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Commentary

Choosing the most appropriate sustainability assessment tool

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1. Introduction

Insights from different academic disciplines become relevant when developing solutions for a sustainable future. This gradual realization has influenced the emergence of dedicated inter- and transdisciplinary fields of enquiry such as sustainability science (Clark, 2007) and sustainability economics (Baumgartner and Quaas, 2010). However, despite this concerted academic effort we are still far from agreeing on how to define, plan and measure the progress towards sustainability.[1]

A key component of sustainability assessments is the comparison of different project/policy alternatives (Bond et al., 2012; Gibson et al., 2005; OECD, 2008; UNECE, 2011). For the purpose of this commentary, assessment tools are defined as the various analytical techniques that can be used to facilitate these comparisons.

After almost 25 years of debate there is no shortage of sustainability assessment tools (Bebbington et al., 2007; Gasparatos et al., 2008; Ness et al., 2007; Singh et al., 2009). According to their assumptions and their valuation perspective, sustainability assessment tools can be divided into three broad categories: monetary, biophysical and indicator-based (Fig. 1):

What is really lacking, however, are guidelines and criteria on how to choose between these tools. The selection of assessment tools is usually performed by the analyst(s) and usually depends on time/data/budgetary constraints, the qualifications of analysts and the range of tools accessible to them rather than on a solid theoretical basis or the context of the overall assessment (de Ridder et al., 2007). Such indiscriminate decisions may result in distorted sustainability assessments and as such carry a number of practical and ethical implications (Gasparatos, 2010).

From this starting point the aim of this commentary is to suggest ways to choose the most appropriate sustainability assessment tool. After briefly introducing the main assumption of each sustainability assessment tool category, we identify the main implications that the choice of a tool entails (Section 2). We then proceed to offer four different suggestions for conscious tool selection (Section 3).

2. Tool Assumptions and their Implications

2.1. Assumptions

The assumptions made by each tool category are in most cases highly value-laden. Essentially these assumptions dictate the following:

(a) the valuation perspective, of the overall assessment;
(b) the adoption of a reductionist or a non-reductionist perspective during the assessment;
(c) the acceptability of trade-offs between the different sustainability issues.

Recent literature has shown that these tools exhibit the characteristics of value articulating institutions (Gasparatos, 2010; Stagl, 2007; TEEB, 2010; Vatn, 2009). According to Vatn (2009) the defining characteristics of value articulating institutions, and as an extension, of the tools commonly used in sustainability assessments, is the explicit or implicit "statement" of the following:

- who, in which role and how he/she should be considered in the decision making process;
- what are relevant data and how data are to be handled;
- how is information provided to the participants, how conclusions are reached and how they are disseminated to decision-makers.

Monetary tools are preference-based. They rely on models of human behavior and rest on the assumption that value arises from the subjective preferences of individuals (TEEB, 2010). Neoclassical monetary valuation tools essentially capture a person's willingness to pay (WTP) for consuming a commodity/service or the willingness to accept (WTA) compensation for forfeiting this consumption. These quantities are considered as proxies to the person's utility. Thus the valuation perspective adopted by monetary valuation tools is inherently anthropocentric with

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[1] The expression "measuring/assessing the progress towards sustainability/sustainable development" has been proposed as the most appropriate (Pintér et al., 2012). For reasons of simplicity this commentary also uses the term "measuring/assessing sustainability".

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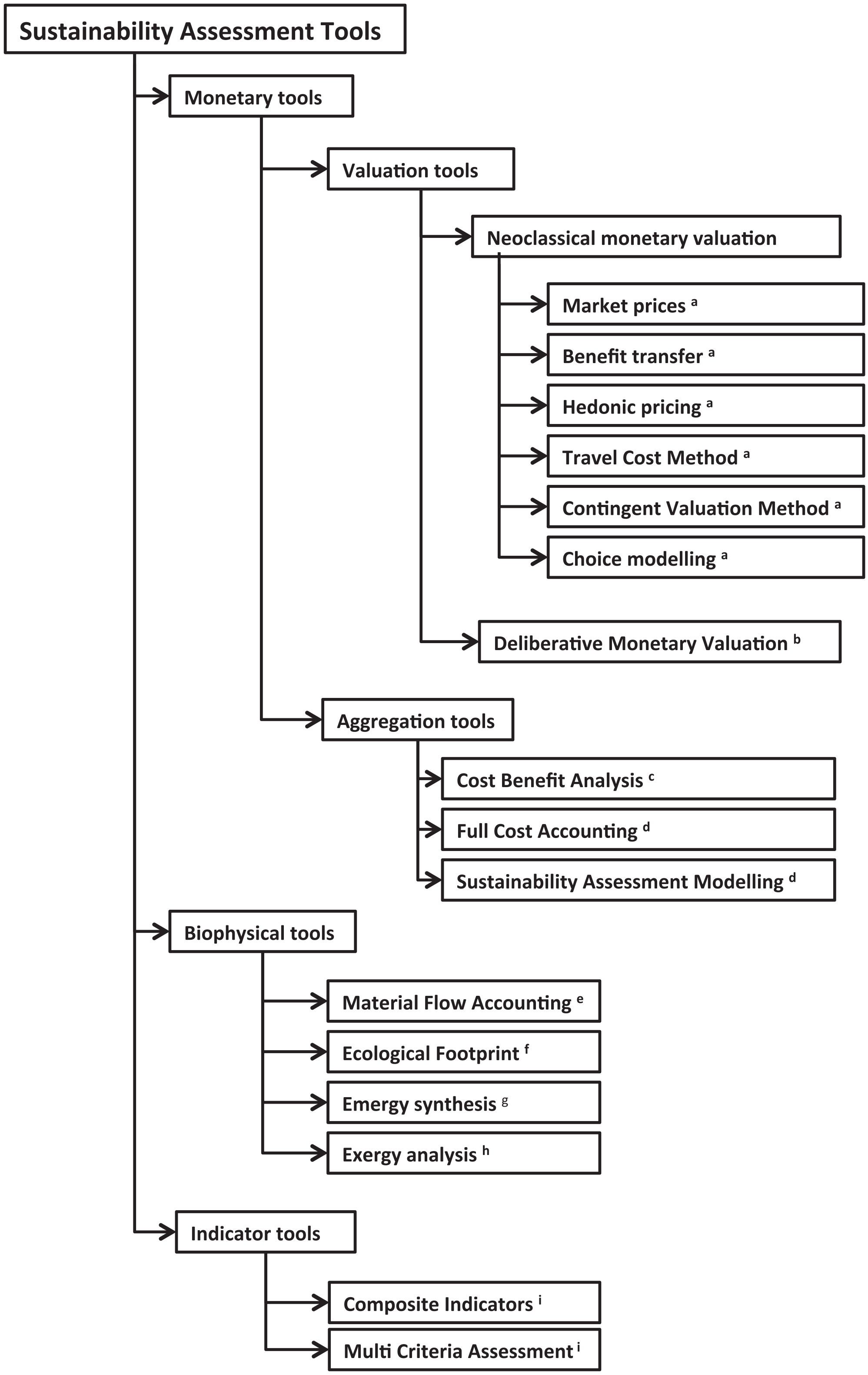

Fig. 1. Typology of sustainability assessment tools.
[a] (TEEB, 2010)
[b] (Zografos and Howarth, 2008)
[c] (Hanley and Spash, 1993)
[d] (Bebbington et al., 2007)
[e] (Haberl et al., 2004)
[f] (Chambers et al., 2000)
[g] (Odum, 1996)
[h] (Gong and Wall, 2001)
[i] (Nardo et al., 2008)

Table 1
Summary of the main features of sustainability assessment tools.
Source: elaborated from Gasparatos (2010).

Tool family	Tools	Concept of value (valuation system)	Valuation perspective	Role of participant[1]	Stance on reductionism
Biophysical	Emergy/exergy analysis, ecological footprint, etc.	Cost of production theory of value, donor system of valuation	Eco-centric	Human preferences become irrelevant	Reductionist
Monetary	Neoclassical monetary valuation/aggregation	Subjective preference theory of value, receiver system of valuation	Anthropocentric	Individual consumer	Reductionist
	DMV	Inconclusive evidence	Anthropocentric	Citizen	Inconclusive evidence
Indicator-based	CI	Lost during normalization and aggregation	Lost during normalization and aggregation	Lost during normalization and aggregation	Reductionist
	MCA	Depends on methodological choices	Depends on methodological choices	Depends on methodological choices	Can be non-reductionist depending on methodological choices

Note 1: This reflects a tool's implicit assumptions on who, in which role and how he/she should be considered in the decision making process. This is a defining characteristic of value articulating institutions (Vatn, 2009).

humans "assuming" the role of individual consumers that aim to maximize their utility (happiness). In order to estimate net-societal benefits these elicited monetary values are aggregated through tools such as the cost–benefit analysis (CBA). Aggregation entails a number of processes that include significant value judgments regarding the commensurability of sustainability issues (linear aggregation of evenly-weighed monetary values), and the intragenerational (Kaldor–Hicks criterion) and intergenerational equity (discounting) (Gasparatos et al., 2008). This anthropocentric valuation perspective is also a feature of deliberative monetary valuation (DMV) with the exception that humans are considered as citizens rather than individual consumers within the valuation process (TEEB, 2010; Vatn, 2009).

Biophysical tools quantify the amount of natural resources that has been invested during the production of a good or a service. Biophysical tools assign value based on the intrinsic properties of objects by measuring underlying physical parameters (TEEB, 2010) and then translating them into a common denominator or unit of measurement, e.g. bioproductive land (ecological footprint), embodied solar energy (emergy synthesis) or available energy (exergy analysis) (Gasparatos et al., 2008). The biophysical value measured is considered a proxy to environmental impact. This means that the most preferable project/policy alternative is the one that results in the appropriation of the lowest amount of natural resources (Gasparatos et al., 2009). In this respect biophysical tools employ a rather eco-centric valuation perspective with the role of human preferences becoming obsolete when assessing the project/policy alternatives.

This duality of valuation perspectives (anthropocentric vs. eco-centric) is essentially the outcome of the two irreconcilable theories of value (i.e. what is important to be measured) employed by economic and biophysical tools (TEEB, 2010; Table 1). These concepts of value have been a major research theme within the Ecological Economics community and can be encountered under different names such as "cost of production vs. subjective preference theory of value" (Patterson, 1998) and "donor vs. receiver concept of value" (Odum, 1996). DMV articulates concerns additional to economic efficiency, such as fairness of distribution, but there is currently inconclusive evidence if this constitutes a distinct concept of value (Spash, 2008). A more comprehensive discussion about the origins, assumptions and perspectives of the concepts of value employed by monetary and biophysical tools can be found elsewhere (Farber et al., 2002; Gasparatos et al., 2009; Patterson, 1998; TEEB, 2010).

Indicator-based tools also entail a series of highly value-laden methodological choices, particularly during indicator selection, weighing, normalization and aggregation. Such methodological choices essentially dictate whether a specific valuation perspective is adopted during the assessment and as an extension the role that humans "assume" within the assessment. In multi-criteria analyses (MCAs) distinct valuation perspectives can be identified (due to the lack of indicator aggregation),[2] but these valuation perspectives depend significantly on the indicators chosen and their weighing. On the other hand in composite indicators (CIs) all notions of value are lost during the normalization and aggregation of indicators (Gasparatos et al., 2009). This implies that it is not possible to assign a specific valuation perspective or understand the role of humans in the same straightforward manner as in economic/biophysical tools.

The existence of such rigid valuation perspectives in economic and biophysical tools suggests the adoption of highly reductionist views of the world when assessing the sustainability of projects and policies. Indicator aggregation in CIs is also an inherently reductionist methodological decision. Such reductionist views of the world might be deemed undesirable in sustainability assessments (Bond and Morrison-Saunders, 2011).

Furthermore, tools such as CBA and CIs that contain explicit aggregation steps essentially allow trade-offs between the different sustainability issues (commensurability of sustainability issues) adopting thus a weak sustainability perspective (Gasparatos et al., 2008). Lack of aggregation in MCAs implies that such tools are closer to the concept of strong sustainability (Gasparatos et al., 2008). A decision over the acceptability of trade-offs entails significant value judgments and to a large extent frames the overall assessment process and its outcomes (Bond and Morrison-Saunders, 2011).

2.2. Implications

Tool selection is in most cases made by the analyst(s) without necessarily having a solid theoretical basis, a good understanding of the cultural/political/economic context of the assessment or of the needs and values of the affected stakeholders. The embedded value-judgments described above means that tool selection (and of certain methodological steps within tools) inevitably becomes a far from value-free decision.[3] In fact, tool selection frames the sustainability assessment and carries practical and ethical implications.

The ethical implication lies in the fact that by choosing a certain tool, the analyst "subscribes to" and in effect "enforces" a specific worldview as the correct or most appropriate yardstick to measure the sustainability of a project/policy (Gasparatos, 2010). In this respect the analyst "assumes" the role of a stakeholder even if he/she is not going to be directly affected by the outcome of the assessment. The practical implication is more relevant to the fact that the value systems embedded in the tools might not necessarily reflect the needs and expectations of the

[2] For the purpose of this commentary CIs are defined as those indicator-based tools that explicitly aggregate the indicators they consist of, while MCAs as the indicator-based tools that do not adopt indicator aggregation.

[3] Additional characteristics of value articulating institutions exhibited by these sustainability assessment tools are discussed elsewhere (Gasparatos, 2010; TEEB, 2010; Vatn, 2009).

stakeholders. In this respect the framing and the outcome of the assessment runs the risk of becoming unacceptable or even irrelevant to stakeholders/decision makers and thus not particularly useful for the decision making process (Spash, 2000; Vatn, 2005).

3. Tool Selection Proposals

This section offers four proposals on how to choose the most appropriate tool for assessing the sustainability of project/policy alternatives. To the authors' best knowledge there is very little academic literature proposing the systematic selection of sustainability assessment tools. The few publications that have attempted to rationalize tool selection either compared tools with highly different purposes within a sustainability assessment (de Ridder et al., 2007; Ness et al., 2007) or were highly context- or tool family-specific (Binder et al., 2010).

3.1. Proposal 1: According to the Desired Perspective(s) of the Assessment

Section 2.1 discussed how biophysical and monetary tools employ different concepts of value when measuring sustainability impacts. As a result the two tool families adopt highly different perspectives when tackling sustainability questions which are both legitimate and pertinent in sustainability assessments (Gasparatos et al., 2009). For example, biophysical tools can quantify meaningfully the resource consumption of the different project/policy alternatives and as such determine whether specific biophysical limits or the operational principles of sustainable development have been breached (Daly, 1990). On the other hand, monetary tools can capture information about human wellbeing, economic efficiency, economic growth and economic welfare, which have been central to the sustainable development debate since its inception (WCED, 1987). Indicator-based tools (CIs or MCAs) can go a long way towards adopting a more comprehensive view of sustainability and capture a broader range of legitimate perspectives. However, the normalization and aggregation of indicators means that CIs eventually lose any concept of value (Section 2.1). Conversely MCAs can articulate specific concepts of value subject to some methodological decisions, particularly indicator selection, normalization and weighing.

However it should be noted that "…no single perspective can fully encompass the reality of the whole system.…although legitimate in its own terms cannot be sufficient for a complete analysis of its (the system's) properties" (Funtowicz and Ravetz, 1994). As a result the combination of biophysical and monetary tools or the development of well balanced indicators sets might be more appropriate if there is the need to meaningfully capture a broader range of legitimate sustainability perspectives in the assessment (Gasparatos et al., 2009); see Section 4 for main challenges.

More importantly the adopted perspective should be consistent with the needs of the affected stakeholders as well as their expectations about the final result and its practical implications.[4] In this sense we agree with Bond and Morrison-Saunders (2011) that the specific perspective adopted in a given sustainability assessment should be well-thought in advance, and require the continuous self-reflection of sustainability practitioners and the awareness of the stakeholders/decision makers.

3.2. Proposal 2: According to the Desirable Features of the Sustainability Assessment

While Proposal 1 alludes to conceptual/philosophical views of the desirable perspective of a sustainability assessment (anthropocentric vs. ecocentric perspective), which can range significantly among individuals (Section 3.4) or institutions, Proposal 2 is concerned with the desirable features of a sustainability assessment and is technocratic in nature.

Our reading of the literature suggests that five desirable features are largely shared across academics and practitioners involved in sustainability assessments (e.g. Binder et al., 2010; Bond et al., 2012; George and Kirkpatrick, 2007; Gibson et al., 2005; OECD, 2008) and include the ability to capture/acknowledge the following:

- relevant economic, environmental and social issues and their interrelations (integrated or triple-bottom-line assessment);
- the impact of projects/policies well into the future (predictive or ex-ante assessment);
- inter- and intra-generational equity (distributional assessment);
- the existence of uncertainties and the need to act on a precautionary basis (precautionary assessment);
- the needs, values and expectations of the affected stakeholders (participatory assessment).

First of all, all tool families can be used to assess the future sustainability impact of different project/policies (predictive assessment), even though certain tools (e.g. biophysical) are rarely used in ex-ante assessments. Furthermore monetary and indicator-based tools are flexible enough to quantify a wide range of economic, social and environmental issues (integrated assessment). Conversely biophysical tools cannot capture adequately social and economic sustainability issues as a result of the valuation perspective they employ (Gasparatos et al., 2008).

The ability of the different tools to capture inter- and intra-generation equity (distributional assessment) is more difficult to delineate.[5] Conventional monetary tools essentially address economic efficiency, and not equity, considerations. As a result it is disputable whether monetary tools can (or should) be used to tackle equity considerations particularly in view of methodological choices such as the widespread use of the Kaldor-Hicks criterion[6] (as the welfare improvement criterion) and the discounting of future costs and benefits (Gasparatos et al., 2008). On the other hand biophysical sustainability assessment tools are able to tackle some inter- and intragenerational equity aspects rather intuitively (Gasparatos et al., 2008). CIs and MCA can in principle capture equity considerations, but this depends significantly on the choice of indicators (Lee, 2006). Further methodological choices during weighing, normalization and aggregation can further affect the extent to which indicator-based tools can capture meaningfully equity considerations.

It is also challenging to unravel the extent to which the different tools can consider the precautionary principle (precautionary assessment). Monetary valuation implies certainty during the monetization of sustainability issues. However for several sustainability issues, their impact on some aspects of human wellbeing might be uncertain or even unknown due to knowledge gaps in the functioning and dynamics of social–ecological systems as well as technical issues of the valuation process itself. An example is the uncertainties surrounding the economic valuation of the impacts that biodiversity loss might have on human wellbeing (TEEB, 2010). Furthermore monetary aggregation tools usually employ the same weights for costs and benefits, which implies risk neutrality and not risk aversion which is a key foundation of the precautionary principle (Gasparatos et al., 2008).

[4] This point had been made extensively in the literature regarding participatory MCAs (e.g. Scolobig et al., 2008).

[5] In this paper we make a distinction between sustainability issues/impacts (social, environmental, economic) and their distribution (inter- and intra-generational equity). This is because equity concerns (distributional effects) are a crosscutting aspect of sustainable development that is relevant to all three sustainability pillars and as a result cannot be attributed unambiguously to a single pillar. This distinction between sustainability issues/impacts and distributional effects (intra- and inter-generation equity) is a common occurrence in the sustainability assessment literature (e.g. Binder et al., 2010; Bond et al., 2012; George and Kirkpatrick, 2007; Gibson et al., 2005).

[6] The Pareto criterion can also be used as the welfare improvement decision criterion in CBAs. Even though the Pareto criterion can better reflect intragenerational equity concerns (Gasparatos et al., 2008), its "strictness" has prohibited its use in CBAs (Layard and Glaister, 1994).

Biophysical tools can capture certain aspects of the precautionary principle rather intuitively (Gasparatos et al., 2008). Like in previous cases CIs and MCA can potentially consider aspects of the precautionary principle subject to certain methodological choices during indicator selection, normalization, weighing and aggregation.

Different tools also exhibit different capacities to involve stakeholders during the assessment (participatory assessment). Conventional monetary valuation tools (e.g. CVM) can be participatory in the loose sense of the term as they capture the public's stated preference as individual consumers, over certain sustainability issues. Needless to say this is a very weak form of participation (Vatn, 2009). On the other hand deliberative monetary valuation (DMV) takes places in stronger participatory settings with more meaningful stakeholder participation but involves fewer people than CVM, raising thus the issue of representation (Vatn, 2009). Due to their valuation perspective and their "indifference" in human preferences (Section 2.1), biophysical tools lack explicit participatory steps. Indicator-based tools can include stages that stakeholders can be meaningfully involved including the choice of the relevant sustainability issues to be considered in the assessment (that greatly influences indicator choice) and indicator weighing. There are several examples of MCA studies conducted in strong participatory settings (e.g. de Marchi et al., 2000; Stagl, 2007).

Table 2 summarizes each tool's capacity to capture the five desirable features of a sustainability assessment.

3.3. Proposal 3: According to the Acceptability Criterion Adopted

According to the acceptability criterion used, Pope et al. (2004) distinguish between three types of sustainability assessments:

- Environmental impact assessment-led (EIA-led) or baseline-led assessments consider projects/policies as acceptable if they do not have unacceptably negative overall sustainability impacts. The acceptability criterion is the minimization of negative environmental, social and economic impacts. In other words the project/policy must not lead to a less sustainable outcome (direction to target). EIA-led assessments allow trade-offs between the different sustainability issues essentially adopting a weak sustainability perspective.
- Objectives-led assessments whose main acceptability criterion is that the most desirable project/policy alternative is the one that maximizes the positive environmental, social and economic impacts by avoiding trade-offs and achieving the greatest win-win outcomes. They also adopt a direction to target approach.
- "Assessment for sustainability" approaches. In contrast to the relativistic understanding of a sustainability state in EIA-led and Objective-led approaches, "assessment for sustainability" approaches initially require "a clear definition of sustainability and corresponding criteria against which the assessment can be conducted" (Pope et al., 2004: 614). As a result they adopt a direction from target approach where it is not only measured the direction towards sustainability (i.e. moving towards a more/less sustainable outcome) but also the exact sustainability of this outcome (how much sustainable/unsustainable this outcome is).

Table 3
Tool appropriateness according to overall SAF.

Assessment types	Appropriate tools
EIA-led	Conventional monetary tools, CIs or MCA
Objectives-led	Biophysical tools or MCA
"Assessment for sustainability"	MCA

Gasparatos et al. (2008) suggest that conventional monetary valuation/aggregation tools or CIs are sounder methodological options for baseline-led assessments considering that they allow trade-offs between sustainability issues (trade-offs are a key characteristic of the linear-aggregation process adopted in CBA and most CIs). Biophysical models on the other hand seem to be better suited to objectives-led assessments considering their ability to calculate the depreciation of natural capital adopting a "stronger" sustainability approach that generally precludes the substitution between natural capital and other forms of capital (Gasparatos, 2010; TEEB, 2010). MCAs are quite flexible tools, which according to the methodological choices made during their construction (particularly indicator selection, normalization, weighing and aggregation) can fit in either assessment type.

Of the tools discussed in this commentary only MCA seems to be a sound methodological choice for "assessment for sustainability" approaches. However specific sustainability targets must be articulated for each of the sustainability issues represented by the MCA indicators and attention must be paid so that the methodological choices made during the construction of the MCA are not at odds with the overall requirements of "assessment for sustainability" frameworks. Biophysical and monetary tools are poor choices for "assessment for sustainability" as they have rarely articulated clear and specific sustainability targets. For example, CBA analysts have avoided so far, justifiably in our opinion, to designate specific cost/benefit ratios as legitimate sustainability targets.

Table 3 summarizes the most appropriate assessment tools for each sustainability assessment approach.

3.4. Proposal 4: According to the Values of the Affected Stakeholders

There is a relationship between human values and how people collectively address problems, form expectations and interpret facts and events (Chong, 2000). Human values and beliefs are in fact major determinants of individual decisions about environmental issues. An extensive body of literature (environmental psychology/sociology) unravels the role of human value systems on the development of stakeholders' perspectives toward environmental issues (e.g. Gregory and Wellman, 2001). For the purpose of this commentary we distinguish between three value orientations that may explain human actions towards the environment (Milfont et al., 2006; Stern et al., 1995):

(a) social-altruistic (concern for other humans);
(b) biospheric (concern for non-human species);
(c) egoistic (self-interest).

Table 2
Extent to which assessment tools capture the desired features of a sustainability assessment.
Source: elaborated from Gasparatos et al. (2008).

Desired features	Neoclassical monetary valuation/aggregation tools[a]	Biophysical tools	Indicator-based tools
Integrated or triple-bottom line assessment	√[b]	X	√
Predictive or ex-ante assessment	√	√	√
Precautionary assessment	X	Debatable	Depends on methodological choices
Participatory assessment	Debatable	X	Depends on methodological choices
Distributional assessment	Debatable	Debatable	Depends on methodological choices

[a] DMV excluded.
[b] √ means that a tool can capture a specific desirable feature while an X that it cannot.

Gasparatos (2010) has suggested that certain stakeholder value orientations are more compatible with certain valuation perspectives (concepts of value) embedded in the different sustainability assessment tools. For example, persons with strong biospheric orientations are generally opposed to the framings adopted in neoclassical monetary valuation as evidenced by their low response rates in CVM studies (Ojea and Loureiro, 2007; Spash, 2006). As a result stakeholder values can constitute a fourth way to inform the selection of the most appropriate sustainability assessment tool.

For example, if the affected stakeholders hold egoistic and social-altruistic value orientations then the choice of monetary tools, and their anthropocentric valuation perspective, seems more fitting. Nevertheless this will also entail the choice of different monetary valuation approaches: conventional monetary valuation (humans as individual consumers) in the former case and DMV (humans as parts of groups) in the latter (Table 2). On the other hand it seems that the eco-centric valuation perspective adopted by biophysical tool is more appropriate when the affected stakeholders hold biospheric value orientations.

The value orientation and the perspectives of stakeholders can also give hints on the acceptability of trade-offs or if there is a strong feeling towards preserving the rights of future generations. Such perceptions can provide insight, for example, for choosing the most relevant tool or the most appropriate methodologies in CIs and MCA.

At this point we should acknowledge this is the least easily implementable tool selection suggestions we offer in this commentary for a number of reasons. First of all capturing and classifying stakeholders' values poses in itself several methodological challenges. Some stakeholders may combine elements of different value orientations in their worldviews. Additionally different stakeholders affected by the same project/policy might hold different value orientation. The above render the choice of one single monetary or biophysical tool questionable. In this sense a combination of biophysical/monetary assessment tools or a well-balanced indicator tool might be necessary in order to better represent the diverse value orientations of the stakeholder(s) with all the challenges that such a combination entails (Section 4). Finally, the design of sustainability indicators able to capture/reflect meaningfully these stakeholder values, particularly altruistic values, remains a big challenge (Dahl, 2012).

4. Conclusions

Sustainability assessment tools contain several assumptions about what is important to be measured, how to measure it, who and in what role needs to be considered in the assessment, and what sustainability perspectives are both relevant and legitimate. These are essentially value judgment with which analyst might not necessarily agree, or even be aware of. However, the fact remains that these value judgments form the worldviews of each tool and are attributes that exists regardless of the analyst. In this sense the moment a sustainability assessment tool is selected and used, then these attributes unequivocally frame the sustainability assessment and its outcomes. In this respect we agree with the premise of Bond and Morrison-Saunders (2011) that sustainability assessment methods are not inherently flawed but contain significant biases towards specific framings.

A direct result of the above is that the selection of a sustainability assessment tool carries practical and ethical implications. In order to avoid erroneous assessments effort should be invested towards the choice of the most appropriate tool.

Biophysical/monetary sustainability assessment tools are rather simplistic in the sense that they embrace a quite narrow valuation perspective (value system) from the plethora of perspectives that become relevant when assessing the sustainability of projects/policies. Incorporating multiple value systems is not so challenging for the analyst(s) as it is a matter of representing a wide variety of assessment tools (with their associated value systems) in the sustainability assessment. What is really challenging is to integrate these multiple value systems, i.e. integrate and synthesize the output of the different tools in a meaningful manner.

This implies that tool selection is not really straightforward if the analysts/stakeholders want the representation of a wide range of desired perspectives/value systems in the assessment. Indeed for some of our four proposals (Proposals 1, 2 and 4) it is the case that a combination of biophysical/monetary tools or a well-balanced indicator might be a more appropriate than using a single tool.

However, our careful reading of the sustainability assessment and ecosystem services valuation literature shows that there has not been any relevant research on how to integrate/synthesize the outputs of biophysical/monetary tools and their generally incompatible value systems (Gasparatos, 2010; TEEB, 2010). Potential ways to integrate the findings of biophysical/monetary tools can be through some sort of MCA (TEEB, 2010) for cases that the main aim of the sustainability assessment is to select between alternative options or through a more qualitative synthesis of the outputs when the aim of the sustainability assessment is to inform decision-making in more normative settings (Bond et al., 2012). However the fact remains that this is a major gap in the sustainability assessment literature with very little research having been conducted so far. In some cases it might also be the case that a shared decision among stakeholders about the tool to be used is the most appropriate option. Yet significant research needs to be conducted to unravel if and how stakeholder values (Section 3.4) and perspectives can indeed be feasibly used to inform tool selection.

We conclude this paper by acknowledging that we see our four proposals as an indicative rather than an exhaustive list of potential rules that could guide tool selection. As a result this commentary should be perceived as an attempt to start a constructive dialogue on a topic that has, so far, been overlooked in the sustainability assessment literature and practice.

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