Operationalisation of Natural Capital and Ecosystem Services

Framework for integration of valuation methods to assess ecosystem service policies

Deliverable D.4.2 / WP4

Final Draft – March 16, 2015

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Prepared under contract from the European Commission
Contract n° 308428
Collaborative project
FP7 Environment

Project acronym:	OpenNESS
Project full title:	Operationalization of natural capital and ecosystem services: from concepts to real-world applications
Start of the project:	01 December 2012
Duration:	54 months
Project coordinator:	Finnish Environment Institute (SYKE)
Project website	http://www.openness-project.eu
Deliverable title:	**Framework for integration of valuation methods to assess ecosystem service policies** (DoW title: D4.2 Framework for integration of valuation methods to assess conservation policies)
Deliverable n°:	D 4.2
Nature of the deliverable:	[Report]
Dissemination level:	[Pu]
WP responsible:	WP4
Lead beneficiary:	Alterra (Stichting DLO)
Citation:	EU FP7 OpenNESS Project Deliverable 4.2., Braat, L. C. , *E. Gómez-Baggethun, B. Martín-López, D. N. Barton, M. García-Llorente, E. Kelemen, H. Saarikoski* ***Framework for integration of valuation methods to assess ecosystem service policies***. European Commission FP7, 2014.
Due date of deliverable:	Month n° 24.
Actual submission date:	Month n° 24.

Deliverable status:

Version	Status	Date	Reviewed by	Author(s)
1.0	Draft	11 January 2015	Coauthors	L. C. Braat, E. Gómez-Baggethun, B. Martín-López, D. N. Barton, M. García-Llorente, E. Kelemen, H. Saarikoski
2.0	Draft	22 February 2015	Coauthors	
		10 March	Coauthors	
			Organizations	Alterra, NINA, UAM, ESSRG, SYKE

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Foreword

The overall objective of WorkPackage 4 of the OpenNESS project is:

> *To develop valuation methodologies that address trade-offs, synergies, and conflicting interests and values in the use of ecosystems and their services, through a combination of monetary, non-monetary and deliberative methods within various modelling approaches to decision support*.

This will be achieved through the following sub-objectives:

- *To advance scientific understanding of how monetary and non-monetary valuation methods of Ecosystem Services (ES) can be operationalised to support specific policy and management needs;*
- *To develop a valuation framework which combines monetary and non-monetary valuation methods to address multiple value dimensions of ES;*
- *To evaluate the ability of valuation methods and frameworks to account for ES in different policy contexts, including green accounting, priority-setting methods, the design of policy instruments, and processes for conflict resolution including environmental liability, litigation, and environmental mediation;* and
- *To create guidelines for application of the methods in the place-based case studies*.

This report, the **Deliverable 4.2: Framework for integration of valuation methods to assess ecosystem service policies** builds on **Deliverable 4.1: State-of-the-art report on integrated valuation of ecosystem services.** We have chosen to go beyond conservation policies, and, following the EU Biodiversity Strategy 2011-2020, include the sustainable use policies, so focus on broad ecosystem service policies.

The EU FP7 OpenNESS project is focusing on operationalising the concept of ecosystem services in the context of EU legislative frameworks. As part of the project, this report presents the structure and components of a ***Framework for integration of valuation methods to assess ecosystem service policies (****as an extension of the original title "conservation" policies****) that combines monetary and non-monetary valuation methods to address multiple value dimensions in environmental, land use, biodiversity, and economic policy.*** The reports introduces the concept of Integrated Valuation (IV) as a logical step in the development of decision procedures in the context of sustainable development. There are different perspectives to *valuation* which were presented in D4.1 (Gomez-Baggethun et al., 2014) and there are also different viewson how to place ”valuation” in sustainable development policy processes which include the use of ecosystems and their services. These are presented and discussed in this Deliverable, together with the implied or expected consequences for policy processes. The Deliverable is also the second step towards Guidelines for Integrated Valuation (Deliverable 4.3) which will be tested in some of the OpenNESS casestudies (WP 5).

Debate Issues

During the process of writing this report, it became clear that the group of authors have different perceptions of the dimensions of the concept of value, which could not be merged into a single one yet. We have therefore chosen to elucidate these differences with this **Debate Issues** format . The report addresses different approaches to operationalise ecosystem service values. In this sense it is a ”living document” designed mainly to structure the debate – half way through the project - with OpenNESS project partners and Opera's colleagues. The **Debate Issues** are listed at the end of each Chapter.

Executive Summary (of the IV framework)

Deliverable 4.2 presents a framework for Integrated Valuation of Ecosystem Services. By Integrated Valuation we mean an activity of assessing, which may include any or several of the following: identifying, characterizing, mapping, eliciting social preferences, ranking, quantifying, monetizing, and which is done in the context of informing economic and environmental policy and planning at various spatial and temporal scales. In fact, we argue that the reason for integration is decision-support, and the extent of integration is defined by the specific policy context. The objects of Integrated Valuation include (1) the biophysical systems and processes in real world landscapes that generate, via so-called ecosystem services, benefits for humans and thus are recognized as sources of value, as well as (2) the socio-political environment because what is recognised as a source of value depends not only on the biophysical system but also on social processes and policy contexts, and (3) humans, as individuals, groups or whole societies, with their physiological and psychological preferences and cultural settings, which determine the perceived and experienced values. Integrated also implies acknowledgement and consideration of different types of values (value pluralistic approach) in assessments and taking care that in supporting transparent decision making, values are presented in the context of those who assign them and of the entities to which values are assigned.

The dimensions of the Framework (see figure A) include spatial and temporal heterogeneity of the natural system as 2 axes, anda third axis is the phases of bringing knowledge into society and thus into decision-making, with requirements as to accuracy and reliability, with associated costs. This is the ***structural aspect of the Integrated Valuation Framework***.

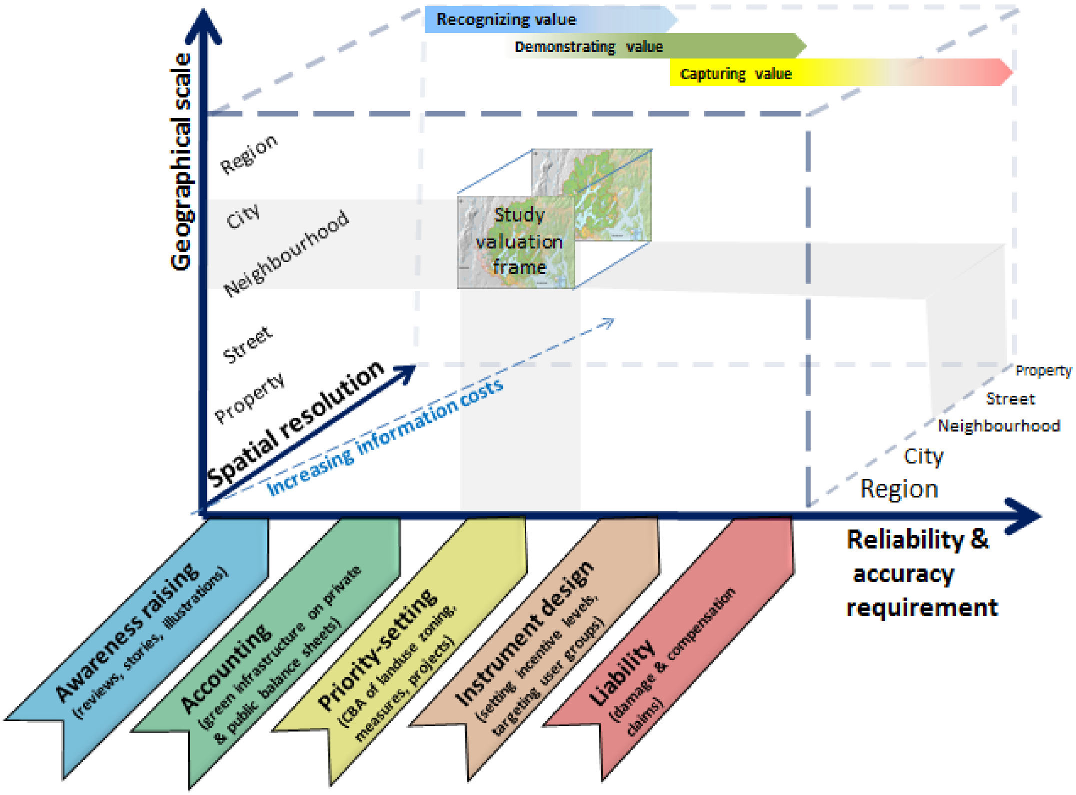


Figure A Source: adapted from Gómez-Baggethun and Barton (2013)

Figure B shows the ***procedural aspect of the Integrated Valuation Framework***. It illustrates that in (1) complex decision situations, involving ecosystems and their services, a series of steps need to be taken, involving (2) the establishment of biophysical data on the ecosystems and (potential) services which are the basis of the production of economic and cultural values (for individuals and groups), (3) the socio-economic aspects of the systems must be determined, including the composition and position of the stakeholders, to be able to develop transparent and reproducible value assignment processes (4). The final step, the integration of values can be a mere technical exercise where monetary values and non-monetary values (preferences, rankings) are combined in cost-effectiveness, and mixed cost-benefit analyses, or, more useful in the real world, they can be related to preferably specific and quantified objectives (of individuals, groups and society in a hierarchy).

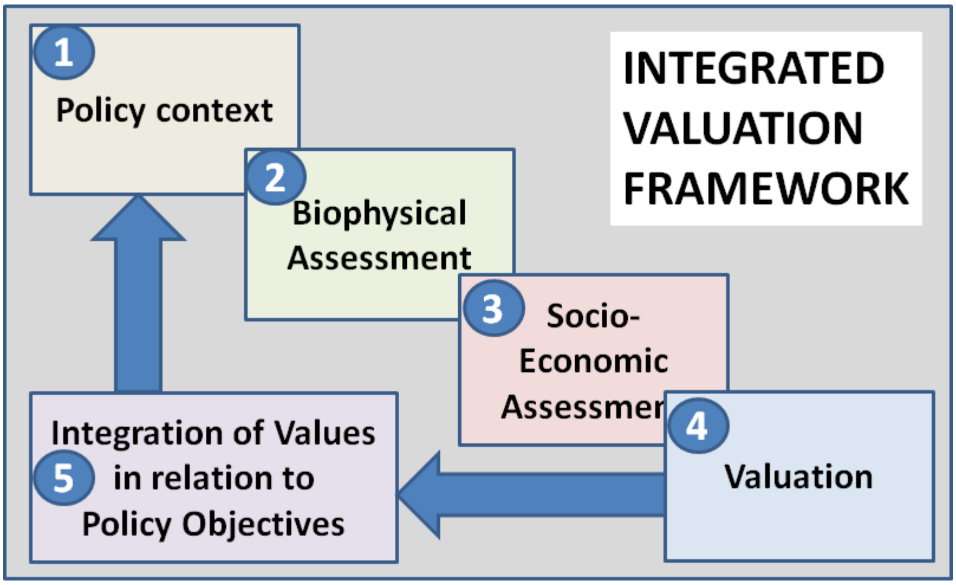


Figure B

The ***third aspect of the Framework is the set of criteria by which a evaluation process can be developed or checked for completion regarding the dimensions of Integrated Valuation*** .

Criterion 1: Policy & Management relevance:
Criterion 2: System Approach:
Criterion 3. Value plurality:
Criterion 4. Value heterogeneity (context dependency):
Criterion 5: Inter- and transdisciplinarity:
Criterion 6: Levels of societal organization:
Criterion 7. Consistent “scaling” of plural values:
Criterion 8: Consistent comparison of plural values in decisions:

In the OpenNESS project, we aim to use, test and further develop this framework in case studies, via a set of specific guidelines, which will be presented in Deliverable 4.3.

1. Introduction

1.1 An Integrated Valuation Framework

Deliverable 4.2 presents a framework for Integrated Valuation of Ecosystem Services. By Integrated Valuation we mean an activity of assessing, which may include any or several of the following: identifying, characterizing, mapping, eliciting social preferences, ranking, quantifying, monetizing, and which is done in the context of informing economic and environmental policy and planning at various spatial and temporal scales. In fact, we argue that the reason for integration is decision-support, and the extent of integration is defined by the specific policy context. The objects of Integrated Valuation include (1) the biophysical systems and processes in real world landscapes that generate, via so-called ecosystem services, benefits for humans and thus are recognized as sources of value, as well as (2) the socio-political environment because what is recognised as a source of value depends not only on the biophysical system but also on social processes and policy contexts, and (3) humans, as individuals, groups or whole societies, with their physiological and psychological preferences and cultural settings, which determine the perceived and experienced values. Integrated also implies acknowledgement and consideration of different types of values (value pluralistic approach) in assessments and taking care that in supporting transparent decision making, values are presented in the context of those who assign them and of the entities to which values are assigned.

The Framework includes five major blocks (see figure 1.1), the first two of which are part of the work area of other OpenNESS Deliverables (WP2 and WP3), but our views are summarized here to support the understanding of the philosophy behind the design of blocks 3, 4 and 5.

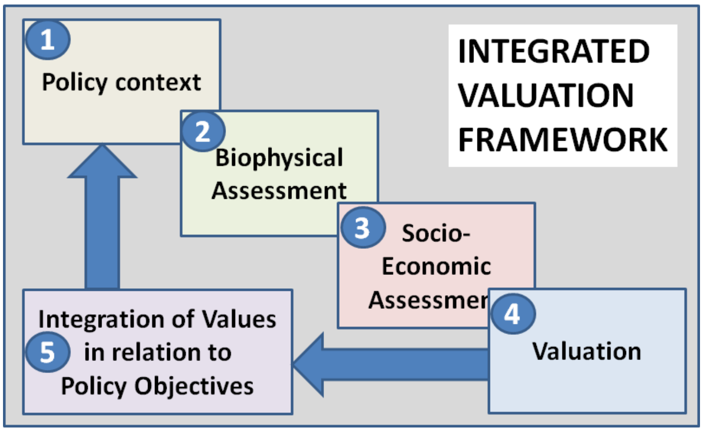


Figure 1.1 The Integrated Valuation Framework as a series of building "blocks"

Before we discuss the various blocks in Chapters 3-7, respectively, we present definitions, some core concepts and the report structure.

1.2 Definitions

Gómez-Baggethun et al. (2014; D4.1) propose a tentative definition of **Integrated Valuation** as:

> *"the process of synthesizing relevant sources of knowledge and information to elicit the various ways in which people conceptualize and appraise ecosystem service values, resulting in different valuation frames that are the basis for informed deliberation, agreement and decision".*

In a methodological sense, Integrated Valuation is characterised by the so called *Total System Approach*, which implies estimating the value of ecosystems and their services (via their contributions to human welfare and well-being, called benefits),

(1) in view of the causal mechanisms in the ecological systems (sometimes called Service Producing Units (SPU)), and

(2) in view of the contributions by human action (e.g. management, harvesting) to make the services "actual", which may require capital or labour inputs. Therefore, the Integrated Valuation underlines the ecological-socio-economic co-production character of ecosystem services (see Braat & De Groot, 2012), which has recently also been recognized by the IPBES conceptual framework (Díaz et al. 2015).

The *Total Systems Approach* is defined by:

1. *Estimating values* for individuals, social stakeholder groups and the whole society (up to international and global society) for the benefits generated via ecosystem services; integrated valuation should thus take into account that the valuators are part of nested hierarchies. (Hierarchical approaches of individuals to identify stakeholders' values have been applied in García-Llorente et al. (2011) and Martín-López et al. (2007))
2. *Estimating values* for delineated systems in space, from local, regional, national to international (global); the spaces are nested (hierarchical) (see e.g. Hein et al. 2006);
3. *Estimating values* for defined periods of time, short term (e.g. 1-5 years), midterm (5-10 years) and long term (>10 years); the periods are nested (hierarchical).

Most valuations so far published in the literature (see e.g. De Groot et al., 2012), have focused on single values, at single scales, single levels of organization, and disciplinary perspectives; existence of multiple values (pluralistic view) has mostly been acknowledged only theoretically and, at best, valuations have assessed different values but without examining in a structured way how they come together in a decision-making context. We therefore will refer to approaches in which services are:

1. Separately valued in terms of the valuating parties (individuals, groups, societies)
2. Separately valued in terms of spatial delineation; not necessarily nested.
3. Separately valued in terms of temporal delineation; not necessarily nested,

Ecological economists have long criticized the way environmental economists value ecosystem services (e.g. the Total Economic Value framework) on the grounds that values can not be compressed into single metrics but until now few operational alternatives have been put on the table in the context of decision making on Ecosystem Services. In the OpenNESS project we aim to fill that knowledge gap in the science-policy interface by developing a framework in which different value perspectives are integrated to assist decision-making and formulate policies.In Integrated Valuation, the approach should also be explicit, to the extent that double-counting is avoided by modelling the flows of mass, energy and information from ecosystems, via services to benefits and by linking beneficiaries (and the *de facto* valuators) 1-on-1, as much as possible, with specific benefits. It is however not clear whether this is possible in all cases, specially with non-economic valuation. For some purposes agreement and consensus building may be more important issue than double counting In single method valuations such a causal chain analysis is not part of the requirements, and thus double-counting is always a risk.

1.3 Value pluralism

The notion of value pluralism is taken to be linked to the value perceptions of different beneficiaries, i.e. the ones that assign the values. It implies that a single ecosystem or service may be attributed different types of values at the same time. There are many different classifications of values. In D4.1 (Gomez-Baggethun et al., 2014) a distinction has been introduced between ecological, cultural and economic values with associated methods, used since the late 1990s (see ***figure 1.2***). It is important for understanding and properly using the Integrated Valuation Framework, to distinguish between the (a) "characteristics" of the different types of values (section 1.3.1 below) , and (b) the differences between various "processes" of valuation (1.3.2). In 1.3.3. we show the "consolidation of an epistemological classification of ecosystem service values through the IPBES conceptual framework (Diaz et al., 2015).

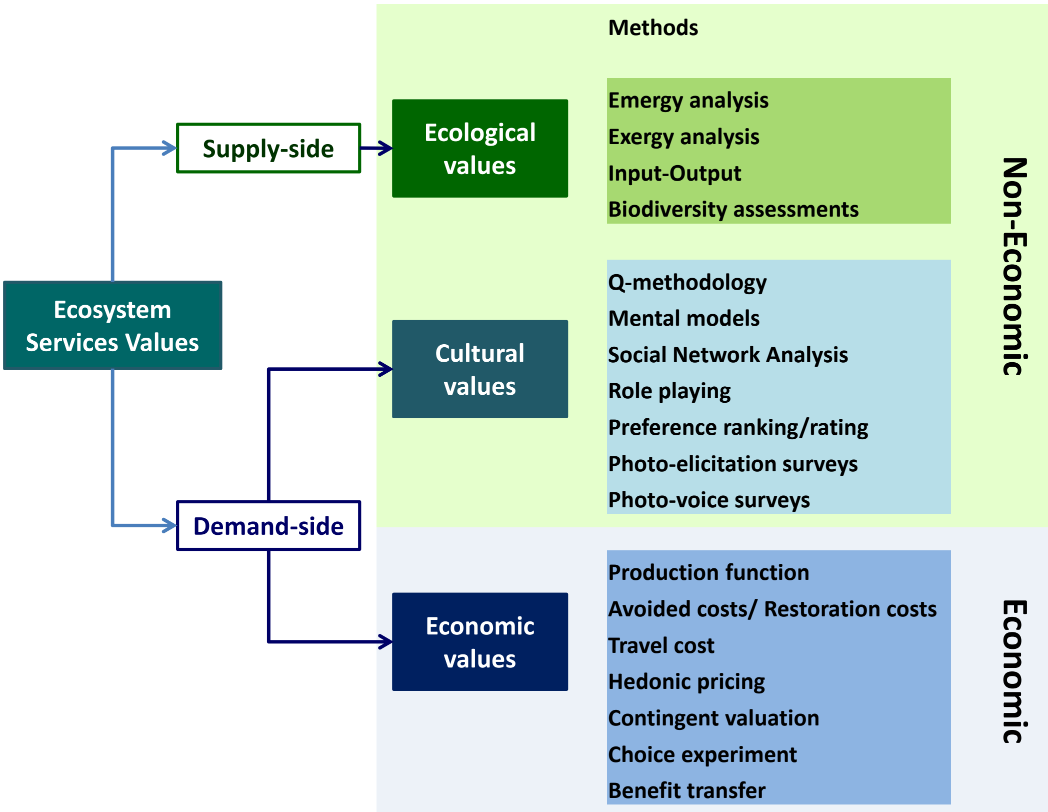


Figure 1.2 Methodological toolbox for an integrated valuation of ecosystem services (from Gomez-Baggethun et al, 2014).

1.3.1 A typology of values

The notion of value pluralism has led to a number of different classifications of values. Here a very basic one is offered, in line with ***figure 1.2***:

1. **Economic values;** this is the most frequently used term for what people are willing to pay for in exchange of benefits or utility of goods and services. It is most often defined in terms of (material) welfare but increasingly also in terms of well-being; in neo-classical economics these values are related to an individual person, e.g. in terms of physical wealth, financial assets, buying power, income flows, or to an individual company; in ecological economics they also cover the welfare and well-being of groups and whole societies, and are there often referred to as *socio-economic* values.

2. **Cultural values** (or *socio-cultural* values): contributions from ecosystems via goods and services that define, support, and enhance the culture of a society; culture refers to the set of historically embedded and generally appreciated customs, including architecture and art, but also the cultural (human designed and managed) landscapes. The latter is often linked to the notion of cultural identity.

The frequently used term **Social values** may mean two quite different things. It is sometimes used to describe the *economic values for groups* of people, e.g. organised in stakeholders around a policy process, or even for the whole of society. Some other authors use it however to refer to *shared preferences among a group* (e.g. a stakeholder group) (Kenter et al., 2014); this overlaps with socio-cultural values. To the extent that economic value for a group of people is the monetary expression of the groups' preferences, these concepts are also overlapping.

In Figure 1.2 the concept of **Ecological Values** is used to highlight the importance of ecosystems and their features on the *supply side* of ecosystem services. This term Ecological Values was assigned by some authors (see e.g. De Groot et al., 2002) to features (or abstractions of such features) of ecosystems (e.g. diversity, stability, productivity). This convention dates back to the 1970s when the importance of protecting natural systems against rapidly expanding economies and associated urbanisation became paramount in political debates. It was useful and to some extent effective in policy to employ terminology which suggested an equivalent position of ecological systems, species and environmental quality in economic decision making, next to profits and fair distribution of income. It can be interpreted as two quite different "views":
View 1: An expression by people of the importance of particular features of nature to those people such ecological diversity, stability, richness, naturalness, etc. It looks like a cultural valuation, and even an economic valuation, because it often translates into a willingness to contribute to the preservation of natural systems (donors) with motives such as ethical, moral, religious or conformation to social group behaviour. It also has similarities to economic valuation when it is linked to a buy-off of guilt or even a tax-write off.
View 2: An expression of understanding the importance of biophysical features as causal factors in the production of economic or cultural benefits in formal (private or public) decision contexts. In this case, from an economic analytical point of view, this importance should not be included as a separate category of values, as one would be double counting. The contributions from the ecosystems to the benefits (material and non-material) are already included in the (socio)economic or (socio)cultural values (see above).

1.3.2 The processes of valuation

If we look at the terminology used in the descriptions of the process of valuation, i.e. assigning value to ecosystems (or: natural capital, including biodiversity features) and to the benefits generated through ecosystem services, then an "adjective" (e.g. utilitarian, socio-economic, financial, cultural, aesthetic, or non-utilitarian) is added to the term "valuation" to indicate the type of value . In other cases it seems to be used to identify the valuators involved in the process (individual, social (group activity)). For the Integrated Valuation Framework we suggest to always being explicit about which type of valuation is referred to. This is because Integrated Valuation takes place across levels of societal organization (e.g. individual vs. group vs society), and stakeholder perspectives, thereby covering also many different valuators involved and also different knowledge systems. With regard to the term 'plural values', see the definitions in D4.1. Kenter et al. (2014) state that values can be "plural" (or multi-dimensional) across the various dimensions identified above, but the term may also refer to the notion that individuals will have multiple sets of values depending on framing and mode of elicitation. The term is often associated with the notion of incommensurability (O'Neill et al. 1997). Valuation frames can also be thought of in terms of multiple valuator spatial and temporal contexts (Figure 2.2) also referred to as value heterogeneity. In this sense, value plurality need not be incommensurable, but rather a source of variability/uncertainty.

1.3.3 IPBES

The IPBES process has generated another classification of values, following an axiological approach (value type) which in ***figure 1.3*** is contrasted with the values as indicators (the TEEB approach) , and valuation process based classifications. The three categories at the top of the figure (intrinsic, relational, instrumental) represent a simplified view of the IPBES conceptual approach. In IPBES, two core groups are identified: intrinsic (in other words inherent) and non-intrinsic, and IPBES states that intrinsic value is not target of any valuation. Non-intrinsic values can be devided into two more groups: non-antropocentric (e.g. cosmocentric or biocentric values) and antropocentric values including instrumental and relation values. Reference to the draft document (now it is under public review):
http://www.ipbes.net/images/documents/WP/comments/20150226/FOR_REVIEW_IPBES_3_INF_7.pdf

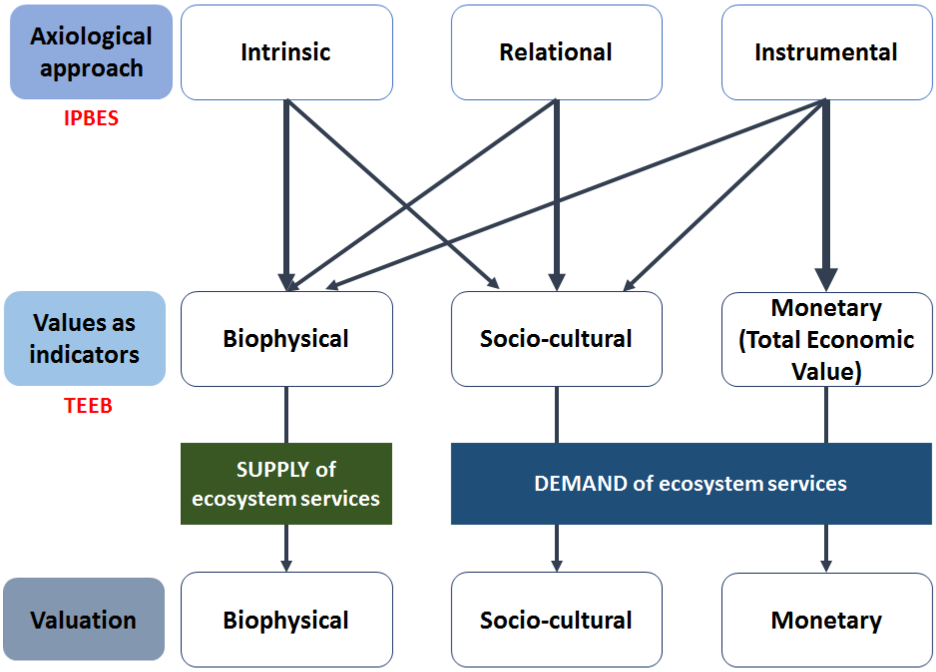


Figure 1.3 IPBES overview of value types

The arrows between the top and middle layer indicate that in the IPBES approach there is a completely new mix of value types defined which combine elements of the TEEB categories. The TEEB categories match well with the 'valuation process' based categories distinguishing between supply side values (biophysical indicators) and demand side values (socio-cultural and (socio) economic/monetary indicators) (see figure 1.2).

1.6 Structure of the report

The focus of the report is on valuation of ecosystems and their services in policy contexts, i.e. in some stage of the policy cycle. The Integrated Valuation framework should reflect and be applicable at different spatial scales of implementation, from national policies via regional planning to projects evaluation.

In Chapter 2 we examine criteria and guidelines for developing an Integrated Valuation Framework. In Chapter 3 we start with Block 1 of the Framework and look at the generic and specific EU Biodiversity policy cycle, and at the role of valuation in the cycle. Adequate biophysical mapping and quantitative assessment of the supply side in the ecosystem services concept is next, in Chapter 4 (Block 2 of the Framework). It is a necessary precursor for a sound estimate of the socio-economic (including but not only financial) values. The

biophysical quantification of ecosystem condition and the goods and services provided, is considered necessary to assess the range of policy decisions that fall within sustainable use margins. In this we employ the strong sustainability definition (see Braat, 2014) at the relevant geographical and administrative decision making level. Since the operational sustainability definition will depend on the scale at which the framework operates, we must be explicit about the scale/decision-making levels addressed. The sustainability definition is determined by the amount of substitution that is possible between natural and other capitals. The amount of substitution that is possible in any case depends on the scale definition of the system boundaries.

In Chapter 5, we examine Block 3, the socio-economic organisation (in as far as relevant in the ecosystem service valuation activities), focusing on the human needs and socio-economic demand side, the match between supply and demand and the organisation of society in stakeholder groups to execute the processes of valuation for ecosystem services policy. In Chapter 6 we turn to the valuation step, Block 4, assuming that the biophysical maps, models, assesments and predictions will become available and will at some point be adequate, and that the valuators are organised at individual, stakeholder or society level.
Finally, in Chapter 7, we look again at the Integrated Valuation criteria and check the Multi Criteria model against the Integrated Valuation approach (Block 5) and discuss an example set up with methods, tools and techniques to implement the Framework.

Debate Issue

Debate Issue 1.1
Hypothesis: Internal consistency of value categories in terms of non-overlapping concepts and empirical methods is achievable within value categories – ecological, cultural, economic- but not across them. Proposition: Avoiding”double counting” of values is a feasible methodological objective within the economic value category only.

Debate Issue 1.2
Proposition 1: ”ecosystem service policies” – policies that promote ecosystem services - are ”nature-based solutions”
Proposition 2: integrated valuation for ”ecosystem service policies” is a ”nature-based solution”

Debate Issue 1.3
We recognise that the new classification shown in Figure 1.3 may become important as IPBES progresses and achieves impact in decision making across land use, economic and environmental policies. At this point we feel however that it is not yet established enough to adopt this terminology for the OpenNESS project. Taking into account this more complex approach to values there are questions about the meaning of the arrows linking categories of IPBES and categories of TEEB. Further clarification is needed on whether “ecological values” (figure 1.2) corresponds to “biophysical values” (as indicators) and whether the methods cited under “ecological values” correspond to” biophysical valuation” methods in Figure 1.3. See also section 3.2.

2. Criteria and guidelines for Integrated valuation of Ecosystem Services

2.1 Introduction

From the definition of Integrated Valuation (see section 1.3) and the conceptual models and definitions of the elements in the causal production chain leading to economic and sociocultural values, a set of criteria (or guiding principles) for Integrated Valuation can be developed, which then are considered the building blocks of an Integrated Valuation framework and guidelines. In 2.2 we present 2 recent approaches to provide guiding principles and criteria for appropriate valuations (in the broadest sense). In 2.3 we derive from these and our own experiences a comprehensive set of criteria to design an Integrated Valuation Framework.

2.2 Recently published principles and criteria to assess ecosystem services values

During a workshop in Portland Oregon in 2013 a group of natural and social scientists developed a set of 10 Guiding Principles "to ensure that assessments of ecosystem service values are comprehensive, credible, and produce sound resource management decisions, ecosystem service assessments" (ACES, 2013):

1. Articulate a **clear purpose for the assessment** and a rationale for the methods used.
2. Reflect a fair and honest effort to **represent ecosystems and all of the benefits** they provide without intent to produce a predetermined outcome.
3. Identify and engage **all interested and affected stakeholders** in a transparent, inclusive manner.
4. Use **interdisciplinary approaches** to address the landscape attributes, ecological functions, and stakeholder perspectives at scales that allow decision makers **to understand the full range of benefits, costs, and potential solutions.**
5. Assess the **full suite of ecological, social, and economic costs and benefits** in quantitative and qualitative terms **using credible methods**, while avoiding the double counting of monetized values.
6. Consider **resilience and the ability to maintain biodiversity and sustain ecosystems for current and future generations**.
7. [Assessments should] be based on the **best scientific information available** while disclosing uncertainties that bear on the decision, and providing analysis on the potential effects of those uncertainties.
8. Apply **robust methodologies and approaches** that strive to be **consistent, repeatable, and transparent**, while encouraging the improvement of ecosystem services methodologies and tools.
9. Provide a **rationale for the exclusion of any social, ecological or economic attributes** relevant to the management decision that were not included in the assessment, and make the full assessment available for technical review.
10. Use **language that is relevant to the intended audience** and sparing in its use of acronyms and abbreviations to make valuation results accessible for non-technical stakeholders**.**

In order to accommodate different audiences one must use different terminologies (also different diagrams). Some of the problems in reaching a common understanding are related to communication. As different individuals (or stakeholders) have different worldviews (or cosmo-visions), maybe, the attempt of getting only one framework (with one figure) across is not helpful and, on the contrary, with different diagrams representing different worldviews one may be more successful? Perhaps the way forward is then to develop frameworks that represent as well as possible different "worldviews" and then try to identify what parts of those frameworks have shared 'values'.

The UK NEA Follow on Project has focused, via a set of case studies on the notion of **shared values** in ecosystem assessment (Kenter et al, 2014; see also Wilson and Howarth, 2002). The approach represents a focus on the Shared Values interpretation of the concept of Social Value:

1: Shared values resulting from deliberative, group-based valuation are different from individual values. They are more informed, considered, confident and reflective of participants' deeper-held, transcendental values.
2: The ethical, moral and justice dimensions of many environmental issues necessitate approaches that allow for the elicitation of shared and plural values.
3: Catalyst and/or conflict points can play a key role in the emergence and articulation of values at a societal or community level that have not previously been outwardly or explicitly articulated.
4: There is a diversity of ways in which shared, plural, cultural and social values are used, but they are rarely conceptualised.
5: Shared and social values in the sense of value to society is conceptualised very differently by conventional economics and other disciplines.
6: A mixed method approach is required to elicit the multiple dimensions of shared values and to translate deeper-held, transcendental values into contextual values and preferences.
7: Deliberative and social learning processes help people to understand the values held by others; they can lead to increased sharing of values and/or to greater acceptance of the decisions emerging from such processes.
8: Media analysis is a promising avenue for characterising different types of shared values at a large scale, as well as assessing the conflicts between the communal values of different sectors of society.
9: Aesthetic and spiritual values of ecosystems have a strong non-instrumental component. While they benefit human well-being, they should not simply be classified as just 'services' or 'benefits'.
10: Subjective well-being measures provide a useful means of assessing 'intangible'cultural ecosystem services and their benefits.

2.3 Criteria

Gómez-Baggethun et al. (2014) offer a ***procedure*** for conducting an *integrated* valuation. They start with the importance of specifying the *purpose* and decision context of valuation (e.g. awareness rising, priority setting, instrument design, litigation), explicitly addressing conflicting interest and value trade-offs in decision-making as an important feature of integrated valuation.

Figure 2.1 captures a range of dimensions of the concept Integrated Valuation. They are made explicit in the description of the criteria to define an Integrated Valuation exercise. Barton et al (in prep), building on Gómez-Baggethun et al. (2014), offer an extension of the procedure and suggest criteria to evaluate whether an approach fullfills the conditions of a fully *integrated* valuation approach. Here we have further sharpened the definition of the criteria**.**

Criterion 1: Policy & Management relevance: The Integrated Valuation framework is designed to have Policy and Management Relevance.

Valuation studies should specify the decision support context and the accuracy and reliability requirements expected by the end-users of the valuation results. This includes specifying the spatial scale of the decision alternatives and the spatial resolution of the mapping data. Figure 2.1.

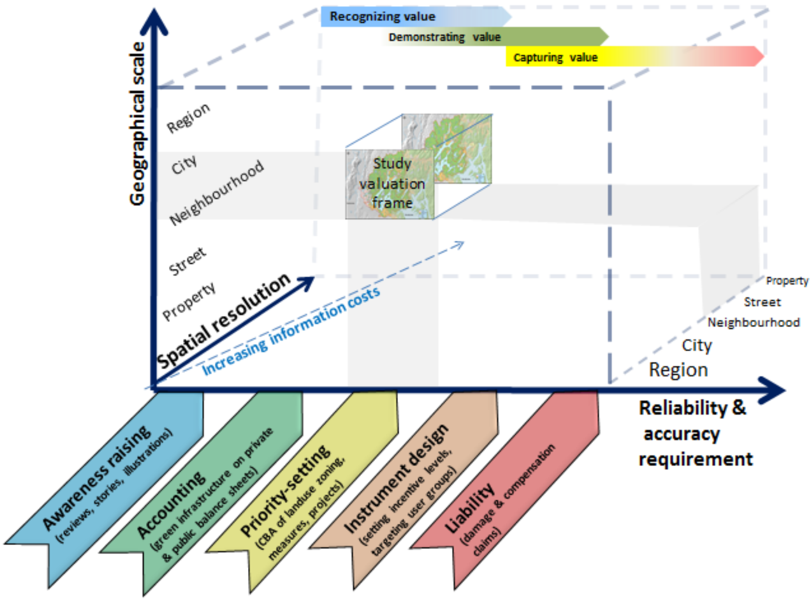


Figure 2.1 Integrated valuation is aimed at management decisions. Within the cube, spatial scale and resolution constitute spatial and temporalheterogeneity of the natural system on 2 axes; the 3rd horizontal axis constitutes the phases of bringing knowledge into society and thus into decision-making. Each context from left to right has higher requirements as to accuracy and reliability. Associated valuation costs increase with scale resolution and decision context requirements . Source: adapted from Gómez-Baggethun and Barton (2013)

Criterion 2: System Approach: The assessment of values requires a multi-scale system analysis in which relevant social strata (individual, group, society) and scales (temporal, spatial) are addressed in a causal chain of production and valuation of ecosystem based benefits.

*A systems approach identifies the **causal relationships in the ecological-economic system**, so that benefits can be traced back to their sources (ecosystem services, including human contribuitons in management, and further back to the ecological and socio-economic systems that provide the services). This may also be phrased in terms of integration of the supply and demand side of the ecosystemn services cascade (see D4.1).Operationality would require a System Model, which can also identify the consequences of any policy-management decision alternative for the benefit producing ecosystems, as well as for the beneficiaries. This avoids double counting and unrealistic trade-offs*.

Criterion 3. Value plurality: Integrated valuation will address different value dimensions (indicators) (socio-cultural, economic) as perceived and held by the valuators (individuals, groups (e.g. stakeholders), society), **and** identifies conflicts of interest across these different value dimensions and among stakeholders, and makes trade-offs explicit.

Conflicts of interest can be analysed using criteria hierarchies and value trees in multi-criteria analysis, and through distributional impact analysis as part of ecosystem service mapping and benefit-cost analysis. They can also be identified and analysed by using participatory and deliberative methods.

Criterion 4. Value heterogeneity (context dependency, uncertainty): Integrated valuation captures how values vary across the time and space (location) of decision contexts, and the location and time at which people are asked to express those values. Integrated valuation uses a consistent approach to describing this heterogeneity(variation) across the cascade of ES models.

Integrated valuation encourages the user (decision maker) to describe the features of this heterogeneity - context dependency - systematically. It uses a consistent modelling approach to describe temporal and spatial heterogeneity – and uncertainty - across sub-models of the system. This raises the question if all values-types can be suitably expressed at different scales or in different context. Our hypothesis is that some values-types fit better in a particular spatial scale than others. For example, socio-cultural values of ecosystem services probably are more relevant at local to small-region scales, where the diversity of stakeholders in the decision making process can appraise which socio-cultural values (sensu D.4.1.) are expressed there. But at national or continental scales, it is not really possible to identify which specific "shared" socio-cultural values are held by different stakeholders, as the diversity of values and the diversity of stakeholders make this task very complicated). Figure 2.2 illustrates the sources of value heterogeneity.

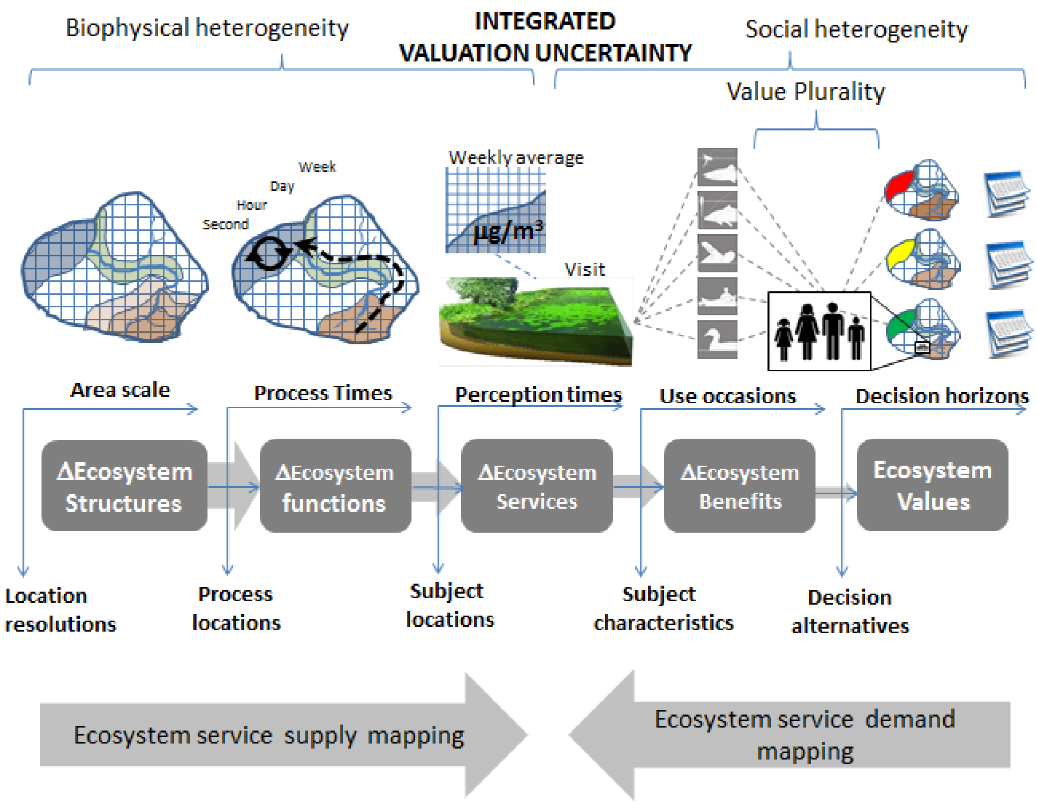


Figure 2.2 Ecosystem service values are context specific. Source: Barton et al. 2015

Criterion 5: Inter- and transdisciplinarity:

Integrated valuation typically involves an interdisciplinary effort comprising multiple expert domains from both the social and the natural sciences, as well as place-based expertise.

Inter-disciplinarity and trans-disciplinarity are key elements in Integrated ecosystem services valuation. Expert input is required even in stakeholder driven valuations about specific features such as ecosystem dynamics, causal dependencies and market failures, as well as about the sociocultural and the policy context of the valuation. However, by applying a transdisciplinary approach, interactions between expert knowledge and local and traditional knowledge held by stakeholders take place in the valuation process, contribute to social learning process and broaden the knowledge base for the final outcomes of the valuation.

Criterion 6: Levels of societal organization: Integrated valuation covers and identifies values emerging at different levels of societal organization, from individuals, to communities, to nations in a systematic, hierarchical, nested model.

Individuals have different roles in these different contexts, mobilizing different rationalities and value systems (consumer, citizen, tax payer, voter, household representative, community resident, association member, public utility user, survey panel participant and so on). A hypothesis for further exploration is that the difficulties of commensurability between ecological, social and economic values is due to expression of these values at different levels of societal organization, with corresponding spatial scales and resolutions. Socio-cultural values predominantly at local scale, group resolution; ecological value (in the sense of insurance value) at multiple scales and resolutions defined by the ecosystem; economic values at national economic scale and individual resolution.

Criterion 7. Consistent "scaling" of plural values. (not to be confused with spatial / temporal scales)

Valuation requires some form of *importance scaling*. *Scaling* of all biophysical impacts to a common normalised scale of impact in is an explicit step in multi-attribute utility theory used in multi-criteria decision analysis (MCDA).

The identification of ecosystem services also requires some form of importance scaling or normalisation. In MCDA this step is often seen as a mere mathematical necessity, disregarding the value information that is implicit in scaling. Value scaling requires knowledge of ecosystem function connecting a decision that changes ecosystem structure to a service outcome. Any scaling from an objective measure of a state of nature to a subjective measure of importance therefore involves some form of knowledge of and (mathematical) integration across ecosystem function. In economic valuation all impacts are scaled/normalised in relation to foregone income (price, willingness-to-pay or willingness-to-accept).

Criterion 8: Consistent comparison of plural values in decisions. Integrated valuation informs and supports decision-making processes on the basis of a transparent cause-effect model, and identifies the consequences of assigning different weights (by stakeholders involved in the process) to different types of values.

Consistency is not a trivial requirement: e.g. if you give a particular benefit (say timber from a forest) a greater weight than another benefit (outdoor recreation) from that same forest, the result will be that demand for outdoor recreation will not be satisfied in favour of timber demand. This is a form of parallel but competitive use of the same resource, which can be traded-off against each other. However, to give timber a greater weight than soil biodiversity makes no sense as the timber beneficiaries will lose out anyway when soil biodiversity is degraded. Timber production is causally depending on soil biodiversity, and these two ecosystem functions cannot be trade off against each other. Similarly it makes no sense to give greater weight to air pollutant removal by trees, and at the same time allow a serious amount of harvesting. These problems arise when the structure of a multi-attribute (integrated) value function do not reflect these interdependencies. If the "value tree" of a MCDA has criteria at the same hierarchy level which are independent then weighting can be consistent. The challenge is designing a value tree that avoids functional interdependencies. This is to MCDA what avoiding "double counting" is to BCA.

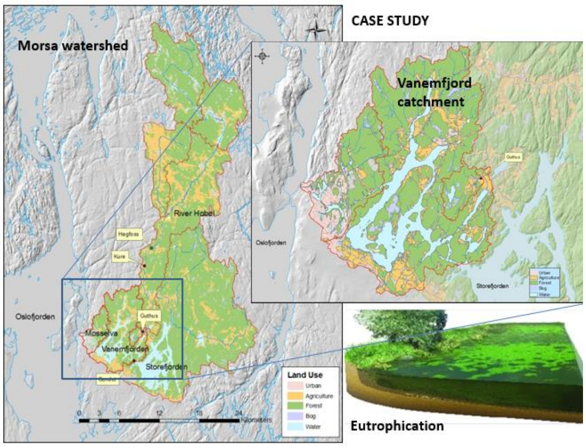
BOX Integrated valuation case study

Barton et al. (in prep) aim to operationalize 'integrated valuation' as a way of bridging the gap between cost-effectiveness analysis and economic valuation of benefits in the implementation of the Water Framework Directive. They evaluate the extent to which cascade of driver-pressure-state-impact-response (DPSIR) models, integrated in an object oriented Bayesian network (OOBN) meet the criteria for 'integrated valuation'. They also discuss the limitations of our integrated valuation model in a systems perspective, and how these limitations may define the role our model plays as a mediator in Water Framework Directive (WFD) policy implementation.

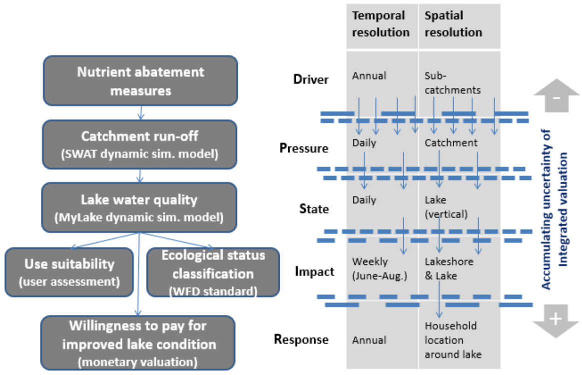
The study was conducted on nutrient abatement measures and their impact on lake eutrophication in the Morsa watershed in South Eastern Norway (Panel 1). The study linked together models of effectiveness of abatement measures on catchment run-off, lake water quality and impacts on lake use suitability, ecological status according to the WFD and willingness to pay for improved water quality (Panel 2). The study fulfilled most of the integrated valuation criteria (Panel 3). Criteria that were not met included policy & management relevance(Criteria 1) because not all relevant abatement measures could be modelled quantitatively, and benefits of measures were not weighed against costs (in a full BCA or MCDA); levels of societal organization (Criteria 6) because valuation did not include group based assessments of value and did not fully validate all models with stakeholders.

The study argued that value plurality was met as economic values were assessed through willingness-to-pay, social values were assessed through use suitability, and ecological values were assessed through compliance with WFD criteria for good ecological status. A consistent approach to quantifying uncertainty (heterogeneity) in the modelling chain was adopted through the use of the OOBN modelling approach. The study argued further that value plurality could be assessed in a multi-criteria framework (Panel 2) without incurring double counting.

Barton, D.N. , T. Andersen, O. Bergland, A. Engebretsen, S.J. Moe , G.I. Orderud, K. Tominaga, E. Romstad, R.D. Vogt (forthcoming 2015) Eutropia – integrated valuation of lake eutrophication abatement decisions using a Bayesian belief network . In Niel, Z. P. (Ed.) Handbook of Applied System Science, Routledge



Panel 1. Integrated valuation of lake eutrophication management in Morsa watershed, Norway



Panel 2. Integrated valuation subject to accumulating uncertainty across the cascade of biophysical, social and economic impact models.

Integrated valuation criteria	IV score card
1: Policy & management relevance?	😐
2: System approach?	😊
3: Value plurality?	😊
4: Value heterogeneity?	😊
5: Inter- and transdisciplinarity?	😊
6: Levels of societal organization?	😐
7: Consistent "scaling" of plural values	😊
8: Consistent comparison of plural values in decisions?	😊

Panel 3: Evaluating valuation study performance according to IV criteria

3. The Policy Cycle

3.1 Introduction

Block 1 in the Integrated Valuation Framework (Figure 1.1) identifies the Policy Context. In addition to the work done in other WPs of OpenNESS we present a few dimensions of the Policy Context which need to be considered in any Integrated Valuation exercise. As OpenNESS caters to the EU policy domain for Environment and Nature, and specifically of the Operationalization of ecosystem services concept, we look at the major Policy document, the EU Biodiversity Strategy and its various policy implementation scales.

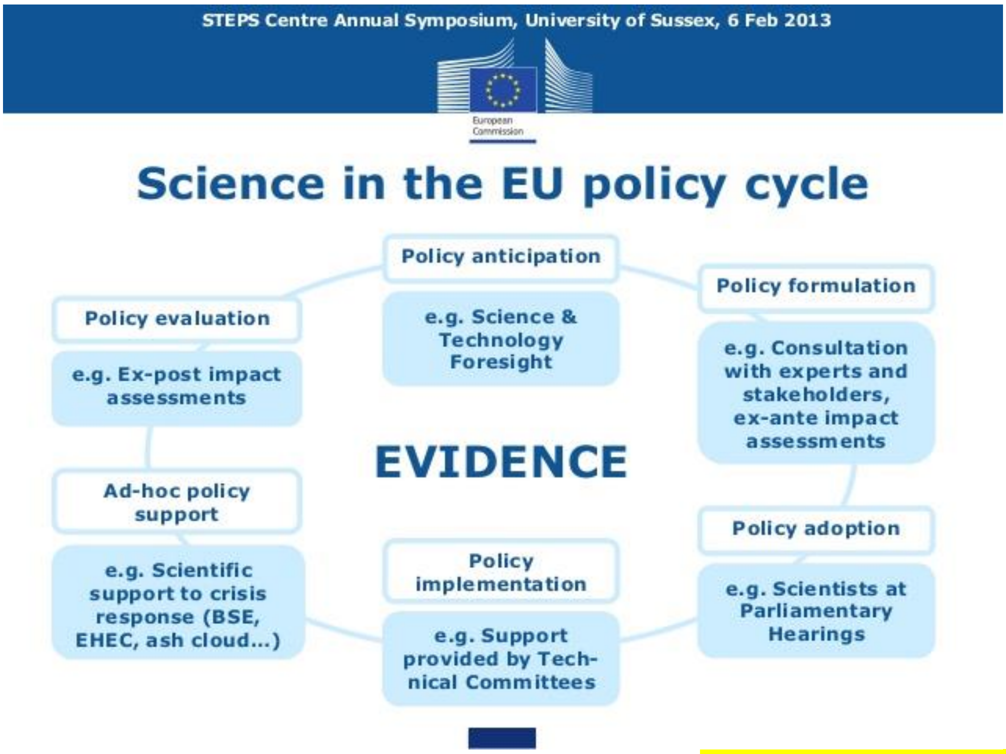


Figure 3.1 Science in the EU policy cycle. (To be redrawn for OpenNESS)

Figure 3.1 presents a generic view of a policy cycle at EU level and the position of science in it. Integrated Valuation of Ecosystem Services would fit in the Blue box under Policy Formulation, as part of the Stakeholder Consultations, Expert consultations and Ex-Impact Assessments. Integrated Valuation aims to cover all these steps, where impact assessments are understood to include environmental, economic, financial and social impact assessments. Up to now, environmental impact assessments (See EIA / SEA Directive) do not include the assessment of change in ecosystem services. This may be just a matter of language, or it may be substantial. One of the challenges of the OpenNESS project is to ”operationalize” the concept of ecosystem service in such a way that it can become an inherent, integrated and feasible part of the EIA / SEA directive. Integrated Valuation would also fit in the ex-post impact assessment under the Policy Evaluation box, and then based on monitoring data instead of model and expert judgment based projections. Within this context of a policy cycle, it is essential to define more specifically what the type of policy plan is, and the requirements for accuracy and reliability that this context places on valuation, e.g. a generic economic investment in a sector, introduction of an environmental quality standard, or a consumer protection program, which may all be part of the EU and National political decision process, as mentioned in criterion 1 above.

3.2 The EU- Biodiversity Strategy 2011-2020

In OpenNESS we focus on biodiversity and ecosystem services, and therefore we zoom in on the policy proposals which have major expected impact on ecosystems, their associated biodiversity and the services they produce. In Figure 3.2 we distinguish three spatial-administrative levels, with different types of policy processes: national policy development, regional planning and project evaluation.

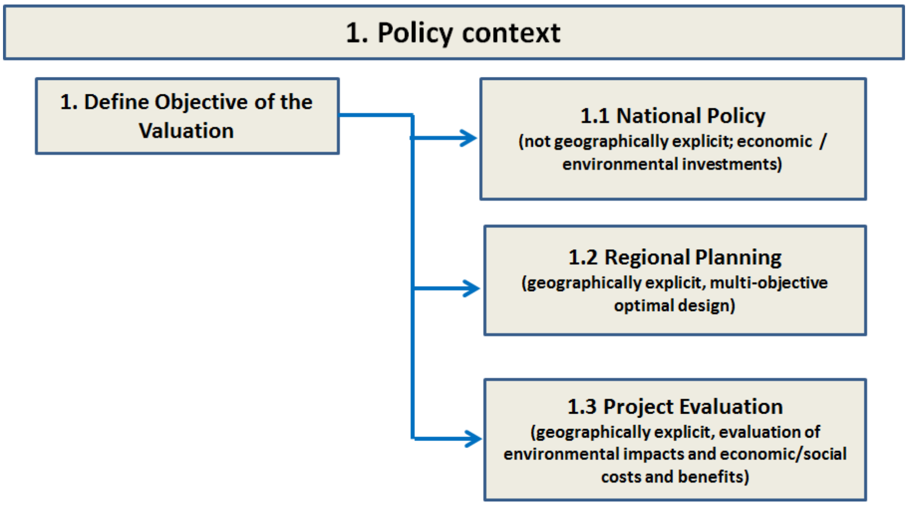


Figure 3.2 Scales and policy character in the Policy cycle of the EU Biodiversity Strategy Policy context

Within the EU, the Biodiversity Strategy is the policy initiative that covers the direct protection, sustainable development and use of biodiversity and ecosystem services. The EU works with the Member States to implement the Strategy and together they develop the knowledge and instruments to achieve the Strategy's targets. Figure 3.2 illustrate for national, regional and project level the type of policy plan for which Integrated Valuation should become the standard. The EU Biodiversity Strategy 2011-2020 (EC, 2011) marks an extension of the objectives and structure of biodiversity conservation in Europe, following the extension of the objectives of the Convention for Biological Diversity (CBD) at the 2010 Nagoya Conference of Parties (CBD, 2010). Next to the strict conservation of biodiversity and ecosystems (in some publications referred to as *natural capital*), the sustainable use of that natural capital and the services that are produced by and with that capital, have become a central pillar of environmental (including nature) policy. In Europe this has implied that Natura 2000 ambitions, incorporating the Habitat and Bird Directives but also relying on other environmental quality Directives, will be further pursued (Target #1 of the Strategy), but will at the same time be extended (Targets #2, #3 and #4 of the Biodiversity strategy). The extension refers to multiple sustainable use of ecosystems in protected areas, but also of agricultural, aquatic and forest ecosystems and it refers to the development of so called "green infrastructure" (see also Baro et al., 2015), in agricultural and forest lands, as well as fresh water and marine (coastal) ecosystems, and also in urban areas. In addition, as compared to previous strategies and action plans, the EU Biodiversity Strategy now includes a target (#5) which addresses the ecological, economic and management challenges of so-called Invasive Alien Species, and a target (#6) which addressed the conservation of biodiversity outside Europe. Actions have been formulated for EU and Member States for each of the targets (see Box 3.1).

BOX 1: EU BIODIVERSITY STRATEGY TARGETS AND ACTIONS

TARGET 1: FULLY IMPLEMENT THE BIRDS AND HABITATS DIRECTIVES

Action 1: Complete the establishment of the Natura 2000 network and ensure good management
Action 2: Ensure adequate financing of Natura 2000 sites
Action 3: Increase stakeholder awareness and involvement and improve enforcement
Action 4: Improve and streamline monitoring and reporting

TARGET 2: MAINTAIN AND RESTORE ECOSYSTEMS AND THEIR SERVICES

Action 5: Improve knowledge of ecosystems and their services in the EUMS/EC, will 5.1 map and assess the state of ecosystems and their services in their national territory by 2014, 5.2 assess the economic value of such services, and 5.3 promote the integration of these values into accounting and reporting systems at EU and national level by 2020.
Action 6: Set priorities to restore and promote the use of green infrastructure
Action 7: Ensure no net loss of biodiversity and ecosystem services

Target 3: INCREASE THE CONTRIBUTION OF AGRICULTURE AND FORESTRY TO MAINTAINING AND ENHANCING BIODIVERSITY

Action 8: Enhance direct payments for environmental public goods in the EU Common Agricultural Policy
Action 9: Better target Rural Development to biodiversity conservation
Action 10: Conserve Europe's agricultural genetic diversity
Action 11: Encourage forest holders to protect and enhance forest biodiversity
Action 12: Integrate biodiversity measures in forest management plans

TARGET 4: ENSURE THE SUSTAINABLE USE OF FISHERIES RESOURCES

Action 13: Improve the management of fished stocks
Action 14: Eliminate adverse impacts on fish stocks, species, habitats and ecosystems

TARGET 5: COMBAT INVASIVE ALIEN SPECIES

Action 15: Strengthen the EU Plant and Animal Health Regimes
Action 16: Establish a dedicated instrument on Invasive Alien Species

TARGET 6: HELP AVERT GLOBAL BIODIVERSITY LOSS

Action 17: Reduce indirect drivers of biodiversity loss
Action 18: Mobilise additional resources for global biodiversity conservation
Action 19: 'Biodiversity proof' EU development cooperation
Action 20: Regulate access to genetic resources and the fair and equitable sharing of benefits arising from their use

This major shift in European policy has already shown to affect land use planning and management at national, regional and local scale, both in urban and rural areas (see e.g. TEEB country studies in the Netherlands (Hendriks et al, 2013). Together with an increasing awareness of the importance of ”healthy” natural systems to economies and people, this has led to a demand in the EU bureaucracy, and in some Member States, for more *up to date* decision-support tools. The knowledge produced in the science community about (a) causal relationships between ecosystem conditions (i.e. the health or vitality of the natural capital) and ecosystem services delivery, and (b) about methods to involve different disciplinary fields, must be mainstreamed,- i.e. made common sense and easy to implement. Major focus in this area is on regional economic, environmental and land use planning, ex ante and ex post project evaluations and business decision making.

With an increasingly more aware and better educated population, it is expected to be possible to develop mechanisms to involve citizens and stakeholder groups to democratically assess and mobilise support for such economic and social changes. In the EU Biodiversity Strategy, Action 5 under Target 2 (see Box 3.1) includes three steps which relate to the Blocks of the Integrated Valuation Framework:

> *(5.1) map and assess the state of ecosystems and their services in their national territory by 2014,*
> *(5.2) assess the economic value of such services, and*
> *(5.3) promote the integration of these values into accounting and reporting systems at EU and national level by 2020*. (EC, 2011).

Ad (5.1) The biophysical mapping and assessment phase has been addressed in the so-called MAES process (Mapping and Assessment of Ecosystems and their Services in Europe), supported by a wealth of research publications (Maes et al., 2011, 2012b; Maes et al., 2012a; Crossman et al., 2012); Maes et al, 2013; Braat et al, 2013; Braat (ed.) (2014)). It is assumed to be understood by all parties involved that the biophysical mapping and assessment is being done to create an *unambiguous*, natural science database for future decisions regarding conservation of ecosystems (natural capital) and sustainable use of the ecosystem services (BISE, Biodiversity Information System for Europe; http://biodiversity.europa.eu/). What is expected by the EU to take place in the mapping and assessment phase is ”*de facto*” the same as has been described in Deliverable 4.1 under the heading of ”*Ecological Valuation*”. Neither TEEB nor the TEEB influenced EU Biodiversity Strategy 2011-2020 mentions the term ”Ecological Valuation”, but have defined the ”supply side” (see figures 1 and 4 in D4.1) as the ”potential ecosystem services” or ”capacity to produce ecosystem services”. The TEEB report uses the term biophysical valuation and describes the methods we describe in the section on ecological valuation in 4.1 (emergy etc). May be it would be clearer to distinguish between the biohpysical sources of socioeconomic value (biophysical accounting) and ecological values. It is acknowledged that the TEEB definition of ecosystem services implies the actual use of ecosystem functions by humans. Actual use is in many of the mapping and assessment projects often ”proxied” by estimates of potential supply or of demand for services. The biophysical mapping and assessment actions are perceived as a necessary first step (precursor, prerequisite) towards social and economic valuations of the ecosystems and ecosystem services.

Ad (5.2) It is observed that to ”mainstream” the ecosystem services approach into environmental policy and decision making, land use and economic planning, a transparent and harmonised approach to assign explicit values to these ecosystems and their services should be developed. The discussions in the EU Working Group MAES and in many Member States have shown that mainstreaming has not yet taken place, but that there is a growing awareness that it would be relevant and beneficial for all to have a better understanding of what the importance of ecosystems for people is (see Braat (ed.) 2014). This would include the usefulness of different levels of biodiversity and of the ”condition” (health) of the ecosystems in the EU. The usefulness is defined in relation to people, individually and in different (social, stakeholder) groups and to the whole economy**,** because, - following TEEB (2010a, b) -, the importance of biodiversity and ecosystem condition for other species than humans is covered by the concept of ecosystem functions. This makes valuation of ecosystems and ecosystem services, by definition, an anthropocentric activity, done by humans to assess their importance for humans. In summary, in the EU policy context the assessment of the biophysical condition of ecosystems via a wide range of biophysical parameters (as described in D4.1. in the section on ecological valuation) is considered the necessary step towards socio- economic valuation. Noteworthy, *it is nowhere called ”ecological valuation”*!

Ad (5.3) *the promotion of the integration of these values into accounting and reporting systems at EU and national level by 2020* (EC, 2011) is something we shall not discuss further in this Deliverable. It basically involves setting up accounting systems, which are now being developed in the MAES process (see Petersen, 2015 in prep.) and in relation with UN national accounting standards as defined in the System of Integrated Environmental and Economic Accounts (SEEA).

Debate Issues:

Debate issue 3.1

Unambiguity in ES mapping is unattainable because mapping is specific to a certain scale and resolution. If a decision problem turns up in one part of the landscape with a finer resolution than what is mapped, the maps are ambiguous. It is impossible to know beforehand what kinds of landuse conflicts may pop up anywhere within national boundaries. Alternatively, ES mapping should be unambiguous about what kind of decisions it is meant to address (and which it cannot). This may become one of the main conceptual difficulties with MAES when it moves to the valuation stage. (See also Chapter 2 of Barton et al. 2015).

Debate Issue 3.2 Views on the concept and term Ecological Value

It seems that two views co-exist now. One is reflecting the 1970s based tradition of explicitly assigning and attaching subjective, emotional, or ethical and religious, importance to e.g. the richness of species in natural communities, and to highlight the so called non-use benefits. The other is acknowledging the essential role of species and ecosystems in producing the full spectrum of benefits (use and non-use, tangible and intangible) and highlighting the causal dependency of all human welfare and wellbeing on the conservation and sustainable use of the services provided by these ecosystems.

The first view (*Source: Gomez-Baggethun et al. 2015. Concepts and methods in ecosystem services valuation. In Turner et al. (eds.) "Handbook on Ecosystem Services", forthcoming)*

Ecologists have traditionally used the term ecological value in its understanding as numerical amount (a magnitude, quantity, or number). In relation to ecosystem services, ecologists have focused mostly on assessing the ecosystem components, functions, and attributes underlying the capacity to provide ecosystem services, including species and functional traits (Luck et al. 2009), or in the direct biophysical measurement of ecosystem services (e.g. tons of carbon, cubic meters of timber or live stocks units) that are used as the basis to assess the condition and trend in ecosystem service delivery (MA 2005). In this sense, ecologists have engaged in assessments of ecosystem function and biophysical accounting more frequently than in valuation per se, at least in the sense of comparing alternatives to assist policy decisions over ecosystem services. It should be noted, however, that there is a long tradition of valuation within the field of ecology (Gosselinck et al. 1973; Odum 1996). For example, the ecological valuation approach has been used to measure the ecological value of a given natural area as compared with similar sites (e.g. in terms of its ability to support biodiversity), providing a rational basis for deciding on different management options (Mitsch and Gosselinck 1993). The ecological valuation approaches often rely on value indexes and comparison through multicriteria analysis (e.g. Odum 1979). This type of ecological valuation has been used in decision-making related to contexts such as the determination of safe minimum standards, environmental impact assessment and prioritization with regard to the conservation of species and ecosystems. The determination of thresholds for the sustainable use of ecosystem services are, or should be, based largely on these ecological values and criteria. The concept of ecological value is there of particular importance for valuing of so-called "supporting" (MA 2005) or "habitat" ecosystem services (TEEB 2010)".

The second view (see Braat, 2014)

The first problem of using the terms "ecological value" and "ecological valuation" lies in the conflict with the original meaning of the term ecological, an adjective derived from the word ecology. Ecology is a natural science, and its descriptive and analytical results are presented in terms of objective standard measures (kg., m., sec.) and their derivates (m/sec; kg/m2 etc.). The only time the term "value" can correctly be used within the scientific discipline "ecology" is when it is combined with "numerical", denoting "numbers" (numerical values). Thus the combination of the term "ecological" with the term "value" as (1) a descriptor of "the ability to support biodiversity" (which since TEEB is called ecological function) and (2) the biophysical basis of social

and economic value of ecosystems and their services, are not consistent with the conventions in the science community. To suggest "importance" by naming this biophysical basis "ecological value" is not an act that resides in the ecological science domain, but in the domain of subjective assignment by humans of importance (values) to humans.

The second problems is the overlap with the concept of ecosystem services, and the associated risk of double counting. When the term was used in the 1970s there was not yet a developed concept of ecosystem services. The use of the concept of ecological value since the 1970s has not helped to stop the global loss of biodiversity. Nowadays, with the concept of ecosystem services firmly established in the political debates around the globe, explicitly generating, via benefits for humans, the economic values and the cultural values at the end of a value production chain, View 2 holds that the importance of ecosystems has become sufficiently well known. The fact that this knowledge does not always lead to sensible practices in line with sustainable use requirements is another matter.

To continue the ecological value terminology now that we have the ecosystem services concept, is inconsistent within the science domain and confusing outside it. Informed decision making would of course make use of ecological knowledge, - what the European Community wants in phase 1 of Action 5: the biophysical mapping and assessment-. For this exercise one could then use for example the term "ecology-based decision making". It is noteworthy that both the TEEB reports and the European Biodiversity Strategy have refrained from using the term "ecological value".

Proposal for an integrated conceptual approach:
The rationale for having the concept of ecological value inside the Integrated Valuation Framework would thus be that in some parts of the world, the concern is still predominant that the utilitarian drift towards the right side of the Ecosystem Services Cascade (the Human Well Being box) is resulting in a gradual loss of ecological information, where the left side of Ecosystem Services Cascade (the Ecosystem box) is increasingly judged only in terms of its capacity to serve and sustain economic values. Putting ecosystem features (such as diversity, stability, resilience, and richness), not as intermediate values to deliver economic (or cultural) ones but as policy goals themselves, on a level where they are on equal footing with economic and cultural policy goals, can be a way to accommodate legitimate concerns about how ecological thinking is being colonized by (rather than integrated with) utilitarian thinking (and indeed market-oriented thinking). In cases where the level of understanding of the full implications of the concept of ecosystem services is considered to be insufficient to produce sustainable policies and planning, "careful" (precautionary) use of the concept ecological value could be a positive factor in the process.

In cases where sufficient knowledge has been gained to achieve a full understanding of ecosystem services implications for society and the ambition of the EU appears to be to achieve this - it would be better to abandon the ecological value as a separate type. The relevance of using the notion of "ecological value" in an integrated assessment and valuation process would have to be determined on a case by case basis relative to the "level of understanding". More specifically, "ecological value" would be a relevant category of analysis, where empirical methods for economic and cultural valuation of ecosystem services had insufficient accuracy or reliability to inform choices required by different policy contexts.

4. The biophysical sources of socio-economic value

4.1 Introduction

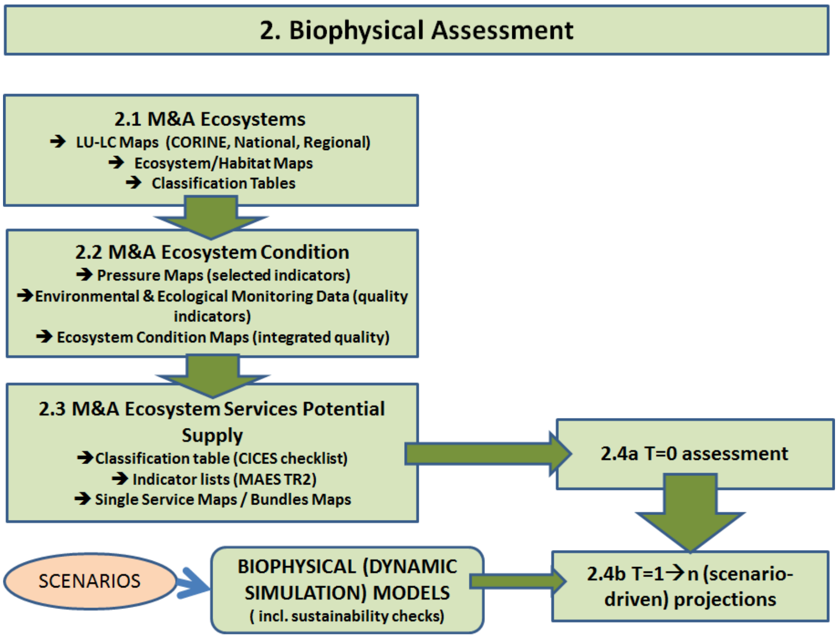


Figure 4.1 The Biophysical Assessment procedure

Figure 4.1 presents an overview of the steps to produce a biophysical assessment, including maps and quantified descriptions of ecosystems and their services for Time = 0 (the present) and alternative future moments, under different scenarios and policy options. In this chapter we shall discuss and illustrate the steps, but we first briefly summarise the concept of ecosystems, natural capital and services.

4.2 Ecosystems, natural capital, ecosystem services and benefits

The ecosystem services concept provides a way to understand interactions between the functioning of ecosystems and human wellbeing. It focuses on conserving, -or rather: sustainably using-, the ecosystem as a whole rather than focusing on specific resource using sectors. It supports a policy shift from resource- and species-based approaches towards ecosystem based approaches. Before we can turn to the valuation issue we need to clarify concepts as Natural Capital, Ecosystem Services and Biodiversity, including a note on stocks (ecosystems and their condition, biodiversity features, natural capital) versus flows (services, management, pollution and degrading actions).

In the TEEB diagram (see figure 4.2, De Groot et al. 2010) the natural science domain is on the left side and the human, social and economic domain on the right side in the diagram. Ecosystem (goods and) services flow from left to right. The TEEB diagram places ecosystem services explicitly between the natural and human systems and separates benefits and values. It also shows clearly that ecosystem services stem from the ecological structure and processes and their functions in ecosystems. By now there is a wide spread recognition that ecosystem services are coproduced by ecosystems and social systems (Braat & De Groot, 2012; Reyers et al., 2013; Diaz et al., 2015) There is a shift from biophysical entities in the ecosystem boxes and in the ecosystem services box, which require natural science methods of measurement and estimation, to entities in the socio-economic domain (benefits and values) which require other (i.e. social science)

methods of measurement or estimation. Users of the model should be well aware of this shift! The diagram suggests that values are based on the benefits recognised by people, individually or in social groups.

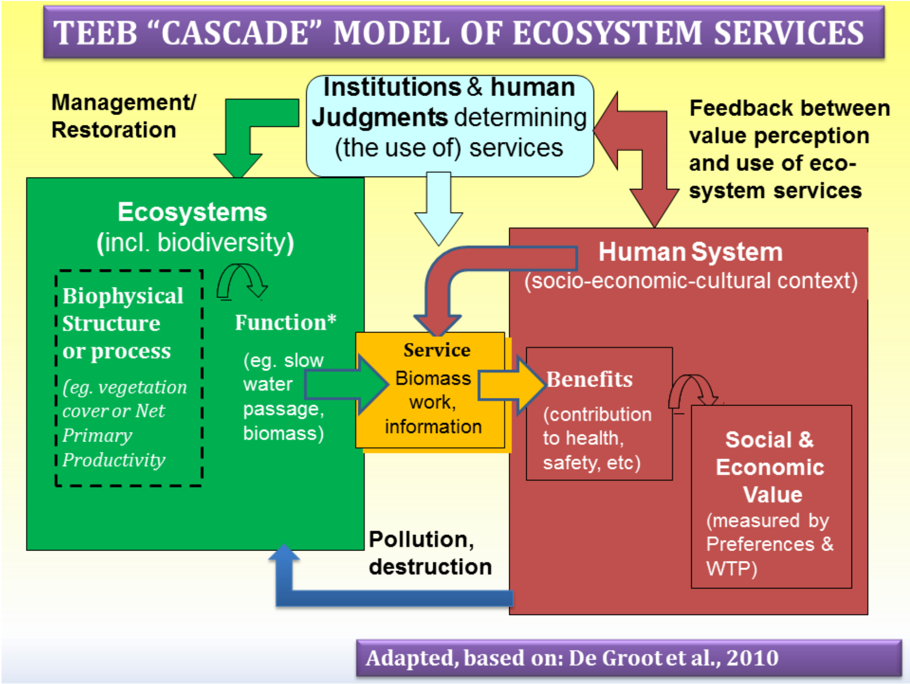


Figure 4.2 The TEEB diagram, based on the cascade model

The negative (reducing in cybernetic terms) feedback via pressures and pressure –mitigating policies adds one of the relevant features of a real world system to the model. There are similarities with the DPSIR (Driver, Pressure, State, Impact, and Response) model (see www.eea.europa.eu). The positive (enhancing) feedbacks via institutions, judgements, management and restoration are relevant, as they connect the "social sciences" angle with the "natural sciences" angle to the ecosystem services phenomenon.

4.3 Mapping and assessment in the European Union

Why mapping and assessment of ecosystems and their services? This question is addressed in the first MAES technical Report (Maes et al, 2013): This *knowledge base* (to be produced by Action 5) is necessary to decide on what ecosystems to restore with priority and where, including decision-making on Green Infrastructure (Action 6). It is dependent on the availability of spatially explicit information on ecosystems and the flow of their services as benefits to the society.

- Furthermore, spatial information on the delivery of and the demand for ecosystem services will provide baseline data to measure net future gains or losses (Action 7) and will support the development of financial instruments to fund investments in nature (Action 7).
- The first MAES Technical Report states that *spatially explicit ecosystem assessments* are useful for prioritization and problem identification.
- Maps can also be used as a communication tool to the public.
- Maps can and already do contribute to the planning and management of biodiversity protection areas and implicitly of their ecosystem services.

In summary, the starting point of the MAES project is that without the maps and scientific assessments of ecosystems, their condition and the services they produce, the spatial information relevant to optimal management choices is missing, and values will be lost. Of course, having ecosystem and ecosystem services

maps are a necessary but not sufficient condition for turning society's decisions towards sustainable optimal use. One concern regarding the current process of mapping ecosystem services (biophysically) is that most of the models used in mapping biophysical capacity to provide services are based on biophysical and land-use data and models, while many papers have emphasized the role of various biodiversity components (species, functional traits) in the provision of ecosystem services (e.g. Cardinale et al., 2012; Mace et al., 2014). Maps shouls therefore pay due attention to all factors of the ecosystem services provision, such as species or functional diversity. Ecosystem services maps in general are still in a early developmental stage where few standard procedures and scientific rigor is applied (See Schulp et al, 2014*).* Figure 4.3 illustrates the 3 mapping steps.

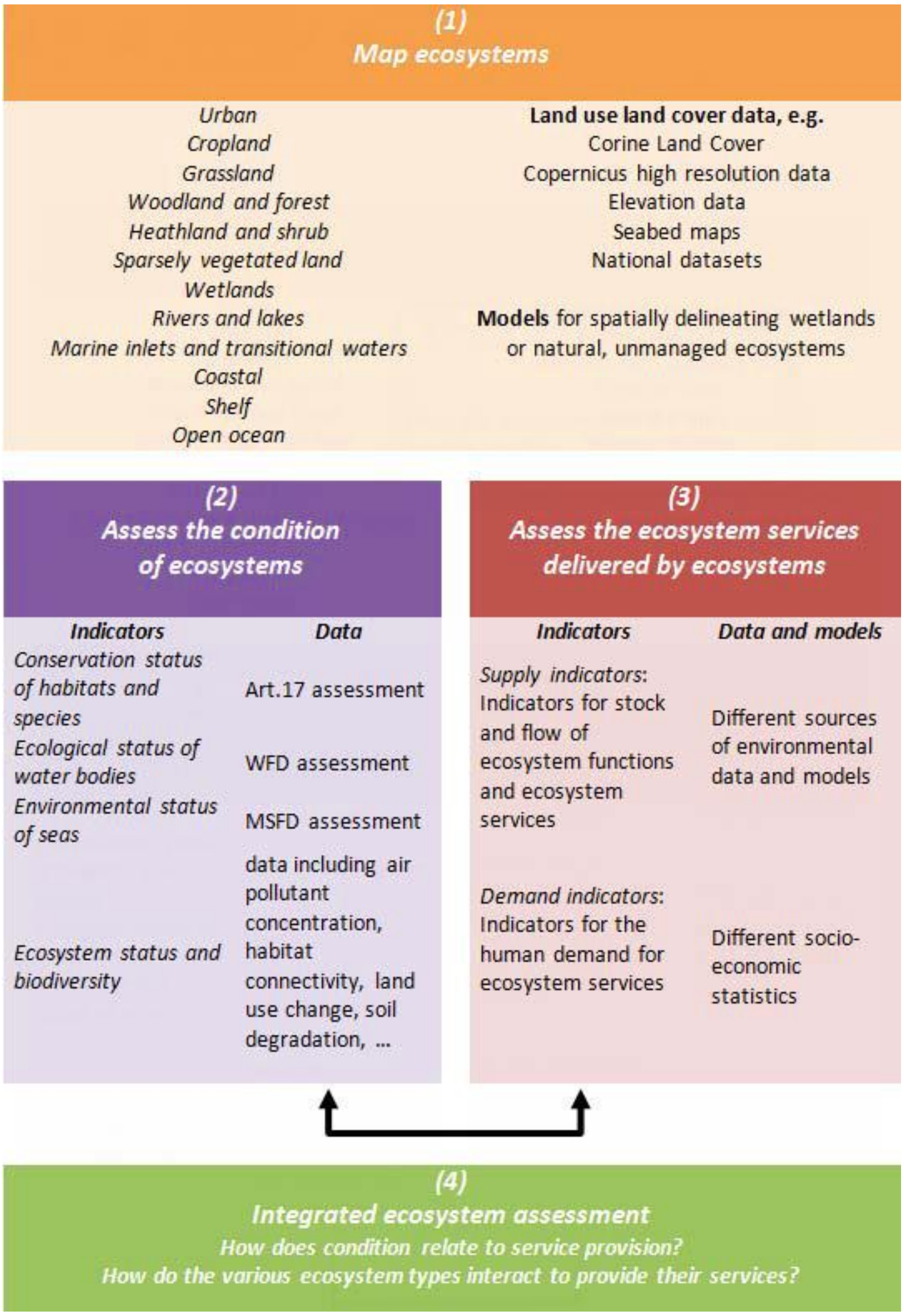


Figure 4.3 mapping approach (Action 5, part 1) From Maes et al., 2013.

4.5 From Biophysical Mapping and Assessment to Socio-Economic Valuation

The current state of affairs is that many EU Member States have started to map their ecosystems and services, some are still organising the process and mobilising the expertise (see Braat et al., 2014). For the next few years, the focus will step by step shift to the assessment of socio-economic values, in principle linked to the biophysical maps. Because the expertise to execute geographically explicit valuation of natural capital and ecosystem services is still limited, we aim to outline in the next few sections the approach which would provide such valuations. Both at National, Regional and Project level, the socio-economic valuations will require 2 situations to be compared (see Chapter ...), e.g. T=0, the current situation, and T= N, an alternative future situation (see Block 2 diagram). Scenarios may play a role in creating alternative future ecosystem service supply (and demand) situations. These scenarios should also be geographically explicit to be useful in an Integrated Valuation Framework.

Debate Issue 4.1

For analytical purposes we may group them in distinct families (ecological, economic and (socio)cultural, ***see Figure 1.2***). Separating ecological from sociocultural values is no less correct than separating economic values from sociocultural values. Perhaps a way forward is to look at the system knowledge assumptions and resulting policy mix implications of the different value concepts, and see whether some of the theoretical disagreement is resolved by the recognition that multiple values mandate multiple policy instruments working in concert.

Debate Issue 4.2

A point we try to make with the "spatial heterogeneity" criteria for integrated valuation, is that specific decisions requre specific mapping resolutions. Integrated valuation could support MAES in clarifying what kinds of decisions by whom (at what level) it is meant to support. At the moment this is foggy. We need to consider whether we should comment on what kind of information these maps actually provide for decision support. At this (EU, National, Regional) scale mapping is merely for awareness raising. It is probably useful for natural capital accounting in aggregate at nation level. But when you zoom in to specific local jurisdictions does the resolution provide support for priority setting/spatial targeting of infrastructure, for targeting of incentives or for natural resource damage assessment? An integrated valuation framework should help clarify these questions

5. Socio-Economic Assessment

5.1 Introduction

In the previous chapter we have illustrated the approach to first map and assess the ecosystem services supply side and ”physical” aspects of the inputs to so-called economic production of intermediate and consumer (goods and) services. In this chapter we turn to the demand side in the economy. The role of the underlying Human Needs in developing value judgements are examined, and identify the step where supply and demand are confronted which each other. First however, the actors, individuals, stakeholder groups or the ”state” are introduced, to arrive at a structured approach to the valuation process (see Figure 5.1).

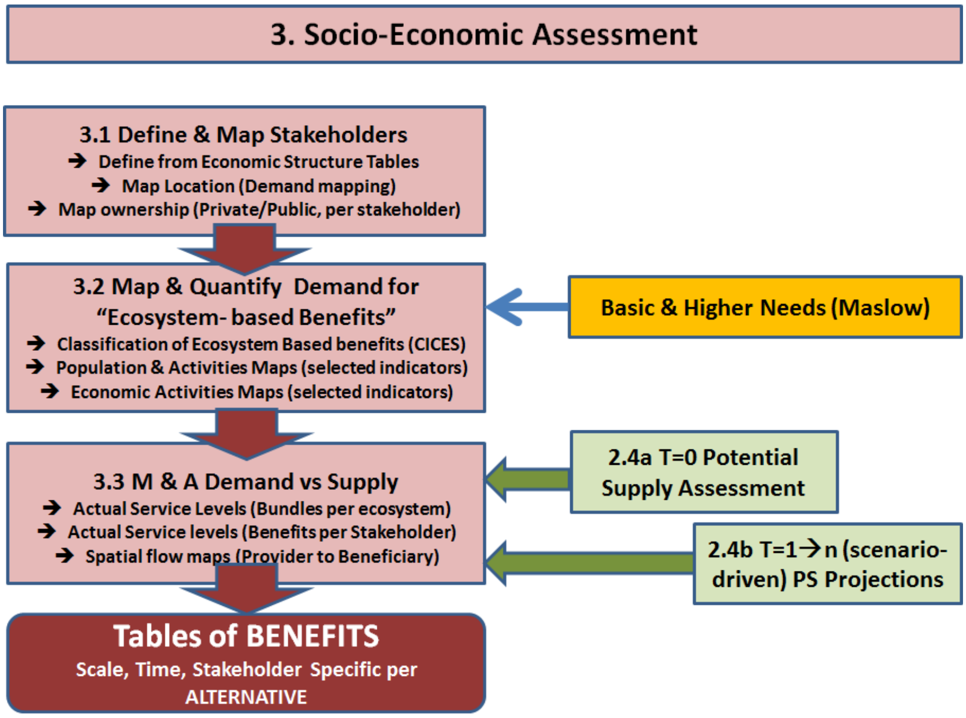


Figure 5.1 Block 3 of the Integrated Valuation Framework

5.2 Stakeholders

Identifying ”the stakes” - the decision at hand - is an essential step of the Integrated Valuation approach. In a situation where a policy is being proposed which is expected to affect the resources of a national, regional or local economy directly and thereby the economy indirectly, the policy cycle dictates (see Chapter 3) that stakeholders are involved. In the EU this principle is followed in all proposed policies. In theory, the selection of Stakeholders can be made via the identification of the beneficiaries of the current set of ecosystem services. These beneficiaries may be ”primary economic producers” (e.g. farmers, foresters) but also the secondary producers, which may be affected (e.g. food and furniture respectively), as well as distributors, and of course ultimately consumer groups. Different authors have already addressed how to identify and analyse stakeholders in the context of environmental management (Reed et al. 2009) and, particularly, in the ecosystem services context (Hauck et al., 2014). Empirical experiences that operationalize the stakeholders' identification and characterization in the context of ecosystem services use and management have frequently identified local producers (e.g. farmers, fishers, and nature tourism enterprises), environmental managers (e.g. agencies, organizations) and consumers (e.g. tourists, urban people, etc.) (Martín-López et al., 2007; Lamarque et al., 2011; García-Llorente et al., 2011; Iniesta-Arandia et al., 2014).,

5.3 Map and Quantify Demand

Mapping of the *ecosystem service demand* aims to spatially explicitly identify *ecosystem services benefiting areas*, i.e. places where use, demand, or values of ecosystem services converge. This approach can integrate monetary and non-monetary valuation by overlapping maps with monetary values information and maps with social values information. Although this approach is currently in its infancy, their use has increased in the last few years. From a methodological point of view, the main advantages and outcomes are that different stakeholders' profiles for eliciting both monetary and non-monetary values are included and thus compare the results obtained from different stakeholders' profiles. In addition, different knowledge-systems (i.e. scientific or technical knowledge and local or experiential knowledge) are integrated and thus compare the results obtained from different knowledge-sources. To integrate and compare information arising from different survey processes, i.e. deliberative and non-deliberative processes. Finally, they help to identify ecosystem service trade-offs emerging because the demand made by different stakeholders.

From an applied point of view, the outcomes and advantages associated to the governance of ecosystem services and landscape management include:

- To spatially identify those social conflicts emerging because different stakeholders' interests and use of ecosystem services. This also contributes to identify conflicting views about the landscape management (Martinez Alier 2002; García-Nieto et al. in press).
- To identify the appropriate institutional level for decision making on the basis of the scale at which stakeholders are benefiting from ecosystem services (Hein et al. 2006; García-Nieto et al. 2013; Palomo et al. 2013). This implies that valuation may be used to define the adequate level at which to constitute management, even before decision alternatives are defined for a specific jurisdiction. This is an explorative role for valuation, rather than directly for decision support. This would be "policy anticipation" in the EU Policy Cycle framework in ex-ante assessments.
- To explore how land-use changes provoke changes in social and monetary values of ecosystem services (Zorrilla et al. 2014).
- To contribute with useful information into the decision-making processes regarding landscape planning, as we can ascertain how different management practices affect the use and demand of ecosystem services .

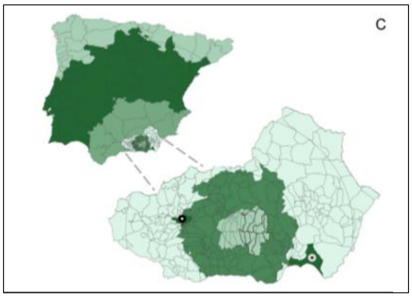
The methodological steps of mapping ES demand in an integrative way entails (1) collecting data through questionnaires or focus groups; (2) analysing data through statistical analysis and econometric analysis, and (3) GIS analysis (see figure 5.3). The Specific requirements of the method are: (1) Policy information: Property-regime information can contribute for understanding the results.; (2) Biophysical information: Biophysical mapping of the ES supply is required for a next step in order to spatially compare supply- and demand-sides., and (3) Practical requirements: Researcher skills required: Social abilities for the phase of collecting data, knowledge about facilitation processes, econometric-based knowledge, and GIS skills. Software types required are (1) software for statistical analysis, (2) NLogit for econometric analysis, and (3) ArcView.

5.4 Map and Assess Demand versus Supply

ES demand and supply spatial (mis)matches requires spatially explicit methods for the quantification of both the ES supply and demand of the ES delivery process (e.g., Spreadsheet GIS methods, ESTIMAP, ES demand mapping) in order to identify and assess ES (mis)matches between both sides. Mismatches, i.e., differences in quality or quantity between the supply and demand of ecosystem services, can occur spatially, temporally or among stakeholders (Geijzendorffer et al. 2015). Being able to identify these mismatches and their nature is of prime importance for informing governance and management decisions.

1. Collecting data	2. Analyzing data	3. GIS analysis
Questionnaires	1. Clustering distance between the respondent's residence place and sample point 2. Estimation of average values according to the distance	Spatial representa tion of social values.
Deliverative mapping	1. A vertical photograph of the map created by participants 2. The images were geopositioned in ArcMap, 3. Polygon shapefiles were created for each service mapped in each group. 4. Raster files were created to permit further analysis, i.e. overlapping.	

Map of non-monetary values of ES_1



1. Collecting data	2. Analyzing data	3. GIS analysis
Questionnaires	Travel Cost	Spatial representation of monetary values on the basis of distance-function.
	Contingent Valuation (distance was considered as explanatory variable)	

Map of monetary values of ES_1

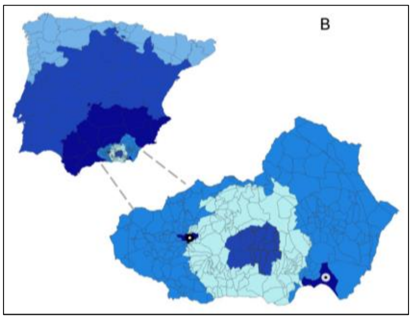


Figure 5.3: An illustration of mapping of ES demand using non-monetary and monetary methods. Source: García-Nieto et al. (2013) and Martín-López et al. (2014)

Among the techniques already applied to identify supply and demand (mis)matches, ecosystem services mapping is the most applied (Burkhard et al. 2012; Nedkov and Burkhard, 2012; García-Nieto et al. 2013; Palomo et al. 2013). Although the current ecosystem services assessments have made great advance on identifying the spatial patterns in the supply and demand, it is still one of the current scientific challenges.
Because ecosystem services management is in the hands of many different stakeholders and institutions, the identification and analysis of (mis)matches still need the consideration of stakeholders. Here, the value pluralism associated with the stakeholders' diversity in the demand of ES (Gómez-Baggethun et al., 2010; Jax et al., 2013) is one of the challenges in the analysis of supply-demand (mis)matches (Geijzendorffer et al. 2015). In this context, integrated valuation of ecosystem services should (1) consider multiple methods able to consider the complexity around ecosystem services supply and demand, (2) include stakeholders groups (see section 5.2.); (3) acknowledge that supply is not only determined by the bio-geophysical conditions, but also determined by society (Díaz et al. 2015) and (4) develop cross-scale analyses in order to allow for a better identification of the organizational scale at which institutions could most effectively act for managing them (Hein et al. 2006; García-Nieto et al. 2013).

The confrontation of supply with demand, in which all stakeholder notions have sufficiently and adequately been incorporated, should provide us with a clear overview of the benefits (and costs) in the T=0 situation and the alternative situations. This overview, in which the benefits are in principle in biophysical units and the costs can be in terms of benefits forsaken, or actual payments necessary to make the benefits possible (e.g. payments for labour, or rents for land etc.), is then the input into the formal valuation procedure . This is described in the next chapter.

Debate issue 5.1

In some views, socio-economic assessment should be carried out before biophysical assessment, because one first needs to identify the decision context including social dimensions (Social, economic, political, cultural characteristics), regulatory frameworks as well as key demographic, economic, legal, social and technological drivers underlying the decision making process (see Chan et al 2012). It also covers stakeholder, or beneficiary, identification. Identifying the ES that stakeholders find important should precede biophysical assessment. As in EIA process, the focus of the assessment is defined in a scoping process, and impact assessment (biophysical assessment) is carried out only after that. In project valuation situations this may be a more appropriate sequence. In national policy and regional planning, the ambition to develop human activities within sustainable use constraints would suggest a start with the assessment of potential ecosystem services. This is, presumably the reason why the EU in Action 5 follows this sequence.

Debate issue 5.2

The Relevance of Stakeholder meetings: defining & mapping stakeholders and their demand for ES is not relevant for decision-support unless the decision at hand is clearly identified. What type of policy at what scale and what resolution? How accurate and reliable does valuation need to be in order to distinguish one alternative from another or from the baseline? An initial box " Identify decision context" is needed (see figure 5.2)We need to check with the documentation of Lovens et al.(2014).

Debate issue 5.3

These three categories imply that every individual in a society can be regarded as an economic actor in the context of ES valuation. Several authors suggest however that when we value nature (and ES) we can act not only as economic actors but as a citizen or as a members of a community, and so the valuation can involve ethical considerations beside rational utility maximizationt. From another point of view listing only economic consumers, producers and government as actors limits the range of involved stakeholders and will have an impact on the result of the valuation too (see Sagoff, M., 1998; Vatn, A., 2009; Wilson & Howarth, 2002.)

Debate issue 5.4

Deliberative processes are not equal to surveys from a methodological point of view. Deliberation relates to the nature of true stakeholder/citizen involvement in valuation (and never deals with consumers or producers from the economic sense). So if we make the decision that only economic actors and the government is included in valuation, then there is only limited role for deliberation (and maybe we should delete it from this sentence). If we enlarge the concept of stakeholders above, then this bullet point can contain a reference to deliberative processes but still I would delete that deliberative process is a type of survey, maybe rather: to integrate and compare information arising from deliberative and non-deliberative processes. Please also note the deliberative (discourse based) methods are able themselves to integrate information and co-generate knowledge, so further integration may not be required if demand mapping is done in a deliberative way.

Debate issue 5.5

To what extent does the identification of spatial mismatches in ES supply and demand address management questions of sustainable landuse ? Can spatial mismatches in supply and demand for ES be identified equally well for provisioning , cultural, regulating and supporting services?

ES mapping of ES "capacity "and "flow" in Telemark Norway by Schröter et al. (2013) showed that mismatches could be used for sustainable use assessments for provisioning services, some cultural services, but not for regulating services. The authors devised a list of mapping criteria do identify whether spatial mismatches could be identified at all, and in what cases they could inform sustainability assessment.

Debate issue 5.6

The integrated valuation framework in Figure 2.1 suggests that costs of conducting integrated valuation are increasing with spatial scale and resolution. The framework does not discuss the kinds of budgets available to conduct integrated valuation in which “all stakeholder notions have been sufficiently and adequately incorporated [..] and the alternative solutions” . There is a danger that IV criteria may not be operational because they are too expensive to implement. Further research is needed to illustrate where the transaction costs of conducting integrated valuation that fulfils IV Criteria 1-8 (Section 2.3) exceed the net benefits of the project.

6. Valuation

6.1 Introduction

The steps in a structured valuation process should begin with a clear and structured overview of the benefits (and costs) in the any situation as a descriptive starting point, which illustrates the state of awareness and degree of documentation (e.g. accounting tables). In assigning values to the current situation people may be invited (and choose) to express them through any of the non-monetary or monetary methods (see Sections 6.2 and 6.3). As valuation is in most situations and for most people a matter of relative values, comparing different situations (current versus future, or 2 existing alternatives) the framework is structure so that values are generated through monetary or non-monetary methods, using the tables (and maps) of registered and quantified benefits (from the Previous step in the Framework) (see figure 6.1)

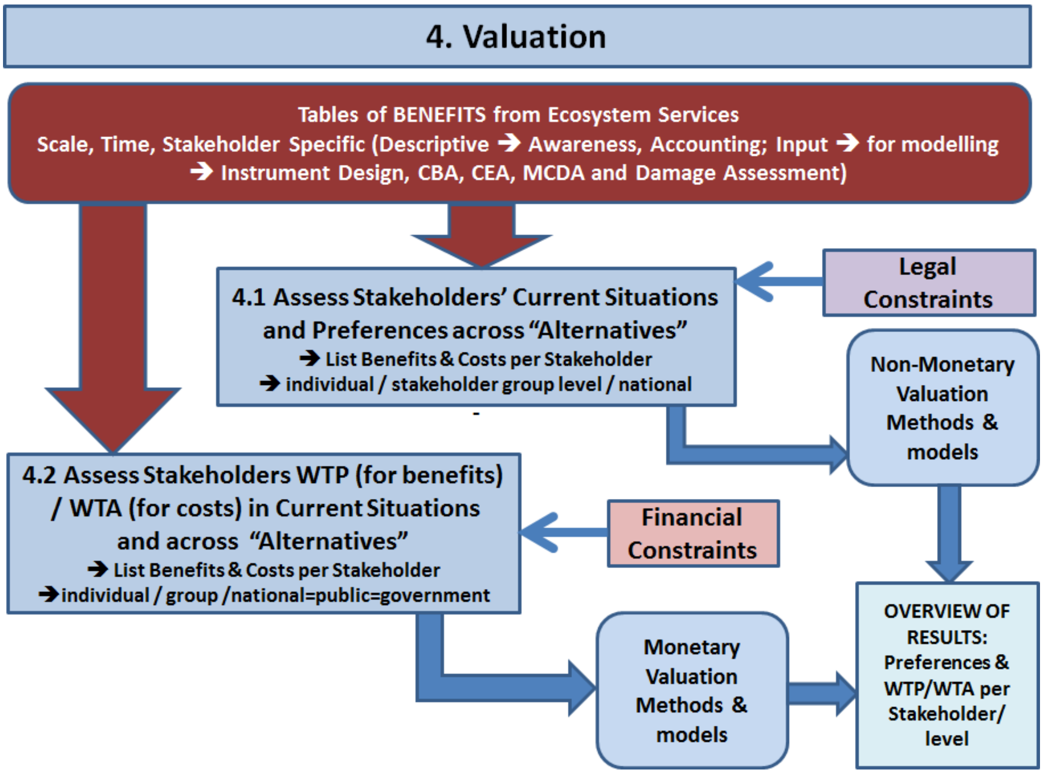


Figure 6.1 Block 4 Valuation

Within economics, valuation in a decision making context has traditionally been approached via monetary methods, but non-monetary methods have always been included in decision-making processes, and have gained recognition and impact in recent years (Kelemen et al. 2014). In the last two decades(since Costanza et al., 1997) economic valuation of ecosystem services has gained broader attention compared to (non-economic) "ecological" valuation, which was stronger in the 1970s-1980s. There is basically one approach then to define what the "total" value is (of alternative plans or projects). This is to have the relevant community of valuators (see previous chapter) determine their (individual) values and with some transparent method combine these individual values into shared, joint, group, stakeholder or community values (Box Overview of Results). This is the topic of the 5th step in the Framework.

Two groups of methods are thus distinguished. First, the traditional and very well developed methods which use money as a common denominator to sum, compare and trade-off values assigned by individuals. Second, the methods which do not use a common denominator to sum, compare and trade-off, but alternative, non-monetary methods (see Figure 6.2). In the literature (see also D4.1), and in Figure 6.2 a third set of methods is distinguished, the so-called biophysical valuation methods which seek a common denominator in the energy (and /or material) cost of producing value in an ecological –economic production chain. This focus on the input (or cost to produce benefits) is relevant in assessing the physical feasibility of (sustainably) producing the benefits for which a demand has been determined (or modelled). It is however rather a real world constraint on the decision making process, which limits the range of options in planning, but does not reveal what individuals, groups and society prefer.

We shall first discuss the non-monetary methods to define values, and in view of the definition of Integrated Valuation, we need to consider the valuation process at different ”levels” (individual, group and society) and different contexts (project, regional plan, national policy). Next we shall review the monetary methods, for which a wealth of literature is available, so we shall focus again on the consequences of our aim to fit the methods in an Integrated Valuation Framework.

Block 4: 4.1 Non-monetary methods

Non-monetary valuation refers to the set of qualitative and quantitative methods used to elicit social values of ecosystems that cannot (or may not) be commensurable in money metrics. This set of methods includes deliberative, discourse-based, and preference-ranking approaches to elicit socio-cultural values that cannot be properly measured through monetary estimations. This includes socio-cultural values shaped by principles or beliefs that may be largely detached from individual preferences as expressed in markets.

Block 4: 4.2 Monetary methods

Monetary valuation methods include valuation based market pricing and production (cost) functions, revealed preferences methods such as hedonic pricing and travel cost techniques, and valuation methods based on stated preferences, such as contingent valuation and choice modelling approaches, as well as deliberative variants of monetary valuation.

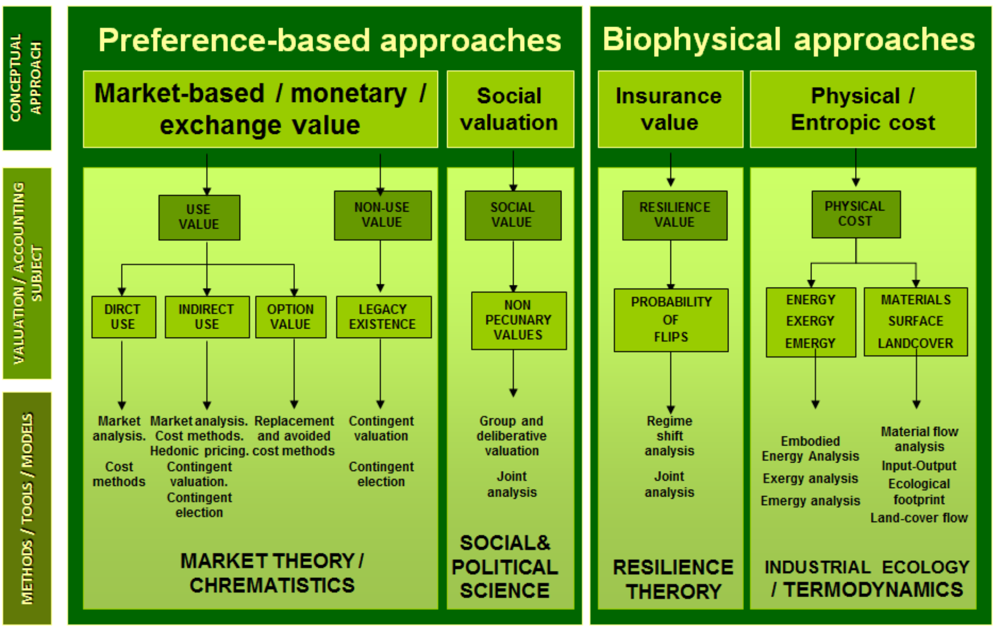


Figure 6.2 Methods for the accounting and valuation of natural capital and ecosystem services
Source: Gomez-Baggethun 2010; Gomez-Baggethun and de Groot 2010; TEEB, 2010

Insurance value reflects the capacity to maintain ecosystem service benefits by remaining within a given regime, despite disturbance and management uncertainty (Bäumgartner 2007). The societal importance of the role that ecosystems and biodiversity can play in buffering shocks has been examined through the notion of insurance value, a metaphor aimed at informing of the need to protect nature to sustain resilience in social-ecological systems and sustaining human well-being. The metaphor of insurance offered by ecosystems suggests that there is an invisible yet valuable service offered by healthy ecosystems. Ensuring the continuity of this service or even strengthening it then appears to be a worthy investment because “keeping an ecosystem in a desirable domain” helps “to prevent catastrophic and irreversible reductions in ecosystem service flows” (Baumgärtner and Strunz, 2014, p. 22). Thus, the insurance metaphor points to additional reasons for acting as good stewards of ecosystems.

6.2 Non-Monetary Valuation (NMV) methods

Non-monetary valuation explores the importance (including cognitive, emotional, and ethical arguments), preferences, needs, or demands expressed by people towards nature (De Groot et al., 2010; Chan et al., 2012; Castro et al., 2014). In the context of ecosystem services, the term refers to a broad and heterogeneous collection of approaches and methods based on different conceptual and philosophical foundations (Christie et al., 2012; Muraca, 2011). In spite of the growing number of scientific papers that present Ecosystem Service assessments based on non-monetary methods (e.g. Calvet et al., 2012; Martín-López et al., 2012), non-monetary valuation does not yet constitute a formalized methodological field in the context of ecosystem services.

There are a number of competing – often synonymously used – terms in the scientific literature applied to distinguish specific methodological approaches from monetary valuations, such as non-economic and non-monetary (Gómez-Baggethun et al., 2009, Christie et al. 2012), deliberative (Howarth and Wilson, 2006, Kenter et al. 2011), discourse based (Wilson and Howarth, 2002), psycho-cultural (Kumar and Kumar, 2008), social (e.g. James et al., 2013, Casado-Arzuaga, 2013), and sociocultural valuation (Castro et al., 2014, Gómez-Baggethun et al., 2009; Calvet-Mir et al., 2012; Martín-López et al., 2014). These different terms often refer to different theoretical backgrounds and apply diverse techniques, but share the commonality that instead of expressing values in monetary terms all of them focus on the process of preference formation and aim to understand how values and preferences are formed and attributed to ESs.

A large number of research methods are used to value ecosystem services in non-monetary terms, for instance: quantitative and qualitative research techniques (i.e. surveys, interviews), participatory and deliberative tools (focus groups, citizens juries, participatory or rapid rural appraisal (PRA/RRA), Delphi panels, etc.), methods expressing preferences in non-monetary but quantifiable terms (i.e. preference assessment, time use studies, Q-methodology) (Christie et al., 2012, Castro et al. 2014).

Some studies also consider the spatial representation of ecosystem services (i.e. demand mapping) (Milcu et al., 2013) and analytic tools rooted in biophysical approaches (i.e. emergy-exergy analysis) as part of the broader family of non-monetary valuation tools (Naredo, 2001; Gómez-Baggethun and De Groot, 2010). Although, taken into account the IV framework (Figure 1.1.) and the related chapters on biophysical and socio-economic assessment, we can argue that these methodological approaches rather belong to the assessment phase of Integrated Valuation, instead of the valuation phase. Therefore in the remaining part of the text we will refer to non-monetary valuation in the narrower sense and focus on hermeneutic methodological approaches which aim to understand how values and preferences to ESs are formed by different members of society.

Non-monetary methods – even in the narrower sense – are very heterogeneous in terms of their ontological and epistemological foundations. They have different theoretical roots, they define the subject of valuation and the meaning of value along different aspects, and they can be used to value different ecosystem services. Thus, the different methodological approaches within non-monetary valuation may be regarded as representing different value articulating institutions[1] (Jacobs 1997, Vatn, 2009).

A first attempt to divide this large and heterogeneous methodological field into formalized and more homogenous groups of methods is represented by ***Figure 6.3***.

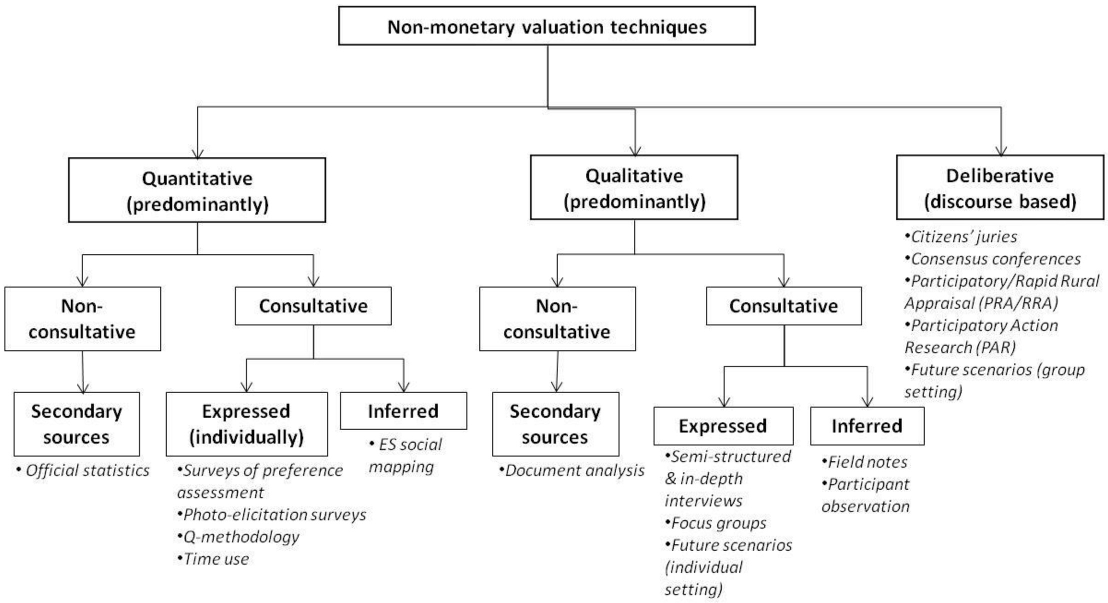


Fig 6.3: Subgroups of non-monetary valuation techniques according to methodological similarities in data collection (edited by the authors). Adapted from: Kelemen et al. (2014)

In the OpenNESS project we focus especially on two subgroups of NMV techniques:

1) predominantly quantitative and consultative methods, especially preference assessment, photo-elicitation and time-use studies; and
2) deliberative (discourse based) methods.

Predominantly qualitative consultative methods (e.g. interviews, focus groups) are also suggested as tools to collect preliminary information and engage stakeholders both in case of preference assessment and deliberative valuation. Brief information on these techniques is provided below (excepting interviews and focus groups since these methods are well described in the social scientific literature):

<u>Preference assessment:</u> this is a direct and quantitative consultative method for analysing perceptions, knowledge and associated value of ecosystem services demand or use (or even social motivations for its maintaining). It could be used with an emphasis on individual perceptions or collective preferences (Castro et al. 2014). In the individual ranking technique respondents usually decide the most important ecosystem services (using scales such as Likert) from a list of the existing services in a given ecosystem (e.g. Castro et al., 2011). In the rating technique respondents rate each service independently (e.g. Martín-López et al., 2012). Preference assessment could be a useful approach for identifying relevant services from different

[1] The term 'value articulating institution' refers to the meaningful rule structures of valuation methodologies that facilitate the process of value articulation. Value articulating institutions „form contexts for such articulation based on different rationalities including distinct principles concerning how the involved values should be articulated." (Vatn, 2009: 2209)

stakeholder perspectives with diverging interest or needs. At a consequence, its application could help to uncover trade-offs or/and synergies on the ecosystem service demand, as well as the motivations behind these preferences.

Photo elicitation survey: is a method to translate people's experiences of landscapes in terms of ecosystem services. Its main objective is to explore the links between the degree of landscape multi-functionality (defined as the capacity of ecosystems to provide ecosystem services to society) and public perceptions toward landscapes, in terms of social perceptions of ecosystem services. This is based on the idea that visual stimuli could be understood as a socially shared communication channel, and then, with potential to identify and analyze social perceptions of ecosystem services (García-Llorente et al., 2012 and López-Santiago in press). This technique could be used to assess a range of landscape views at the same time, allowing to connect landscape views with ecosystem services in a second question or even with other aspects such as land-use patterns in a particular area. At the same time, a limitation could be related with the fact that ecosystem services are linked to the landscape views in a later stage (being indirectly assessed) and could not be evident with those less tangible services such as regulating services. However, this technique has been found as very suitable to assess cultural services and with potential to assess a range of values (e.g. spiritual, heritage, aesthetic).

Time use study: is an innovation of the conventional stated preference techniques, in particular taken from the contingent valuation approach. In this case, the payment vehicle is expressed in labour hours rather than monetary units (classical from the willingness to pay studies) (Kenter et al. 2011). Willingness to give up time (WTT) creates a hypothetical scenario using surveys to calculate the value of ecosystems related with use and non-use values, where the method elicits public preferences by directly asking people how much would be the maximum time to be invested for a change in the quantity or quality of a given ecosystem service or conservation plan. This approach could be understood as a useful non-monetary technique, particularly in areas with economic limitations, avoiding equity problems (Higuera et al. 2012). It also avoids incommensurating issues resulted from the assignation of monetary value to service properties that could not be monetarily measured (García-Llorente et al. 2011). Time use studies through WTT could be an appropriate indicator for uncovering socio-cultural factors behind consumer preferences but they can also be used to understand social demands and priorities for conservation.

Deliberative methods: invites stakeholders to form their preferences to ecosystem services together in a transparent way through an open discourse (Kelemen et al. 2013). It may combine different social scientific and participatory techniques, e.g. interviews, focus groups, in-depth groups, citizens' juries, etc. (Fish et al. 2011), to be able to flexibly adapt to local contextual factors and stakeholder needs. Deliberative valuation allows consideration of ethical beliefs, moral commitments and social norms beyond individual and collective utility (Aldred, 1997), and helps respondents articulate a wide range of non-utilitarian values together with utilitarian ones (Satterfield, 2001). Furthermore, deliberative valuation gives voice to marginalized stakeholder groups and often sheds light on social conflicts that accompany ecosystem service trade-offs. The results of the valuation process are socially accepted arguments about ecosystem services and their importance. However, the aim of deliberative valuation usually goes further than providing useful information to decision makers towards the transformation of the decision making process itself.

Contextual factors (e.g. capabilities and cultural characteristics of the communities involved, the value system held by stakeholders, institutional processes and characteristics etc.) can remarkably influence the process and the results of non-monetary valuation. A key step towards the applicability of non-monetary valuation of ecosystem services is, thus, to provide guidance on which valuation contexts enable the use of which methods (and which methods cannot be used reliably in certain contexts).

6.3 Monetary valuation methods

Monetary valuation of ecosystem services is the term used to denote the association of a positive number of currency units with some service provided by ecosystems (with or without human contributions). As to the ecosystem services, the monetary valuation may be based on market transaction or involve a 'non-market' valuation, the point being that only the so called provisioning ecosystem services (e.g. food, timber, fish, drinking water, medicinal plants) and some of the so called cultural services (outdoor recreation) are traded in markets; regulating services do generally not get traded in real markets (the Carbon market is an artificially, policy based market) and so market prices are not attached to them to reflect people's values.[2] The motivation is to inform decision-makers in different contexts that have implications for ecosystem services. Monetary valuation methods / techniques are often used for evaluating the effect of a change in ecosystem services on components of human wellbeing (i.e. the change in the flow and quality of ecosystem based benefits) as they are a way to guide trade-offs in decision-making processes (Winkler, 2006). Many papers deal with the difficulty of valuating ecosystem services (e.g. Costanza et al., 1997; de Groot et al., 2002) and the complexity to comprehend interactions between ecological functionalities and the production of ecosystem services used by humans (Daily et al., 2009; Polasky et al., 2011).

Whatever the method used, no one is exempt from criticism. Even though a monetary valuation, albeit imperfect, has the advantage of bringing about indications about ecosystem services, it is risky to use as the sole decision making criterion because…. Other social and nature conservation objectives (many of which may not be adequately captured by money metrics) should be considered as well. There are several government and non-government originated handbooks available presenting and discussing monetary and non-monetary valuation methods: Pagiola et al. (2004), EFTEC (2005), EPA Science Advisory Board (2009), WBCSD (2011) and a very large number of critical articles in the scientific literature of which the following are interesting examples: Spangenberg and Settele (2010), Bateman et al. (2013) and Spash (2013).

1. Direct valuation methods (market price or cost based methods):

Market price: These methods have in common that they use observed market prices to assign value to ecosystem services. They use little or no information about ecosystem functions. A market price method would also use information from ecosystem service offsets markets (i.e. carbon, wetland restoration).

Avoided damage cost: Where an ecosystem service is the main mechanism of avoiding damage to property or economic production, the economic value at risk, valued at market prices, can be assigned directly as the value of the ecosystem service. If the avoided damage is co-produced with human management a production function approach is used where the contribution of the ecosystem service is estimated. Prevention and mitigation cost: The costs of actions in preventing or mitigating damage that would be or is caused by the loss of ecosystem services constitute a conservative estimate of the value of the ecosystem service.

Replacement, restoration cost: Coastal wetlands once removed may be replaced or restored with more or less artificial wetlands. The costs associated with replacement or restoration are a conservative estimate of the value of the ecosystem services of the original wetland habitat.

Substitute cost: When an ecosystem service is lost it may be substituted by some other means of providing the service. While closely related to the idea of prevention and replacement cost, which happen on-site, substitution cost often refers to replacing the ecosystem service by importing it from *other locations*.

The production function or productivity method[3]: this is one of the key methods for valuing ecosystem services. In cases where ecosystem services are a combination of ecosystem function and human management, the approach estimates the marginal contribution of the ecosystem relative to human 'input' to the overall production of the service. The service is valued at market prices.

[2] See: http://www.eoearth.org/view/article/154669/

[3] Natural capitals project – INVEST http://www.naturalcapitalproject.org/InVEST.html http://www.ecosystemvaluation.org/productivity.htm

Government spending: A special case of cost-based methods is public spending on damage avoidance, prevention, mitigation, restoration of ecosystems. Governments, in democratic political systems, are considered as representing the (majority of) the preferences of the people, and as such the decisions on how to spend public money (tax revenues) can be seen as an aggregate willingness to pay. So the analysis of budgets is step 1 (stated preference; intended spending) and actual spending is step 2 (revealed preference).

2. Revealed preference methods:

Revealed preferences estimate the value of a given ecosystem service without market price through the observation of substitute markets related to the service. The two main techniques are travel cost (TC) method and hedonic pricing (HP). Opportunity costs may be considered a lower bound estimate.

Travel cost: The TC is used to estimate monetary values of the contribution that ecosystems make to recreation experience by humans (which should be separated from the factor accessibility (roads, parking) and distance to the origin of the recreating people, thus estimate direct use values of nature tourism or recreational activities.

Hedonic pricing: The HP method can be used to estimate monetary values for ecosystem services that directly affect market prices of goods not necessarily produced by the ecosystem in question. It estimates the monetary value on the basis of changes in commodity prices (usually a property) according to changes on quality or quantity of specific attributes including an ecosystem one (e.g. an aesthetically pleasant landscape from the window).

Opportunity costs: Governments, businesses, land owners and agents in general may forego income streams from land uses when undertaking conservation actions. The foregone net income from alternative (less sustainable) opportunities is called 'opportunity cost' and can be understood as a lower estimate of the bundle of ecosystem services that are conserved by the conservation action.

3. Stated preference methods:

Stated preference methods in environmental economics refers to a family of techniques which use individual respondents' statements about their preferences to estimate change in utility associated with a proposed increase in quality or quantity of an ecosystem service or bundle of services. Stated preferences are often elicited through surveys (typically web, phone, mail or in-person) that use questionnaires following strict guidelines. The two most common forms of stated preference methods are contingent valuation (CV) and the more recent choice experiments (CE). CV elicits willingness to pay (WTP) by asking respondents directly their WTP for the change in the ecosystem service(s). CE breaks the description of the environmental good into physical attributes, where each attribute has different levels. The respondents then face a number of choice sets with different combinations of physical attribute levels combined with a cost attribute. This design yields indirectly the respondents' trade-offs between money and changes in individual attributes, and their WTP for a general environmental change described by combinations of the attributes. The advantage of stated preference methods is that they can be used in any situation where there is no or limited data of people's actual behaviour that can say something about their environmental preferences. In contrast with so-called revealed preference methods, stated preference methods are also able to estimate the utility loss or gain people may experience even if they do not directly utilize the ecosystem service ("non-use value"). The main disadvantage of stated preference methods is that the data collected are hypothetical in nature. (A combination of stated and revealed (as validation) is much preferred!)

4. Benefit/value transfer methods:

Value transfer refers to the use of secondary estimates of ES value from a 'study site' to a new 'policy site' for which the original valuation estimates were not originally intended. Transfers can be of both benefit (BT) and cost estimates, hence the general term value transfer. The BT method is typically used for stated-preference estimates, while transfer of cost estimates is typical for the market-based valuation estimate (prevention, mitigation, substitution costs).

Unit value transfer: Value estimates are assumed to be correct 'on average' and transferred without any form of adjustment; Adjusted unit value transfer: Value estimates are transferred with simple adjustments typically for study and policy site differences in income and purchasing power. Value function transfer: Significant predictors at the study site of willingness-to-pay typically (from CV or CE studies), are identified at the policy site. The average value of predictors at the 'policy site' are then 'plugged into' the 'study site' value-function to derive an adjusted WTP figure for the policy site. Meta-analytic function transfer: Similar to value function transfer, but the value function is generated from a meta-analysis of many valuation study sites instead of a single study site. The method assumes that there is a meta-value function (i.e. similar preferences) that applies across all the study sites.

6.4 Discussion and conclusions

There are still many problems in the valuation processes involving ecosystems and their services. Aside from the degree to which information in Block 1, 2 and 3 has been adequately gathered and systematically processed, the valuation methods discussed in this chapter, monetary or non-monetary, have been used in the past in a somewhat haphazard way, using whatever method was either considered politically correct, or technically feasible with the data available, within the time frame allowed for the assessment and decision process. Decades of a single focus on market based monetary valuation in the academic literature have at least contributed to loss of potential ecosystem services and uncompensated loss of benefits to various stakeholders. In environmental impact assessment by local authorities in many countries, monetary based valuation has not had the opportunity to achieve such (dubious) prominence, given lacking assessment budgets, lacking awareness of the academic valuation literature and/or formal guidelines excluding monetary valuation of ES (e.g. in the case of Norway).

Now that the EU EIA/SEA Directive and national equivalents require ex ante assessments of environmental impacts of proposals and plans, and the EU has procedures for social, economic and financial impact assessments of EU policy proposals, there are still many countries where impact assessments follow single or at best hybrid methodologies, which suffer from the pitfalls outlined in Chapters 1 and 2.

Our contribution is to present an outline of an Integrated Assessment and Valuation Framework with inclusion of the full causal chain from ecosystems to values perceived by people, covering the relevant social strata (individual, stakeholder group and society), the relevant spatial and temporal scales, and address the plurality of values held by people. The approach should aim to be transparent and theoretically consistent across natural and social science paradigms, and it should aim to be possible to implement, even without expensive long term research programs to produce data and model predictions (see definitions and criteria in Chapters 1 and 2).

The recurring major methodological problems in valuation processes are:

- Selection of the relevant and representative human population to involve in the various methods employed, to elicit preferences and willingness to pay (or accept) from at individual level, and then to sum across sub-populations and the whole population.
- Time and space dependency of the preferences assigned: people in the selected population have different preferences and are willing to pay different amounts of money for their preferred benefits in different phases of their life; there are also marked differences in cost-of-living levels across regions and countries, even in Europe. Such factors are important when decisions are made in processes involving a high degree of democratic input. Likewise, the use of monetary valuation to inform decisions may be more appropriate in a market economy than in a context of peasant, indigenous, or other community based societies where environmental values are deeply interwoven with community and spiritual values (Gómez-Baggethun and De Groot, 2010).

- The temporal and spatial scales of the ecological dynamics of the service providing ecosystems may not be ”in synch” with the temporal and spatial scales of the social and economic dynamics of the community of people which strive to satisfy their human needs, and therefore choose to manipulate and manage ecosystems with a focus to produce the relevant benefits. Expert knowledge is always needed to match the supply dynamics and the appropriate management strategies with the social and economic dynamics of the demand side, and thus create a transparent decision space for individual and group valuators and ultimate decision makers.
- Monetization within and across currency systems has dependencies on financial markets and currency exchange rates, and for some ecosystem services valuation methods even depends on housing and commodities market and stock exchange dynamics. Decision makers face the challenge to make decisions with long term impacts, across highly dynamic markets with fluctuating prices. Economic and financial expertise is essential, even though the predictive power of the experts has proven quite limited.
- The traditional market flaws also include the lack of information to the ”valuator” about supply quantities, quality and cost of alternatives, which are items best added in the process by experts. And when adding this information it should be multi-level (social strata), multi (system) scale (from local to EU and for some services even global). In Western Europe, shifts in local, or regional, land use may affect the food production and food producers, but hardly affects the food consumers, as the trade and distribution networks already have an international character. And consumer food prices are more determined by regional competitions between supermarket chains than by the production prices, which are generally cheaper away from these western European markets. On the other hand, outdoor recreation is in terms of quantity still more depending on local and regional supply, next to the international tourist flows.

These limitations are mainly related to monetary valuation. Non-monetary valuation, and especially deliberative valuation have different methodological limitations and problems, e.g. transparency of the process, active involvement of participants and commitment of decision makers to apply the results of deliberative valuation, empowering participants and decreasing the inequalities between them stemming from different social and communicative skills, giving voice to marginalized social groups etc.

Debate Issue 6.1
Can insurance value be operationalised in terms of valuation methods, or does it work only at the level of a metaphor?

7. Discussion and conclusions

7.1 Introduction

OpenNESS aims to develop guidance for decision makers in their ambition to make informed decisions towards sustainable development in complex systems of man and environment.
We therefore search for a scientifically sound approach (*i.e. the causalities are accounted for*), which is at the same time also policy effective (*it supports the decision makers by delivering clear sets of values held by relevant stakeholders at the appropriate system levels (~geographical and administrative units*), and socially responsible (*it offers clear overviews of beenfits and costst to all stakeholders involved)* and socially fair (*it offers compensation for those who lose benefits as a consequence of decisions*).

So far we have presented the steps 1 – 4 of the Integrated Valuation Framework, which cover the above items of the search. We now have arrived at the final step, where the values which have been clarified through monetary or non-monetary methods, must be combined into a frame which links the values to general national or international sustainable development policy objectives or specific local project objectives.

To combine monetary and non-monetary methods is a challenge indeed. Some argue that the inherent ontological and epistemological differences of monetary and non-monetary methods make it impossible to apply them together. As has been indicated above, both non-monetary methods and monetary methods are very diverse, and in some contexts the needs of the decision-makers and the capabilities of the local community may receive due consideration if monetary and non-monetary techniques are combined in a valuation exercise. This sounds attractive, and has in fact been done increasingly, but the questions come back now, after discussion of the 4 Blocks of the Integrated Valuation Framework:

1. Does the set of currently available and known methods of valuation, monetary and non-monetary, at the end of a geographically explicit, multi-level (individual, group and society, multi-scale (local, regional, national, EU) assessment across the steps in the TEEB / Cascade model provide a transparent toolbox to support robust decision making?
2. Is it self-evident which combination of tools, in which sequence , must be applied to provide such decisions? Do we need a stepwise approach in applying both non-monetary and monetary methods? How is it possible to integrate the results of non-monetary and monetary methods?
3. What needs to be added to the framework as outlined to make it a useful instrument of Case Study assessments in OpenNESS (as Testing Ground)?

Summarising the methods to produce value estimates (of projects or ongoing developments) we have in fact distinguished 4 approaches:

1. **Single method or technique**: there is a multitude of papers illustrating the values of ecosystem services in case studies employing a single monetary, non-monetary or even biophysical method. They all highlight a very limited part of their decision problem - or do not clearly identify the decision problem - and generally do not score well the Integrated Valuation Criteria (see Chapter 2.)

2. **A mix of monetary methods or a mix of non-monetary methods**: there is much less reporting of such mixed methods approaches, but regional ecosystem services valuation studies do increasingly address a complex or bundles of services, where provisioning services are valued via market prices, regulating services via shadow prices (avoided cost or damage functions) and cultural services via contingent valuation or choice experiments. Non-monetary valuation papers are still a minority compared to the monetary, but are slowly taking an increasing share of the publications. Examples include regional valuation of ES where narrative methods, surveys and group based deliberative methods were combined (e.g. Palomo et al. 2011). Other examples for mixing monetary or non-

monetary methods are Martín-López et al. (2007) and Barton et al. (2015). Other OpenNESS case studies that could fit into one of these categories are e.g. the Kiskunság Hungarian case study (Kelemen et al in prep.)

3. **A Hybrid (mix) of monetary and non-monetary approaches**, which has already been characterised (and scored on the IV criteria). The major challenge, beyond deciding which method to use for which ecosystem service as in Approach 2, is how to elicit preferences from valuators and then combine it with their willingness to actually pay for their expressed preferences. It resembles the comparison between stated preferences and revealed preferences, but then without the monetary units when stating the preferences. Most Multi-Criteria decision processes can be characterised as Hybrid approaches (see next section for an explanation of MCDA) (see Barton et al. (forthcoming) on valuation of eutrophication which conducts a self-evaluation on proposed IV criteria)

4. And, finally, the **Integrated Valuation approach**, which adds the requirements as presented in Chapter 2 in the IV set of criteria, but does not in itself give a recipe for when and how to transparently and consistently combine monetary with non-monetary methods.

Before turning to the Integrated Valuation approach we first look at the multi-criteria assessment approach, which according to many is already considered as an integrated model for valuation and decision support methodology. We discuss here whether it captures our criteria for integrated valuation methods.

7.2 Multi-criteria decision analysis (MCDA)

MCDA is a combination of methods and procedures by which concerns about multiple, conflicting criteria (= *benefits from ecosystems via services*) can be incorporated in a transparent and traceable way into a decision-making process (Figure 6.4). As an analytic-deliberative approach, (*which can be used to address trade-offs, distributional impacts and less tangible social and ethical concerns*), it is seen by some as an **alternative or complementary method to economic valuation** (Chan et al 2012, Keune et al 2013, Munda 2004, 2006).

The features of MCDA are:

- It provides an evaluation and discussion framework for ***structuring the decision situation and identifying 'decision-makers' and stakeholders' objectives***;
- It allows ***comparison of "ecological" objectives*** (= *objectives regarding the conservation and sustainable use of ecosystems and their services*) ***with (socio-)cultural and (socio-)economic ones*** in a structured and shared framework *(by comparing the degree of achievement of explicit objectives in each of the distinguished (alternative) system states ?)*
- It can ***facilitate multi-stakeholder processes*** and ***discussion about the subjective elements*** in policy analysis, including ***the nature and scope of the decision problem, the selection and definition of options, and the characterizing and prioritizing of evaluation criteria. (****the prioritization is a notion which is hidden in the monetary and non-monetary methods, where people explicitly or implicitly list and rank their preferences)*
- It can deal with incomplete information, characteristic for most environmental planning situations by allowing use of a mixed set of both quantitative and qualitative information.

The formal steps of MCDA are quite similar to the criteria of the Integrated Valuation- framework as outlined in Chapter 2, in this report.:

1. Define a hierarchy of objectives and evaluation criteria (*see Chapter 3; Block 1*)
2. Define alternatives *(See chapter 4: Block 2; building on Block 1*)
3. Evaluate the performance of the alternatives with respect to the criteria (*The Demand versus Supply confrontation? Block 3 in Chapter 5*)

4. Define **value functions** that normalize individual impacts to a common scale of comparison (*a technique which imitates the monetization of preferences*)
5. Elicit **weights for criteria** that **represent their importance to the (e)valuators** (weighing) (*adds the expressed preferences of valuators across the different benefits; useful for transparency*)
6. And **allow comparison** of alternatives (*similar to what needs to be done in Block 4 after Valuation for T=0 , also Valuation for the t=1…n situations*).
7. Multiplying the criteria-wise performance values by corresponding criteria weights and then summing them up to obtain overall value for each alternative (*mimicking the summation of monetary values across benefits per alternative and across alternatives*)
8. Conduct a sensitivity analysis of the results to changes in scores or weights (*not addressed (yet) in IV framework, but useful addition*)

The MCDA process has most of the procedural elements we would recommend for Integrated Valuation. It is important to recognize that it is a tool for decision support for comparison of alternative courses of action (e.g. policy or management options). It does not capture other purposes of (integrated) valuation. It does not recognize that the purpose of valuation is "updated" as the policy process proceeds (see Barton et al., 2015, for a discussion).

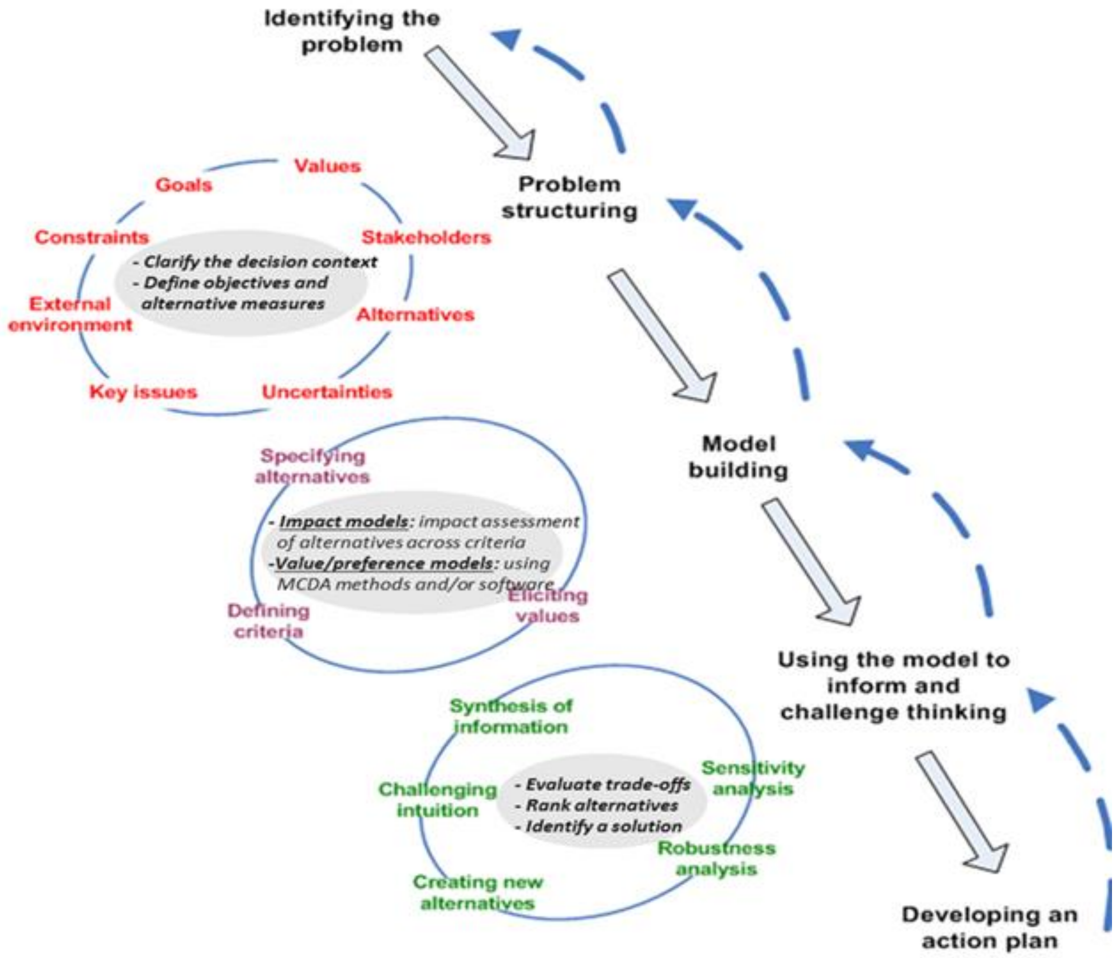


Figure 7.1: An illustration of a MCDA process in Catrinu-Renström et al (2013).

The assessment of ecological, social and economic impacts is a prerequisite to carry out MCDA in order to define performance levels for each of the alternatives with respect to each criterion. Information from mandatory EIAs is often augmented to better account for social-economic impacts. Mixed monetary and non-monetary valuation technique can be used to develop value scaling functions for single impacts so that they may be compared. Value scaling and weighing approaches using a using focus / Delphi/expert group methods are examples of a non-monetary approach.

7.3 Methods and tools in an Integrated Valuation Framework

Figure 7.2 presents an example design of an Integrated Valuation Framework illustrating the Causal Chain of Value production based on ecosystems and their services (i.c. a simplified TEEB model , see Chapter 4), and a selection of methods, techniques and tools that makes it possible to execute the assessment in a quantified way.

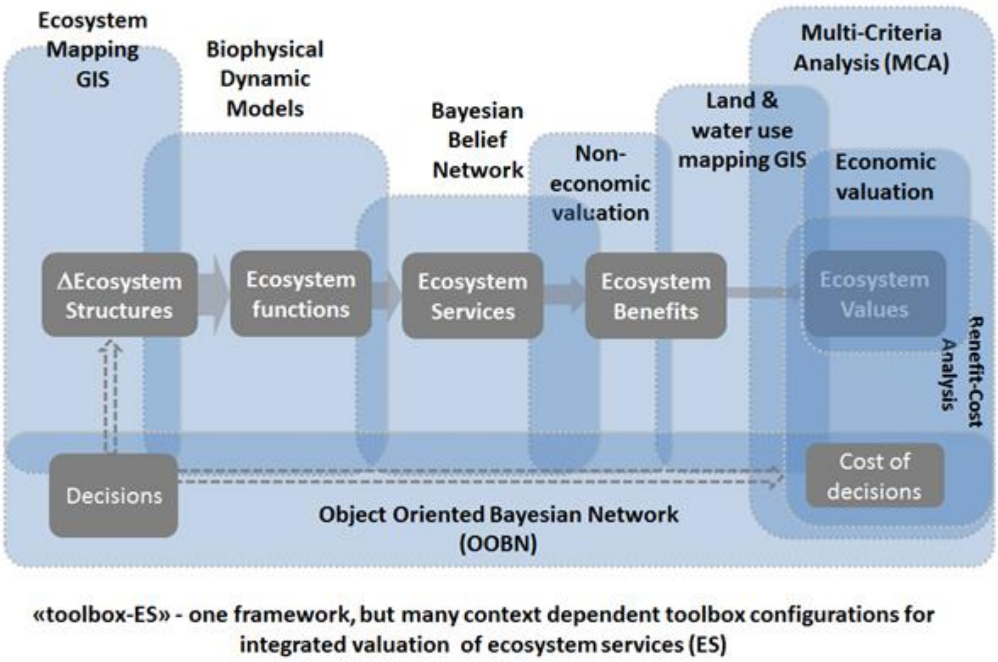


Figure 7.2 Methods and Tools across the TEEB / CASCADE model (Source: Barton et al. (2014))

The tools are superimposed on the ecosystem services cascade. While MCDA is method for addressing trade-offs across plural values, 'meta-modelling' tools are needed to integrate across a cascade of ecosystem function and service sub-models. OpenNESS is testing the extent to which Bayesian belief networks can fulfil this integrating meta-modelling role. It is one example of an integrated valuation tailored for a specific case study. OpenNNES should provide others. The point with the example is to show that all the "blocks" in the IV framework are covered.There should be other examples that show that IV can be done in different ways depending on the decision context.The combination of tools is ad hoc and tailored to meet specific needs of a case study on eutrophication modelling (Barton et al. forthcoming). As the subtitle suggests, the tools can be placed in the framework dependent on the context. However, in all cases, the Integrated Framework Criteria need to be adhered to. For example, the diagram does not show the spatial and temporal differentiation and the different stakeholder groups which are crucial in addressing the ecosystem and service based utilitarian and non-utilitarian values.

7.4 Conclusions

The dimensions of the Framework (see figure 7.3) were identified in Figure 2.1 . In the Cube, spatial and temporal heterogeneity of the natural system are 2 axes; the 3rd is constituted by the phases of bringing knowledge into society and thus into decision-making, with requirements as to accuracy and reliability, with associated costs. This is the structural aspect of the Integrated Valuation Framework.

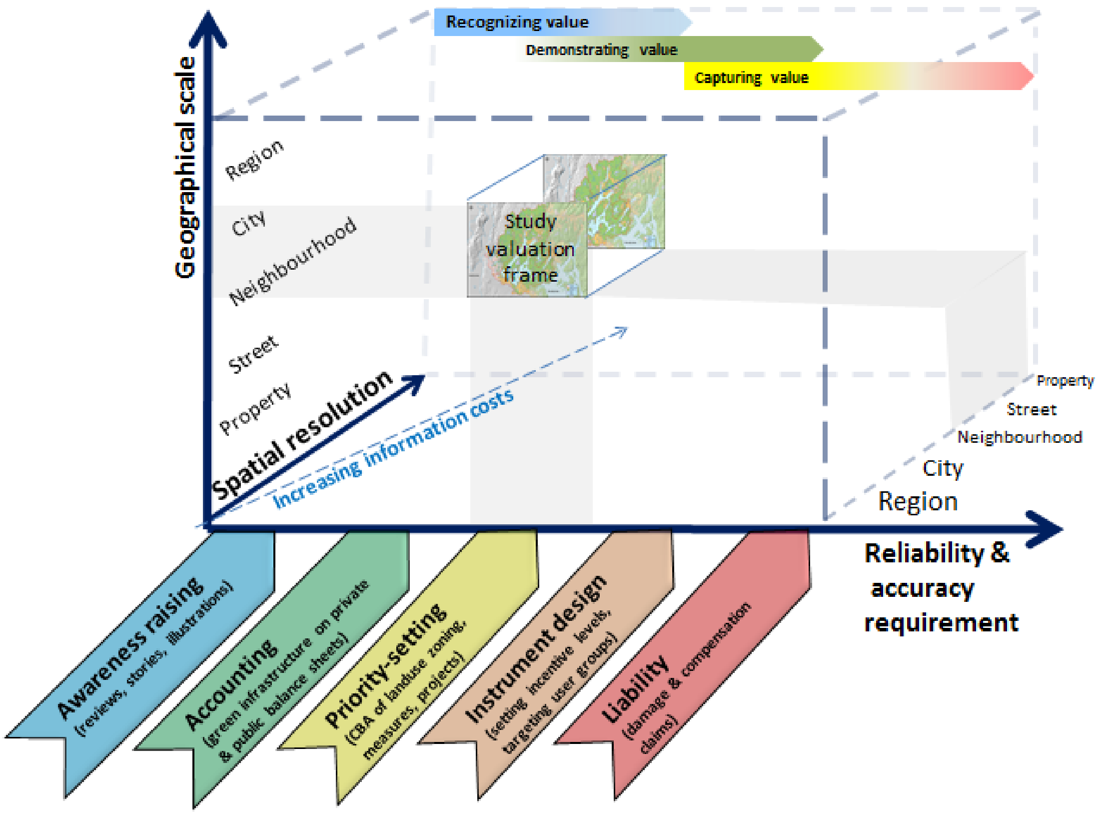


Figure 7.3 (is figure 2.1) Source: adapted from Gómez-Baggethun and Barton (2013)

The next figure (7.4, which is already presented as figure 1.1.) shows the procedural aspect of the Integrated Valuation Framework. It illustrates that in(1) complex decision situations, involving ecosystems and their services, a series of steps need to be taken, involving (2) the establishment of biophysical data on the ecosystems and (potential) services which are the basis of the production of economic and cultural values (for individuals and groups) , (3) the socio-economic aspects of the systems must be determined, including the composition and position of the stakeholders, to be able to develop transparent and reproducible value assignment processes (4). The final step, the integration of values can be a mere technical exercise where monetary values and non-monetary values (preferences, rankings) are combined in cost-effectiveness, and mixed cost-benefit analyses, or, more useful in the real world, they can be related to preferably specific and quantified objectives (of individuals, groups and society in a hierarchy).

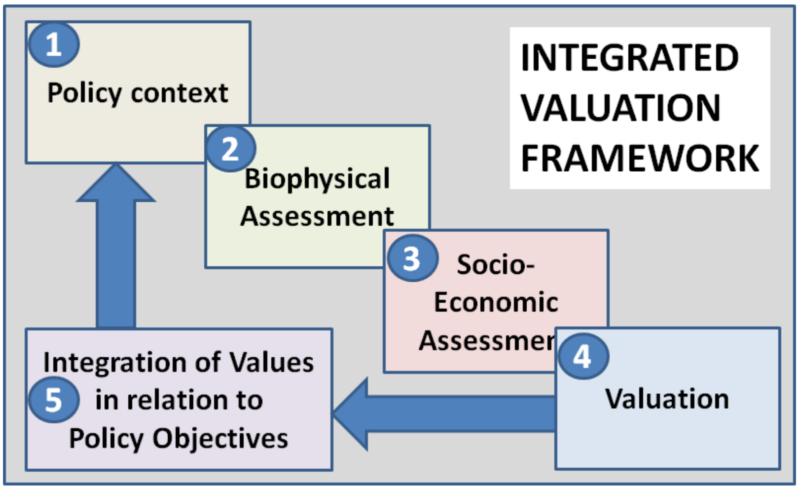


Figure 7.4 (is figure 1.1)

The Third aspect of the Framework is the set of criteria by which a evaluation process can be developed or checked for completion regarding the dimensions of Integrated Valuation .

Criterion 1: Policy & Management relevance:
The Integrated Valuation framework is designed to have Policy and Management Relevance.

Criterion 2: System Approach:
The assessment of values requires a multi-scale system approach in which relevant social strata (individual, group, society) and scales (temporal, spatial) are addressed in a causal chain of production and valuation of ecosystem based benefits.

Criterion 3. Value plurality:
Integrated valuation will address different value dimensions (economic, cultural) as perceived and held by the valuators (individuals, groups (e.g. stakeholders), society), **and** identifies conflicts of interest across these different value dimensions and among stakeholders.

Criterion 4. Value heterogeneity (context dependency):
Values vary across the time and space (location) of decision contexts, and the location and time at which people are asked to express those values.

Criterion 5: Inter- and transdisciplinarity:
Integrated valuation typically involves an interdisciplinary effort comprising multiple expert domains from both the social and the natural sciences, as well as place-based expertise.

Criterion 6: Levels of societal organization:
Integrated valuation covers and identifies values emerging at different levels of societal organization, from individuals, to communities, to nations in a systematic, hierarchical, nested model.

Criterion 7. Consistent "scaling" of plural values:
Any valuation requires *scaling*. The identification of ecosystem services requires some form of importance scaling (*specific to the action context of a subject)*.

Criterion 8: Consistent comparison of plural values in decisions:
Integrated valuation informs and supports decision-making processes on the basis of a transparent cause-effect model, and identifies the consequences of assigning different weights (by valuators and decision makers) to different types of values.

In the OpenNESS project, we aim to use, test and further develop this framework in case studies, via a set of specific guidelines, which will be presented in Deliverable 4.3

Debate Issue 7.1

We must realise at this point in the OpenNESS project that we are experimenting with ideas, and have the Case Studies to test them, next to the case studies already done, and described in the professional literature.

We have described an Integrated Valaution Framework which Integrates (a) values as they are produced along the causal (cascade) chain and (b) values as they are assigned by people in different social contexts (individual, group, society) and different geographical and temporal contexts (local, short term to global, long term).

We now need to show how combinations of monetised and non-monetised values can be effectively linked to policy ambitions that may exist in these contexts.

It is proposed that the leading motto is to have a comparative table of specific values of the benefits resulting from relevant (bundles of) ecosystem services versus so called SMART (Specific, Measurable, Acceptable, Realistic, Timely) policy objectives. Can we provide an indicative example of what such a table would look like? I cannot envisage it clearly. There are too many contexts to deal with. Ultimately we can then test the generated table against the Integrated valuation Criteria

Debate Issue 7.2

- Maybe include some axes, trying to guide the criteria in which the gradient is represented. Maybe in terms of ecological functions complexity and from quantitative to qualitative (Similar to Daniel et al. 2012 Contributions of cultural services to the ecosystem services agenda)
- Another criterion could be in terms of the ecosystem service type, even temporal and spatial scale? Of course, some services are better represented maybe at a local scale (soil fertility) meanwhile others are more global (climate regulation). However, these ecosystems services do occur together in bundles generated by some ecosystem.
- At the same time, we could think on Ecosystem service production and coproduction. In this sense, we could define at least the “priorities in terms of assessment methods to different ecosystem services”.
    - Maybe for a regulating service first use a biophysical method, or in case it is in a vulnerable state I would analyze its actual consumption or demand.
    - Some other services are more co-produced, like cultural services, which have a lower dependence on nature systems but more on social systems would need to be measure from the social side.

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