conflated under the broader umbrella of the ES framework (Díaz et al., 2015).

Muraca (2011) and Chan et al., (2016) argue that the values attributed by humans originates in the *relational* domain of subjects and objects of valuations. From this analytic perspective, ES values do not originate in human’s attributions (i.e., subjectivist approach) nor are they inherently located in nature (i.e., objectivist approach). It is through valuation processes that humans, via reflection, recognise the importance of nature and ES (Muraca, 2011), making it explicit through the articulation of ES values. In ES valuations, the valuing agents or value providers may include individuals, social groups or communities (Kenter et al., 2015). On this basis, ES values and valuations can be regarded as socially constructed. The choice of a value articulating method influences policy conclusions because it frames which data is relevant, how it should be produced (Farrell, 2007), and who can participate and in which role (Vatn, 2005). This position frames values and valuations as contingent in regards to the social and political context in which they are immersed. It further recognises ES values and valuations as

being shaped by power relations among valuing agents (Martínez-Alier, 2002, Farrell, 2007; Douai, 2009). These agents frame:

- i) how value is defined;
- ii) what type of ES values are included in ES valuations; and
- iii) which value articulating methods are used.

In the following sections we will provide a taxonomy of value definitions, value types and valuation methods as a pluralistic answer to address these three concerns.

### **Value definitions for ES valuation**

In its broader meaning, the word value is usually related to the notion of importance (Dietz et al., 2005). Although in the ES framework value is often equated to monetary value (Christie et al., 2012; Abson et al., 2014). We identified six definitions of value that need to be considered within the discussion of plural values of ES, and these are specified in Table 1. These definitions have been the subject of major (inter)disciplinary debates and our aim here is to only briefly present them.

#### TABLE 1 ABOUT HERE

Value definition 1 derives from philosophers and ethicists who have developed theories supporting the concept of intrinsic value. We take intrinsic values as defined by Callicot (1987) to embrace the notion that biodiversity and ecosystems have value in themselves independently of their usefulness for humans. This argument has been a normative postulate of conservation science for decades (Soulé, 1985). However, some authors have questioned its relevance for ES conservation on the basis that intrinsic value represents an abstract and non-operational concept (Justus et al., 2009).

Value definition 2 comes from scholars in fields of social psychology (e.g., Rokeach, 1973; Schwartz, 2005), political ecology (e.g., Kallis et al., 2013) and environmental law (e.g., Bell et al., 2013). They refer to value as guiding human realisation and orienting judgements and actions (Schwartz, 2005). From this perspective, ES values are principles and convictions that guide the ways in which humans relate to each other and nature on ethical and political grounds (Chan et al., 2012, 2016; Gómez-Baggethun et al., 2016). For example, the principle of intergenerational altruism encompasses the concern for sustaining a healthy environment for future generations to inherit.

Value definition 3 comes from neoclassical economics which employs the concept of ‘monetary value’. This rests upon the idea of price as the measure of exchange value and the assumption that exchange value measures utility (e.g., Peace and Turner, 1990). This utilitarian and chrematistic perspective explains choice through the rational actor model, which portrays humans as calculative and self-interested beings. Monetary values are assumed to be morally neutral from the individual’s viewpoint and as providing a suitable objectification of human valuation. Ecological economists have discussed the limitations of the neoclassical economics approach both as an explanation of human behaviour and for understanding of human-nature relationships (see Kapp, 1972; O’Neill, 1997; Gustafsson & Frolova, 1998, Vatn, 2000; O’Neill et al., 2008; Spash, 2008; 2013).

Value definition 4 contrasts with the neoclassical economists’ individualistic rationality and instead uses the notion of shared values. This has been used to refer to the ES values people hold as citizens (Sagoff, 1986). This concept relies on a social constructionist perspective (Durkheim, 1981), which argues that individuals act based on institutions, or patterns of

thinking, roles and social norms (Vatn 2005). Shared values are generally derived through deliberation (Kenter et al., 2015). They may also be expressed in monetary terms (Spash, 2007); for example, exploring ‘societal willingness to pay’ for the protection of a particular ES (Kenter et al., 2015).

Definition 5 comes from ecology. The term ‘ecological value’ has been used to refer to the degree to which an entity or process contributes to ecological features (de Groot et al., 2010). For instance, ecological resilience relates to an ecosystems’ capacity to maintain its integrity in the face of disturbances (Holling 1973; Folke, 2006). In ecological economics, a critical level of ecological integrity is considered a precondition for any socio-economic system to be sustainable in the long term (Costanza, 1991; Martínez-Alier and Muradian, 2015).

Finally, definition 6 refers to how some philosophers have defined values as ‘ways of concern’ or the different ways in which people care about something (O’Neill et al., 2008). In an environmental valuation context, people’s ways of concern about nature emerge from the various ways people engage with nature (Centemeri 2015). For instance, a community can consider a forest important because it provides inputs for their productive activities (e.g., wood and fibres) but also because it is a sacred place.

By framing the notion of ES values as the different ways in which nature, ecosystems and biodiversity are important for people, the ES framework can conceptually integrate concerns related to diverse definitions of value including: intrinsic value, principles, monetary values, ecological values and shared values. Some of these definitions are not mutually exclusive. For example, the principle of altruism as a motivation for nature conservation may be endorsed from a citizen perspective (i.e., shared value); moral concerns towards ecosystems (i.e.,

intrinsic values) can be framed from a citizen perspective (i.e. shared value) and as a guiding principle for environmental decision-making.

### **Linking metaphors of human-nature relationships to ES values**

The ES concept alone cannot account for the multiple ways in which people engage with nature (Raymond et al., 2013; Klain et al., 2014). Stakeholders have reshaped or rejected the ES concept when it does not represent the ways in which they relate with nature. For instance, non-western participants in the IPBES have played a key role in the integration of alternative metaphors representing their cosmological visions, e.g., ‘nature gifts’ instead of the ES concept (Borie and Hulme 2015; Díaz et al., 2015). Stakeholders have used the ES concept in very different ways to shape local policy agendas beyond ES commodification (Barnaud and Antona, 2014; Kull et al., 2015). By allowing multiple metaphors on human-nature relationships, scholars concerned with the valuation of ES can advance the recognition of plural values and thus propose alternative policy pathways. In this section we present three metaphors on human-nature relationships: ‘gaining from nature’, ‘living for nature’, and ‘living in nature’ (O’Neill et al., 2008). These are summarised in Table 2.

#### TABLE 2 ABOUT HERE

The metaphors of human-nature relationships ‘gaining from nature’ and ‘living for nature’ were chosen in order to represent two opposing value domains on which the discussion of ES valuation has revolved: instrumental and intrinsic values (Justus et al., 2009; Reyers et al., 2012; Chan et al. 2016). The metaphor ‘gaining from nature’ relates to the view that human

welfare and economic productivity depend upon the benefits humans obtain from ecosystems. This metaphor encompasses the importance of nature and ES as being merely a means towards the maximisation of economic utility (i.e. instrumental value domain) and its articulated monetary values. Provisioning services (e.g. food, water and fibres) are examples of ES that have been valued primarily for their instrumental value. However, even within the ES provisioning category, the appraisal of ES importance for people is often strongly influenced by the way they are intertwined with cultural and ecological values (Chan et al., 2012; Reyes-García et al., 2015). The metaphor ‘living for nature’ relates to the view that humans share the environment with other non-human species which deserve concern for their own sake and which have a right to exist. Hence, this metaphor encompasses the intrinsic value domain and its articulation as human’s moral duties towards biodiversity and ecosystems. Biodiversity and the so-called ES of ‘nursery habitats’ and ‘gene pool protection’, may be valued grounded on moral concerns and thus can be accommodated within the intrinsic value domain.

The third metaphor, ‘we live in nature’, was taken into account to integrate an intermediary position for those ES value domains and articulated values that cannot be classified as instrumental or intrinsic (Muraca, 2011). This third metaphor stresses a mode of engagement in which people are relating to a dwelled-in nature (see Centemeri, 2015). In other words, nature is the space where connections among the biophysical, social and cultural worlds take place in a relational way, i.e., through relations (Muraca, 2011;2016; Chan et al., 2016). For example, the importance people attribute to a forest as a place where social relations can be enhanced where the forest cannot be substituted by another place where social relations can be enhanced (e.g., a football stadium). What is of concern is the context-specific relation of people with that forest for purposes of social enhancement. The number of relational values

that may emerge from human-nature relationships can be numerous. Hence, the metaphor ‘we live in nature’ will encompass more value domains and articulated values than the other two metaphors.

The metaphor ‘living with nature’ can encompass two value domains: fundamental and eudaimonistic values (Muraca, 2011).<sup>1</sup> The fundamental value domain refers to all systems of relations and processes that are conditions to protect the life supporting system (Muraca, 2011), or those that contribute to ecological resilience. The fundamental value domain also refers to all systems of relations and processes that are conditions that allow people to define themselves and provide sense to their existence (Muraca, 2011). Or in other words, those conditions necessary for enhancing social resilience.<sup>2</sup> Articulations of the fundamental value domain may include ecological resilience, livelihoods and subsistence, mental and physical health, identity, cultural heritage, sacredness values, symbolic values, social cohesion and sense of place. The eudaimonistic value domain relates to those entities and processes that are conditions for a ‘good human life’, they are not driven by merely egoistic preferences, instead they extend to notions of what one considers meaningful actions in the context of a virtuous life e.g., meaningful occupation, aesthetic values, cognitive development, recreation and leisure, inspiration, altruism and environmental justice.

Although fundamental and eudaimonistic values can be related to human goals, they differ from instrumental values in that they are related to higher ends such as the preservation of life on Earth, the spiritual embedment with nature, or the fulfilment of a ‘good human life’.

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<sup>1</sup> Eudaimonia is a central concept in ancient Greek moral philosophy and in any modern virtue ethics. This concept has been interpreted as ‘flourishing’ or as a non-hedonist concept of ‘happiness’, and also as ‘well-being’ (Hursthouse, 2013).

<sup>2</sup> Social resilience has been defined as the “ability of groups or communities to cope with external stresses and disturbances as a result of social, political and environmental change” (Adger, 2000: 347)

Intrinsic, eudaimonistic, and fundamental values of ES emerge from non-instrumental relations with nature and these value domains often express a sense of collective meaning (i.e., shared values). Thus, ES monetary values cannot represent intrinsic, eudaimonistic and fundamental values of ES.

The classification presented in Table 2 aims to provide a heuristic tool for ES valuations that are conceptually open to integrate plural ES values. However, it does not intend to draw clear boundaries between ES value domains and their articulated values or to dictate a universal way of classifying them, and the classification of the articulated values of the fundamental and eudaimonistic value domains is speculative. The classification in Table 2 also intends to highlight the fact that multiple value domains can co-exist in the object of valuation and they are also often intertwined. For example, a peasant community can state water is important because it is fundamental for sustaining their life (fundamental value domain), they may also recognise that water has a value in itself (intrinsic value domain) and lastly, because it is an input for crop production (instrumental value domain).

#### FIGURE 1 ABOUT HERE

Figure 1 shows how the proposed classification of value domains (i.e. instrumental, intrinsic, fundamental and eudaimonistic) can be broadly related with the commonly used classification of ES values in ecological, socio-cultural and economic values (TEEB, 2011; Gómez-Baggethun and Martín-López, 2015). It also shows how the proposed value taxonomy of ES values can be aligned with the sustainability perspective of nested ecological, socio-cultural and economic systems in ecological economics. This perspective implies that human flourishing and development should remain within ecological boundaries in order to not

degrade the ecological life support system (Costanza, 1991; Martínez-Alier and Muradian, 2015). Finally, Figure 1 shows that monetary values do not represent ‘the value’ of nature. The embeddedness of the economic system in the socio-cultural system further conveys the notion of monetary values as a category that cannot be conceived as independent from the socio-cultural context (Vatn and Bromley, 1994; Douai, 2009).<sup>3</sup> ES valuations can rely on deliberative valuation methods aimed towards the identification and classification of ES values.

### **Value articulation: Diversifying methods for ES valuation**

Various value articulating methods (Vatn, 2005; Farrell, 2007) have been applied for ES valuation from the perspective of the beneficiaries’ subjective appreciation. Table 3 provides an overview of ES valuation methods and classifies them along three different axes: i) monetary and non-monetary valuation methods, ii) qualitative, quantitative and mixed valuation methods, and iii) consultation approach (i.e., group-based, individual-based or non-consultative).

#### TABLE 3 ABOUT HERE

The most widely applied methods are those of monetary valuation (Christie et al., 2012) including: market price-based approaches, market cost-based approaches, revealed preference methods, stated preference methods, benefit transfer, economic field experiments and deliberative monetary valuation. Non-monetary valuation of ES (sometimes referred to as

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<sup>3</sup> The monetary bias of the ES framework can be framed as an example of the embeddedness of the economic system in the socio-cultural system. This bias resulted from the dominance of two political trends under which the ES discourse expanded in the late 1990’s: the neoliberal ideology, supporting markets as the most efficient regulatory tool and ii) ecological modernization, which conceives technology as the solution for environmental crisis (Gómez-Baggethun et al., 2010; Barnaud and Antona, 2014; Kull et al., 2015).

socio-cultural valuation) covers a collection of methods that aims to reveal the importance of ES by using other metrics than money (Kelemen et al., 2014; Castro et al., 2014). Non-monetary valuation methods elicit information about the emotional, symbolic, cognitive or ethical importance of ES. These methods include quantitative (e.g., surveys of preference assessments); qualitative (e.g., semi-structured and in-depth interviews), mixed methods (e.g., Q methodology) and deliberative methods (e.g., citizen juries). Valuation methods determine how values are articulated into concrete qualitative or quantitative expressions, including premises about what is possible to do in regards to decision-making (Vatn, 2005; Farrell, 2007). For example, individual monetary valuation methods often stress market-based instruments as solutions for environmental problems (Gómez-Baggethun and Muradian, 2015). When choosing a particular valuation method, ES practitioners should take into account how that method actually answers the questions: what is value and how are values generated and held?

First, by discriminating between monetary and non-monetary methods, we highlight how the valuation methods broadly respond to the question: What is value? The bulk of the literature on monetary valuation often rests on a neoclassical economics and strongly emphasises instrumental values. As stated earlier, intrinsic, fundamental and eudaimonistic value domains represent non-instrumental relations with nature and a sense of collective meaning (i.e. shared values); therefore, they might be better addressed by non-monetary valuation methods.

Second, by discriminating between whether a method is based on individual or group consultation, we broadly delineate a response to the question: How are values generated and held? Valuation methods based on individual consultation rely on methodological individualism (Weber 1968), which analyses collective forms as the result of the sum of

individual actions (e.g. aggregation of individual willingness to pay). On the other hand, group based consultation through deliberative methods generally considers shared values to be fundamentally different from the sum of its parts. Deliberative methods may allow participants to reflect on the values at stake and to share their knowledge, views and perceptions with other participants (Zografos and Howarth 2010; Kenter et al., 2015).

Valuation methods can be combined to depict a more complex picture of why and how people value ES. For instance, the sacredness value of an ecosystem (a fundamental value) may be elicited through in-depth interviews, where people can express ‘why’ they conceive the ecosystem to be sacred. For example, some Berber shepherds of the High Atlas in Morocco have attributed sacred values to the communal pastoral areas because the existence of a patron saint that is also connected with the internal regulations of when, how and by whom the communal pastures are used (Dominguez et al., 2010). Surveys, on the other hand, may be used to address ‘how’ sacred values relate to socio-demographic conditions. In the example of the High Atlas, beliefs underpinning sacred values may be weaker among younger generations due to the on-going acculturation and abandonment of local belief systems (Dominguez et al., 2010).

## **Conclusions**

Understanding the importance of nature, ecosystems or ES for people involves dealing with multiple and, often, conflicting valuation languages. Plural values, representing different ways of engagement with nature, may be integrated not only in environmental valuation but also in the more specific field of ES assessments. Beyond attributing instrumental and intrinsic values, people can value ecosystems and biodiversity because they are fundamental in human-nature relationships and because they fulfil a ‘good human life’. The ES framework can

enhance the integration of value pluralism in ES valuations by integrating *relational values* such as fundamental and eudaimonistic values.

The taxonomy of plural values presented here classifies ES value types across different conceptualisations of human-nature relationships, thereby providing an open conceptual framework that is able to accommodate a diverse set of ontological and epistemological perspectives. This taxonomy may orient ES practitioners to identify the broad types of values that may emerge on the ground. In a context where monetary valuations remain the dominant valuation language in ES assessments, our taxonomy of plural values and valuation methods may also aid in clarifying which values of ecosystems and biodiversity are overlooked or misrepresented when expressed merely by monetary values.

Articulating value pluralism in the ES framework implies stressing the ES concept in a heuristic understanding that enables integrating different visions on humans' engagement with nature. This process implies a departure from ES as the only object of valuation and the use of other scales of nature and metaphors of human-nature relationships. This has been the case for the IPBES conceptual framework, which has integrated Western and non-Western visions on human-nature relationships. In this context, our taxonomy on plural ES values and valuation methods can support the advancement towards understanding and recognising the multiple ways in which humans relate to and care about nature.

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**Table 1. Value definitions to be considered in ecosystem services valuation**

Value definitions		Discipline	References	Examples	
1)	Intrinsic value	Biodiversity and ecosystems are considered ends in themselves.	Philosophy, deontological ethics	Callicott, (1987); Rolston, (1989)	An endangered species conservation because it has the right to exist.
2)	Principles	Stable references that guide human realization and thus orient human judgements and actions.	Social psychology, political ecology, environmental law	Schwartz, (2005), Kallis et al., (2013),	Altruism towards future generations
3)	Monetary value	Utility measurements through prices.	Neoclassical economics	Peace and Turner, (1990)	Willingness to pay for a particular ES
4)	Shared values	Values people hold for biodiversity, ecosystems and ES as citizens.	Sociology, political science	Sagoff, (1986); Kenter et al., (2015)	Aesthetic value of a landscape
5)	Ecological value	Degree to which an entity or process contributes to ecological attributes	Ecology, among others	Farber et al., (2002); de Groot et al., (2010)	An Ecosystem's ecological resilience
6)	Ways of concern	Distinctive ways in which it makes sense to care about nature and the provided ES.	Philosophy	O'Neill et al., (2008)	A forest's sacredness value

**Table 2. Classification of ecosystem services values across different metaphors of human-nature relationships.**

<b>Metaphors of human-nature relationship</b>	<b>Value Domain</b>	<b>Articulated values</b>	<b>Definition</b>	<b>Examples of valued ecosystem services†</b>
Gaining from nature	<i>Instrumental</i> Ecosystems and biodiversity seen as merely a means to achieve utility	Monetary value	Biodiversity and ecosystems contributions to utility, which are measured through prices	Erosion protection Fibres, fuel and other raw materials Genetic material Biochemical species and or resources Ornamental resources
Living for nature	<i>Intrinsic</i> Biodiversity and ecosystems have value in themselves	Moral duties towards nature	Moral duties towards biodiversity and ecosystems	Nursery habitat Genepool protection
Living in nature	<i>Fundamental</i> Conditions to i) protect the life supporting system, ii) allow people to define themselves, and iii) provide sense to their existence.	Ecological resilience	The capacity of ecosystems of maintaining their integrity in face of disturbance	Climate regulation Water regulation Soil formation and regeneration Biological regulation
		Livelihood, subsistence	Critical ES to achieve livelihood goals	Food Water
		Mental and physical health	Physical benefits perceived from ecosystems' regulation of water, air and diseases; and mental benefits due to nature exposure	Air quality regulation Natural hazard mitigation Waste treatment Opportunities for recreation and ecotourism
		Identity	Biodiversity and ecosystems are considered references to determine people's sense of personal and social identity	Cultural heritage and identity
		Cultural heritage	Landscape's tangible and intangible features which are historically significant (e.g., buildings monuments, traditions, stories, traditional ecological knowledge, other knowledge systems).	Cultural heritage and identity

	Sacredness	Spiritual, religious or sacred attachment to biodiversity and ecosystems	Spiritual and religious inspiration
	Symbolic value	Meanings associated to ecosystems. These meanings are conceived to be inseparable of the represented ecosystems but are also valuable in themselves	Cultural heritage and identity
	Social cohesion	Human uses of biodiversity and ecosystems as a context for social cohesion enhancement	Opportunities for enhancing social relations
	Sense of place	Emotional attachment to a place (feelings of belonging, commitment, identity or community)	Cultural heritage and identity
<i>Eudaimonistic</i> Entities and processes which represent conditions for leading a 'good human life'	Meaningful occupation	Occupations related to biodiversity and ecosystems that allow people to fulfil a 'good human life'	Cultural heritage and identity
	Aesthetic value	Appreciation of the beauty of nature, grounded on sensations and emotions.	Opportunities for aesthetic appreciation
	Recreational, leisure	Appreciation of tourism, recreational and leisure activities in natural areas	Opportunities for recreation and ecotourism
	Cognitive development,	Appreciation of ecosystems' features within special educational and scientific interest	Opportunities for education and science
	Inspiration	Appreciation of the inspirational values of ecosystems' features	Opportunities for inspiration for culture, art, design
	Environmental justice	Biodiversity, ecosystems or ES are matters of concern within a human rights or a justice context	All ecosystem services
	Altruism	Concern for biodiversity, ecosystems or ES in favour of a present larger community (intra-generational) or future generations (inter-generational)	All ecosystem services

† Ecosystem services are largely based on the classification of de Groot et al., (2010).

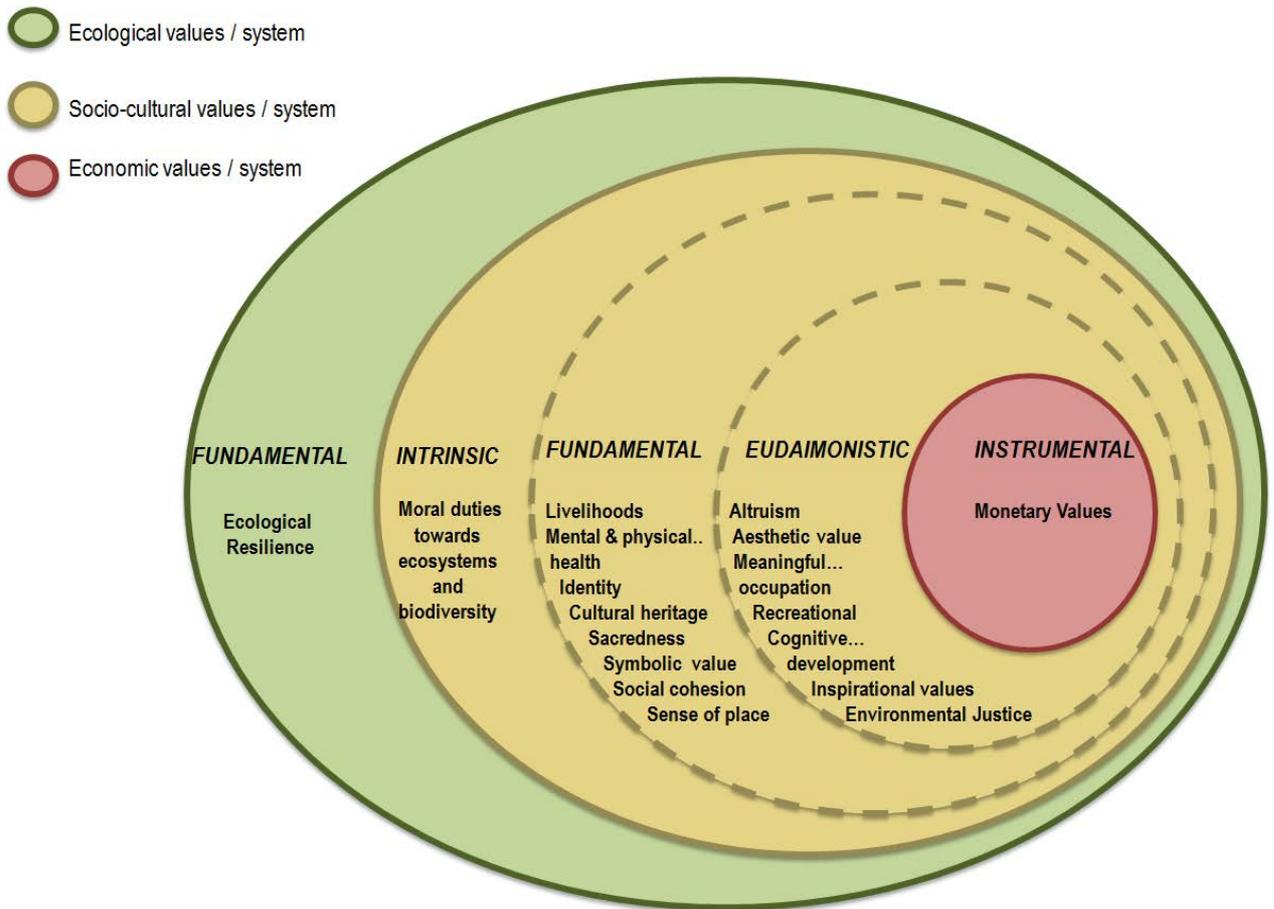
**Table 3. Methods for plural ecosystem services (ES) valuation**

Method	Brief description	Consultation approach		
		Group-	Individual	Non-
<b>1. Monetary Valuation Methods</b>				
<b>A. Quantitative</b>				
<i>Market price-based approaches</i>	Uses prices of ES traded in markets (e.g., water, timber) as a proxy for its monetary value.			✓
<i>Market cost-based approaches</i>	Estimate the costs that are averted due to the ES functioning: costs of replacing an ES (e.g., waste treatment) or mitigating environmental damage (e.g., natural hazard mitigation by forests). The production function estimates how much an ES contributes to the delivery of a marketed good.			✓
- Replacement costs				
- Damage cost avoided				
- Production function				
<i>Revealed preference methods</i>	Travel cost method analyses individual choices in markets related to ES. Travel cost methods use the costs of travel to a natural area as a measure of the value of recreation.		✓	
- Travel cost				
- Hedonic pricing	Hedonic pricing method reveals the monetary value of ES (e.g. green areas) mainly through house prices.			✓
<i>Stated preference methods:</i>	Constructs hypothetical markets and asks willingness to pay (WTP) to obtain a specified ES or willingness to accept (WTA) giving it up. Choice modelling infers WTP through trade-offs incurred when choosing between alternatives with different levels of ES and costs.		✓	
- Contingent valuation				
- Choice modelling				
<i>Benefit transfer method</i>	Estimate the monetary value of an ES by transferring a measure estimated in a similar context.			✓
<b>B. Mixed (quantitative and qualitative)</b>				
<i>Economic field experiments</i>	Experiments developed in naturally-occurring settings aimed at analysing behaviour and decision making (e.g., choices influenced by reciprocity, norms, altruism and uncertainty).	✓	✓	
<i>Deliberative economic valuation</i>	Combines stated preference valuation methods with elements of deliberative processes.	✓	✓	
<b>2. Non-monetary Valuation Methods</b>				
<b>A. Quantitative</b>				
<i>Surveys of preference assessments</i>	Surveys aimed to rank or rate ES preferences. Used to analyse perceptions, knowledge and values of ES demand or use.		✓	

Method	Brief description	Consultation approach		
		Group-	Individual	Non-
<i>Photo-elicitation surveys</i>	Visual elements (e.g. photographs, pictures) are included in surveys to assess individuals' perception of ES supply and preferences towards landscape views.		✓	
<i>Time use surveys</i>	Captures individual's willingness to give up time (WTT) for activities that promote ES maintenance.		✓	
<i>Psychometric Surveys</i>	Elicits data of individual attitudes, views, reported behaviour, motivations and values towards ES.		✓	
<b>B. Mixed (quantitative and qualitative)</b>				
<i>Delphi Method</i>	Uses expert opinion to reach an agreed conclusion. It may involve quantitative and qualitative assessments.		✓	
<i>Q Methodology</i>	Analyses subjectivity (i.e. attitudes, shared perceptions, and worldviews) through individual ranking of statements. Common worldviews are elucidated through factor analysis.		✓	
<b>C. Qualitative</b>				
<i>Semi-structured and in-depth interviews</i>	In-depth interviews capture how people value or understand something. In a semi-structured interview, the researcher orients the conversation to specific topics.		✓	
<i>Participatory observation</i>	The researcher gets involved with people in their natural environment. Aimed at analysing people's cultural behaviours and interactions.			✓
<i>Participant diaries</i>	Participants are asked to make regular records or narrative descriptions of personal experiences. Aimed at exploring thoughts, feelings and understandings of a topic of interest to the research.		✓	
<i>Photo-voice</i>	Stakeholders take their own photographs of different features of ecosystems and landscape (e.g. ES). Useful to integrate the perceptions of marginalized social groups.	✓	✓	
<i>Focus groups</i>	An externally guided group discussion about a topic. Aimed at discovering different positions and to explore how participants interact when discussing.		✓	
<b>Deliberative methods</b>				
<i>Citizen juries</i>	Groups of representative citizens -randomly chosen- act as jurors to consider issues of public importance.		✓	
<i>Deliberative focus group</i>	Similar to focus groups but may take more than one reunion and has an emphasis on consensus and collective decision.		✓	
<i>Participant action research</i>	People work collaboratively with researchers in knowledge co-production. Aimed at finding solutions to problems of common interest.		✓	
<i>Participatory</i>	Promote local knowledge and enable local people to		✓	

Method	Brief description	Consultation approach		
		Group-	Individual	Non-
<i>Rural Appraisal; Rapid Rural Appraisal</i>	make their own appraisals, analysis and plans.			
<i>Participatory scenario planning</i>	A tool for analysing future prospects of change in ES and its trade-offs. Involves the participatory identification of storylines, drivers of change, uncertainties and scenario outcomes.	✓		
<i>Mediated Modelling</i>	Combines dynamic system modelling with stakeholder participation aimed at creating a shared model of alternative outcomes.	✓		
<i>Deliberative mapping</i>	Stakeholders create a map via consensus, indicating valuable ES and landscape futures.	✓		

Sources: Christie et al., (2012), Castro et al., (2014), Kelemen et al., (2014), Gómez-Baggethun et al., (2016).



**Figure 1. Correspondence of intrinsic, fundamental, eudaimonistic and instrumental value domains with the frequently used framework of ecosystem services values classification (ecological, socio-cultural and economic values).**