OpenNESS

Operationalisation of Natural Capital and Ecosystem Services

Preliminary conceptual frameworks for the analysis of ES and NC in relation to the four challenges, and how these issues can be communicated and resolved in difference place based-contexts

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SEVENTH FRAMEWORK PROGRAMME

From concepts to real-world applications

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Executive Summary

OpenNESS aims to operationalise the concepts of Natural capital (NC) and Ecosystem services (ES) and to examine how they link to, and support, wider EU economic, social and environmental policy initiatives. WP1 focuses on the conceptual frameworks that underpin this broad aim. If these concepts are to be successfully used then methods must be theoretically robust, relevant and easily understood by those seeking to apply them. Moreover, in a consortium as large as OpenNESS, a common understanding of the core concepts is essential if an integrated approach is to be achieved. The development of appropriate conceptual frameworks will help achieve the kind of shared vision that is required.

The work in OpenNESS has been designed around four 'operational challenges', namely to examine the:

- potential of the ES and NC concepts for promoting **human well-being** in different geographical contexts;
- contribution of the ES and NC concepts to strategies for **sustainable ecosystem management**;
- relevant of ES and NC concepts to notions of **good governance**; and,
- the role of ES and NC in supporting EU **competitiveness** at different geographical scales.

Although the challenges partly overlap, they were devised as a way of helping to clearly identify and communicate the way in which the concepts of ES and NE could be 'mainstreamed' in management and policy. The challenges are clearly significant ones, and any final conclusion about them or how to respond to them must wait until the end of the project. Nevertheless, it is important to consider them from the outset so that the different strategies for exploring them can be discussed (Milestone 1, M12). In particular we need to understand how they are linked conceptually, and what the implications of interactions between them are. In this document we review what each challenge entails and how they link to conceptual frameworks.

This document presents our preliminary findings on the question of whether a common conceptual framework can be developed for the OpenNESS project. In order to defining the scope of the task, the analysis considered why conceptual frameworks are useful, and therefore what kinds of role they needed to play in OpenNESS. Conceptual frameworks are valuable as a way of help people to understand and clarify complex ideas, as a device for structuring and prioritizing work, and as a communication tool that can encourage the involvement of different stakeholders groups in a programmer of work. Our review of the needs of OpenNESS suggests that all these features are important for the project.

The 'cascade model' was used as a starting point for discussion, because it captured something of the trans-disciplinary nature of the work on the four challenges. We found that to a large extent ideas about these areas of concern could be accommodated by modifying the cascade in various ways, but that given their overlapping nature there was a need to retain a common framework. The cascade was further tested in a practical way with case study partners, and this confirmed the adaptability of the model, and the basis it provided for discussion. Our analysis of the outcomes of this work suggests that the process of building a conceptual frameworks is probably as important as any final product, in terms of social learning, and so we recommend a deliberative approach is continued in the next stages of the work. An important additional finding to emerge is that to accommodate the challenges within the cascade model explicitly, it is useful considering them as 'outputs' or 'performance characteristics' of the socio-ecological system represented by the cascade, and then use the latter to trace the implications of different kinds of relationship for a given situation. This strategy may overcome the problem that there may not be a single conceptual framework that meets all requirements. An exploration of this idea will also be a feature of the next stages of the analysis.

1. Introduction

The aim of this document is to stimulate discussion of the conceptual frameworks that underpin the 'Four Challenges' that are a focus of OpenNESS. The Challenges are to examine ecosystem service (ES) and natural capital (NC) concepts to:

- promote **human well-being**;
- contribute to **sustainable ecosystem management** by maintaining and enhancing a sustainable flow of a broad range of services, and preserving their ecological value and biological diversity;
- promote more effective and inclusive ecosystem **governance**; and,
- increase **competitiveness** by encouraging innovative activities and processes in society.

They were devised as a way of helping to identify and communicate the way in which the ideas of ES and NC could be 'operationalised' or 'mainstreamed' in management and policy. They were also intended to capture important and relevant issues that directly impinge on current approaches to how we factor nature into our decision making.

The successful mainstreaming of ES and NC can only be achieved if we approach these issues from a secure science base. In this document we therefore review what each challenge entails and suggest how they might be conceptualised so that decisions can be as well-grounded on evidence as possible. The fundamental question then is as to whether the four challenges can be viewed through a single conceptual framework or if they pose such particular issues that each has to be approached in specific ways.

The overall aim for WP1 is to advance the conceptual understanding of ES and NC and provide operational frameworks for the application of the concepts in real-world management and decision-making situations. It sits on the left hand side of Figure 1.1 and will explore what constitutes the "OpenNESS approach" which is based on and iterative cycles of methodological development linked to application in case studies

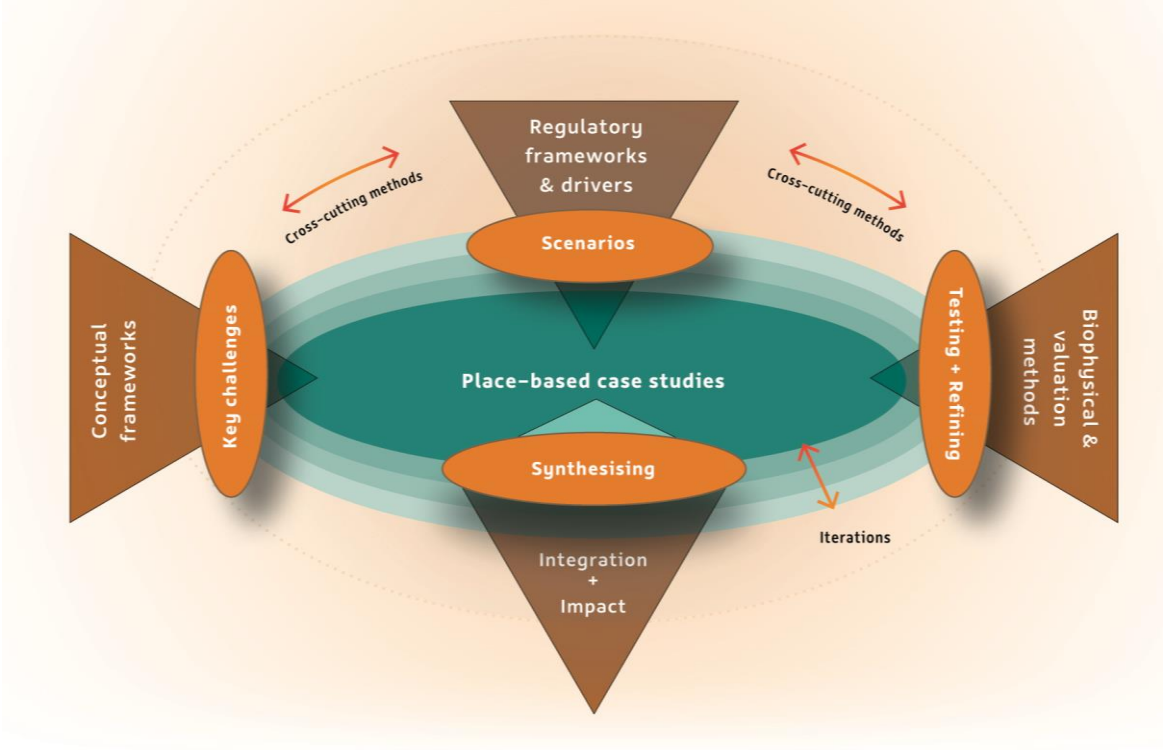


Fig. 1.1: The "OpenNESS-Approach" (modified according to OpenNESS Dow, p.12)

1.1 The Role of Conceptual Frameworks[1]

Conceptual frameworks (CF) are used in science in many different ways, and so in OpenNESS it is important to be clear what we are expecting them to do. Some of the issues are illustrated by the debates that shaped the conceptual framework for the Intergovernmental Platform for Biodiversity and Ecosystem Services (IPBES[2]). The discussions identified four distinct roles that conceptual frameworks can play. It was suggested that they can be seen as a:

1. tool that can help to make complex systems as simple as they need to be for their intended purpose;
2. device for structuring and prioritizing work;
3. way of clarifying and focusing thinking about complex relationships, thereby supporting communication across disciplines, knowledge systems and between science and policy; and,
4. common reference point that encourages buy-in from different stakeholders groups.

Although the aims and objectives of OpenNESS are obviously very different to those of IPBES, these four themes are a useful starting point for our work.

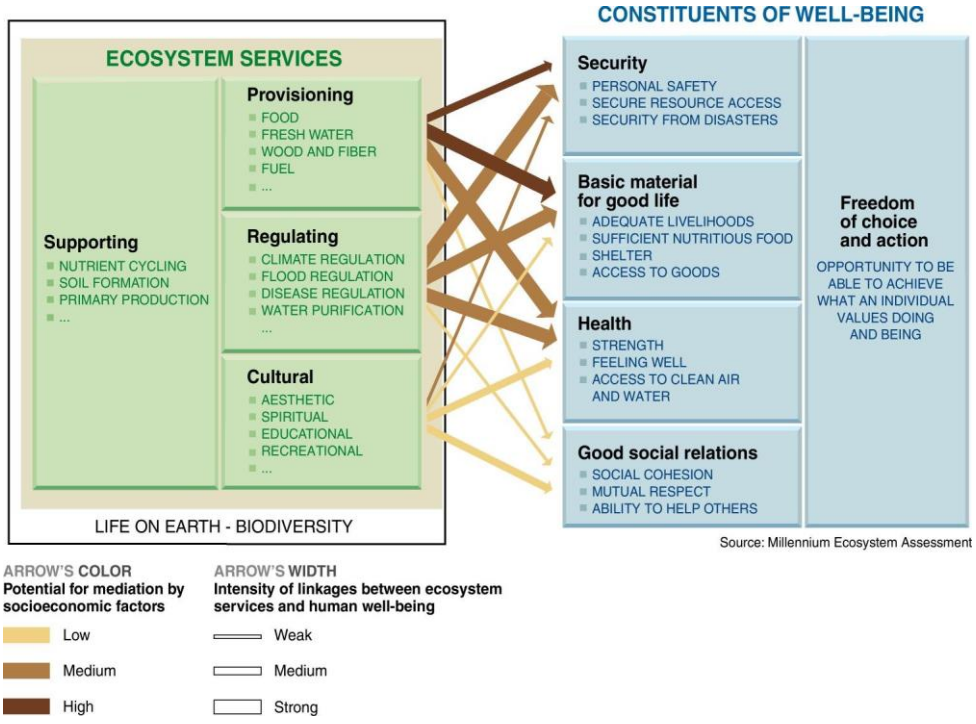
The Millennium Ecosystem Assessment (MA) (2005) described ecosystem assessments as a 'social process' through which scientific evidence about the causes of ecosystem change and their consequences for human well-being are identified, so that appropriate management and policy options can be developed to support the needs of decision-makers. Clearly, if the science and policy communities are to be brought together in a joint 'problem focussed' enterprise, then some kind of shared vision or common reference point is essential (as often required for transdisciplinary research in general; see Jahn et al., 2012). The design of a conceptual framework to represent this collective understanding is clearly a strong theme amongst those identified in the IPBES discussions.

That science and policy communities can become engaged in a social process defined by an agreed or accepted conceptual framework is not only to be seen in the context of ecosystem assessments. Indeed it is a manifestation of the fundamentally 'paradigmatic' character of science. Kuhn (1962) has argued, for example, that for long periods much scientific work can be seen as working within a shared world view, or paradigm. Such paradigms define main concepts within the field and the relationships between them. They also identify the problems that legitimately need to be solved, and hence serve to prioritise and structure work.

[1] This chapter is based on work within OpenNESS but also refers back to work done by Potschin and Haines-Young outside OpenNESS and currently forms the basis of a paper: Potschin, M, Haines-Young, R., Loft, L., Jax, K. and C. Görg (in preparation)

[2] http://www.ipbes.net/, e.g. document on conceptual frameworks (IPBES, 2014)

Figure 1.2: Ecosystem Services and Human Well-Being (MA, 2005)

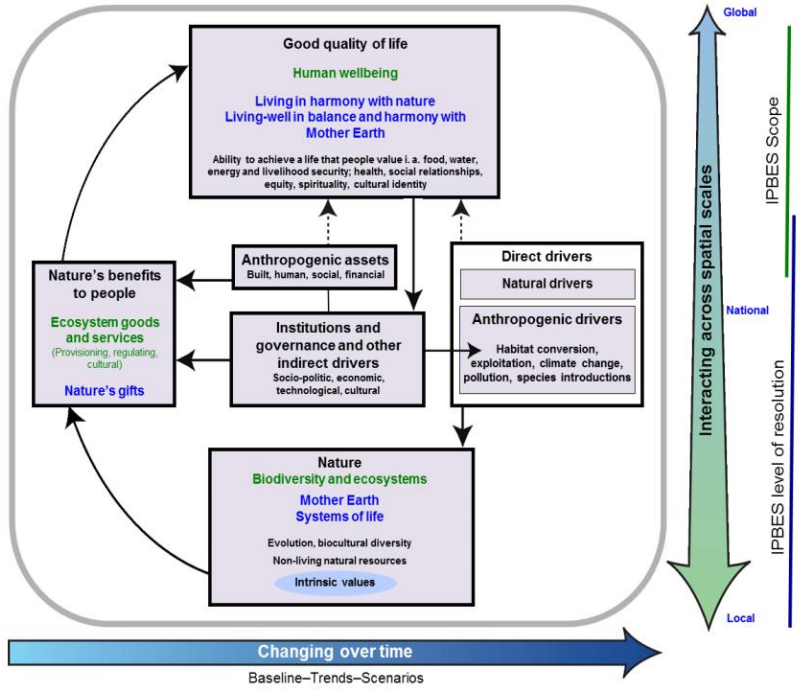


There are many features of the contemporary ecosystem service debate that echo Kuhn's account of science as a social process (cf. Potschin and Haines-Young, 2011), not least the iconic nature of the diagram generated by the MA that links different ecosystem services and to the various components of human well-being (Figure 1.2). As the subsequent development of the conceptual framework for the IPBES showed, the accommodation of different cultural perspectives and languages in one framework was seen as a key, continuing task. Reporting on the debates within IPBES, Vadrot (2014) and Brand and Vadrot (2013) have noted that some participants in IPBES expressed worries about the emphasis that the 'western perspective' placed on the economic value of ecosystem services, and the resulting framework better reflects the 'dual character of natural capital', that is the contrast between the view that nature as a 'product' and nature as a 'provider'. The duality is reflected, for example, in the alternative terminologies that are used to define the different components of the currently agreed IPBES conceptual framework (Figure 1.3); the inclusion of notions of 'mother earth' as an equivalent to biodiversity and ecosystem services highlights the way in which the conceptual framing of IPBES differs from that of the MA while acknowledging cultural differences between science and other knowledge types.

To the extent that OpenNESS is also a multi-partner project, albeit on a different scale to IBPES, then it too may need some kind of conceptual framework around which its work can crystallise. However, while frameworks such as that suggested for IPBES can represent something of the Project's shared understanding, there are important differences, mainly arising from the goal of OpenNESS to move beyond conceptualisation to *operationalization*. This goal seems to demand that any conceptual framework must not only be a communication device but also a tried and tested *analytical tool* to be *ready for implementation*.

The theoretical character of conceptual frameworks is easily overlooked in the list of key characteristics suggested by the early IPBES discussions, but it is one that has to underpin all other purposes for which they

Figure 1.3: IPBES conceptual Framework (IPBES, 2014)



are used – at least if the discussions are to be 'science' based. Theories and models are *primarily* means by which the world is simplified and complex relationships represented, but we do this not just to communicate ideas but to enable these ideas to be *tested* more effectively. If we are to provide and communicate an evidence base on which decisions can justifiably be made, then we must ensure that whatever conceptual frameworks we use are both *testable*, in terms of the propositions that they make about the way the way in which socio-ecological systems work, and be well *tested*. In other words when designing conceptual frameworks we must recognise their hypothetical character and be prepared to challenge them by exposing them to both empirical evidence and the experience of practical application.

There is a potential tension between the objectives of constructing conceptual frameworks to promote shared understandings and 'buy in', and those dealing with the theoretical relationships between key concepts. The methodological and especially the theoretical aspects of conceptual frameworks do not always sit easily with the needs of CF as communications tools, if we see them as provisional and open to challenge. It is, in fact, on these grounds where many (e.g. Popper) would depart from the description of science as a social process focussed around some paradigm, and argue that despite holding a common view of the world, the primary task for the research community is to criticise and potentially refute these theoretical propositions.

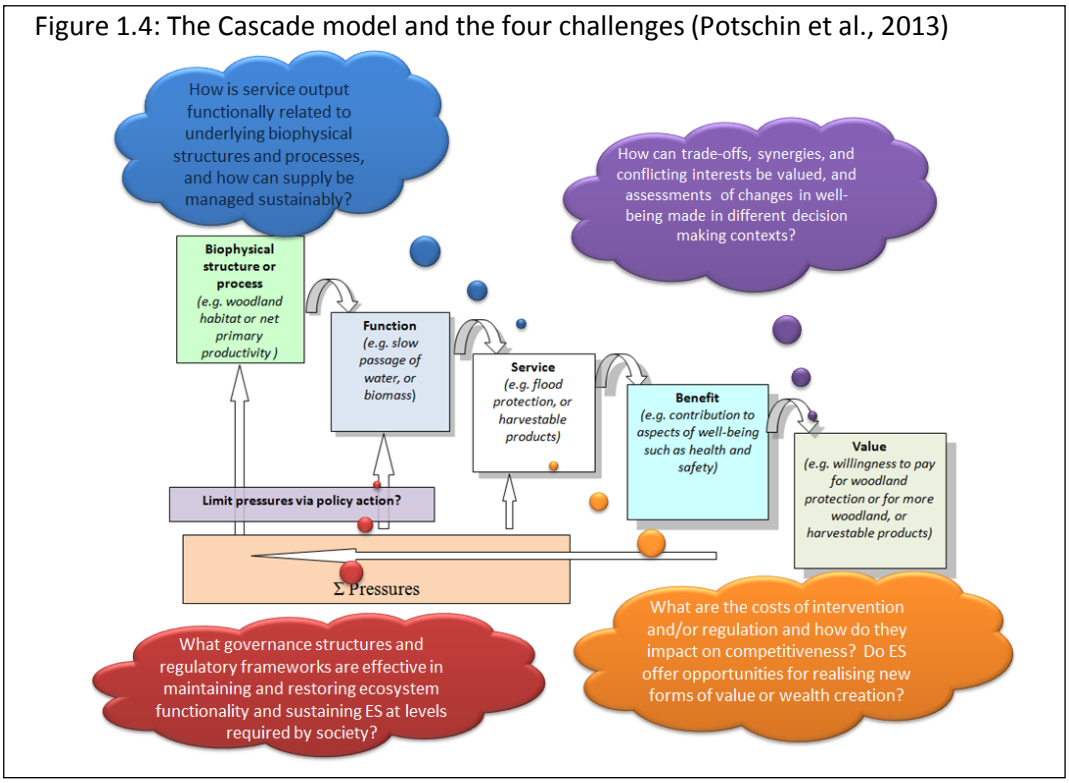
The requirement that we should make our conceptual frameworks testable *and* be prepared to test them, may seem obvious to natural scientists, but for those who stress the importance of participatory processes, the co-construction of conceptual frameworks and the conversation this process generates, may seem equally important. Both perspectives are, of course, valid, and so if we are to navigate successfully between them, then the purposes for which conceptual frameworks are being developed and used must be made clear.

While some with a social science perspective may find the idea of testability rather restrictive, there are grounds to suggest that it should not be dismissed too casually. If the goal of OpenNESS is to operationalize the ES paradigm, then this will mean finding general understandings and ways of transferring knowledge between different problem situations. Whatever 'evidence based decision making' involves it must include the appeal to 'experience' and judgements about what worked where, etc. and where limitations of current thinking were apparent. These are both theoretical and practical issues. The need to establish 'shared understandings' must not, we suggest, lapse into some kind of relativism, were what is regarded as legitimate or useful knowledge is simply contingent on particular sets of circumstances.

1.2 The Cascade Model as a Conceptual Framework: Meeting Policy Needs

The cascade model (Figure 1.4) has been proposed as an initial conceptual framework for OpenNESS. It was selected not because it was thought to present a complete picture of what the project involved, or sought to do, but that it captured something of the trans-disciplinary nature of the work and how the four 'OpenNESS Challenges' relate to each other. In particular it was used to highlight the key policy concerns of OpenNESS.

Figure 1.4: The Cascade model and the four challenges (Potschin et al., 2013)



At its most basic, the cascade model meets many of the requirements for a conceptual framework that IPBES listed: For example, it defines what we mean by a final ecosystem service, and what we mean by the interface between people and ecosystems. It also provides a framework in which we can pose particular questions arising from the relationship *between* the different elements. Moreover, it implies that if we want to *apply* the ES paradigm, we need to populate *all* the boxes – otherwise we are simply back in our traditional disciplinary silos. One of the things claimed in a sense with the cascade model is that it is the relationship between these five things that count in terms of solving our questions about how people and nature are connected – a theme that has shaped the design of OpenNESS.

When first proposed the cascade model was designed to help non-specialists (especially policy customers) understand the concept of ecosystem services, and what it might mean for their work. If we are now to take this to an operational level within OpenNESS, then we need to understand and analyse the relationships between ecological structures and processes, functions, final services, goods and benefits, and values more fully, and indicate how natural capital is represented within the framework. Moreover, we need to understand and explain how these relationships change in different contexts. For example, we need to understand how the relationships change across scale, from the landscape scale up to the European scale of mapping and valuation (Hauck et al., 2012). We also need to understand how trade-offs and synergies

between services and benefits arise when dealing with *multi-functional* ecosystems. The cross-sectorial issues that arise in the context of these multi-functional ecosystems are perhaps the key policy dilemma that we face in using an ecosystem approach in decision making.

Recognition of the importance of 'place' has emerged in recent discussions about approaches to making an ecosystem assessment (Potschin and Haines-Young, 2013). It is argued that place is important because it sets the context in which people assign values to particular ecosystem service outputs and stresses that these values will change as we move from one place to another. While the place-based idea is important because it encourages us to look at the bundles of services that are available and hence the synergies and trade-offs that occur between them, has it dangers if it traps us in the study of the unique. A conceptual framework, such as the cascade, can be used to organise and represent knowledge about different places in a unified way. They can potentially help us quantify the relationships between the main components of socio-ecological systems more systematically. As a result such frameworks can help us identify and apply general understandings to the particular circumstances that decision makes often have to deal with.

It may be difficult to develop one conceptual framework that is both theoretically rich and an effective communication tool. Thus in OpenNESS we need to consider what the options are, and what works best in different situations. If the concepts of ecosystem services and natural capital are to be successfully operationalised, then we also need to understand the limitations of our knowledge about socio-ecological systems and therefore what knowledge gaps remain.

1.3 Linking conceptual frameworks to the four challenges

Although OpenNESS has been framed around 'four challenges' it has always been recognised that they are partially overlapping, and that each has implications for the other. Thus, for example, ensuring that an area is 'competitive' in environmental terms will also have implications for human well-being, in terms of securing 'prosperity'; similarly the sustainable management of environmental resources will have implications for human well-being in terms of 'security' etc. In the context of these examples, both might only be achieved if appropriate modes of governance are established.

The conceptual links between the four challenges was highlighted in the OpenNESS Milestone 1 Report (Potschin et al., 2013), where it was emphasised that it is important to consider these connections from the outset, so that an integrated view can be developed. The extent to which a common conceptual framework can be created that accommodates them all is therefore the stimulus to the work reported here.

Preliminary work on the links between the four challenges is summarised in Table 1.1. Further analysis of the connections in conceptual terms is provided in Appendix 1, which sets out how the concepts covered in the OpenNESS synthesis papers relate to the four challenges. In preparing the Synthesis Papers the authors were asked to identify the ways in which the concept was relevant to each challenge, and so these materials provide a first view of some of the commonalities between these different areas of concern. In the preliminary discussions leading up to the development of the IPBES conceptual framework, participants agreed what the key ideas were that need to be included (Table 1.2), namely: biodiversity, ecosystem goods and services, human well-being, decisions and institutions, and scale. The listing in Appendix 1 provides a foundation for the more specific discussions in OpenNESS. Thus as a first step toward developing some graphical representation of an 'OpenNESS Conceptual Framework', we need to identify what ideas need to be covered and how they are connected to each other.

Table 1.1: Links between the four OpenNESS Challenges

	Human Well-Being	Sustainable Ecosystem Management	Governance	Competitiveness	SP Source
Human Well-Being	self-evident	sustainable ecosystem management must be in accordance with the aim of fostering human well-being	Good governance must reflect the aim of enhancing human well-being and harmonise different interests and ideas of human well-being involved	Competitiveness concepts should include an accepted idea of a good life (human well-being). The role of human well-being as an aspect of competitiveness needs to be clarified.	Jax and Heink (2014, draft)
Sustainable Ecosystem Management		self-evident			Potschin and Haines-Young
Governance	How is HWB addressed (e.g. inclusion of a broad variety of cultural perceptions?) and balanced with other aims (e.g. biodiversity protection)?	Depends on inclusive and effective governance processes: what does it mean in practice? In what ways are different modes of governance benefit or frustrate management options?	How are normative considerations linked to the analysis of governance processes?	Represent a specific policy goal which must be balanced with other goals and must be addressed by appropriate processes.	Görg et al. (2014, draft)
Competitiveness	Regions that are attractive to inward investment (in economic and social terms) are likely to be more prosperous and secure in the long term.	Stable environments are a pre-requisite for investment, to the extent that sustainable management ensures resilient communities then it is also a pre-requisite for competitiveness	Governance might be essential in terms of promoting virtuous development cycles necessary for maintaining and developing the attractiveness or regions.	self-evident	Haines-Young and Potschin

Table 1.2: The 'Ingredients' of the IPBES Conceptual Framework (UNESCO, 2013)

Biodiversity and ecosystem functioning:
Biodiversity and ecosystem functioning play multiple roles in underpinning the quality, quantity and resilience of ecosystem services, in providing the raw material for adapting to change, as well as in providing direct benefits and having particular meanings to people.

Ecosystem goods and services
These are the benefits that flow to people from ecosystems. Their delivery is dependent on biodiversity, ecosystem functioning and other forms of wealth a society possesses.

Human well-being
Human well-being is multi-dimensional and dependent on access to and changes in bundles of goods and services and is context specific with preferences for constituents of human well-being varying across individuals and societies.

Decisions and institutions
Decisions both influence and are influenced by institutions, and can become key indirect and direct drivers of change, thereby affecting interactions among biodiversity, ecosystem functioning, ecosystem services and human well-being.

Scales
A conceptual framework for IPBES might consider the properties and processes that occur at different scales of space, time and governance, as well as the interactions across these scales.

1.4 The purpose of this deliverable

In the remaining parts of this document we will explore role of conceptual frameworks in relation to the four OpenNESS challenges. In particular, we seek to explore the adequacy of the cascade model in relation to the challenges, both as communication device and an analytical approach. The key questions that need to be addressed in each section are therefore:

1. How we can communicate the issues that surround the four challenges most effectively, and are there common themes and elements that run across all of them? Is the cascade model sufficient?
2. To what extent does the cascade model, or any alternative, embody and operationalise important theoretical insights in relation to the challenges?
3. Are the conceptual frameworks that we propose in relation to the four challenges really testable? In other words, do these conceptual frameworks enable us to set up empirical observations and collect data, that would enable us to challenge the story they tell, and so, by discovering their shortcomings develop, new and better ones?

The purpose of this introduction has been to suggest that if we want to address the task of discussing and developing conceptual frameworks for OpenNESS then we have to be aware of what they represent. In developing the ecosystem service paradigm it is clearly important for the research community to find some common view of what the issues are, and how we go about solving them. The development of a clear and theoretically rich conceptual framework is an essential first step.

In taking this work forward, it is important to note that this document is an initial step, and the conclusions we draw here are preliminary ones; in terms of the OpenNESS work programme we are only 18 months into a 54 month process. The achievement of the early work that has led up to this document include the agreement by the partners that the cascade is a useful starting point for discussions, an initial test of its applicability to all the case studies (see, for example section 6.3).

This document therefore reflects WP1's early thoughts on the four key societal key challenges in the OpenNESS research process and provides some initial ideas on the links between the four challenges and conceptual Frameworks. It will be revised for Deliverable 1.2 (due month 45; August 2016).

2. Ecosystem Services and Natural Capital and the promotion of well-being

2.1 The place of human well-being in the OpenNESS Conceptual Framework

Human well-being is a central component of the ecosystem services framework and in fact its major endpoint in terms of at what ES aims at. The Millennium Ecosystem Assessment (2003) put the relation between ecosystems and human well-being at the core of its thinking (see Fig. 1.1). It further emphasised that human well-being goes beyond economic wealth and included dimensions such as health or good social relations. The concept of human well-being, in fact, is seen as the pivotal link between human society and nature, because it highlights the relationship between environmental issues and other factors that influence individual and societal well-being, such as income, infrastructure, culture, or the financial system. Further, by linking ecosystem services to human well-being it clarifies their dependence on societal choices and the needs and interests of individuals or groups. This proposition leads *inter alia* to the assertion of Polishchuk and Rauschmayer (2012, p. 109) that 'identifying the ways in which ES contribute to human well-being essentially depends on how we define human well-being in the first place'. Thus the question of what is meant by, and what specifically constitutes, human well-being, is of major importance in any application of the ES concept (Summers et al., 2012). Within the cascade framework, which is the basic point of departure for the OpenNESS CF, human well-being links specifically to benefits and values, but indirectly also determines the very idea of what – especially in specific place-based applications – constitutes an ES. In order to explore the empirical links between ES and human well-being, it is evident then, that a clear understanding of the concept of human well-being, and methods to operationalise it, has to be developed.

As we develop ideas about human well-being, it is important to note that it is intimately linked to the other three OpenNESS challenges discussed below (see above and also Chapter 6.1 of this report), as, for example, (good) governance or increasing competitiveness *ultimately* aim at securing (or increasing) human well-being. To be consistent within the ES framework, for example, competitiveness concepts should include an accepted idea of a good life (human well-being). Thus any framework for human well-being developed here, must, as far as possible provide a platform for developing out thinking in these other areas within OpenNESS.

2.2 State-of-the-art: exploring the well-being challenge

There are already many and elaborate studies on conceptualising and operationalising the ecological and economic aspects of the ES concept. The concept of human well-being, however, and especially the social component of ES, remains rather vague and underdetermined in the literature. In other fields beyond the environmental sciences, however, such as psychology, philosophy, social and political science, extensive and interrelated debates exist on what human well-being can and should mean, how it could be measured, and how these insights could be made practical, especially in development research. These debates have, however, only rarely been linked to ES, if at all.

The MA characterised human well-being by means of five major components: materials for a good life, security, health, good social relations, and freedom of choice and action. These categories were derived from an empirical study commissioned by the World Bank ('Voices of the Poor'; Narayan et al., 2000) in which

(poor) people from 23 developing countries were asked about their ideas of a good (and bad) life (MA, 2003, p. 74). However, the MA did not discuss or develop the literature on this issue further, and this situation has not changed much in subsequent publications on ES (see also below). Most of the existing treatments of human well-being in fact do not deal with environmental concerns but were developed from perspectives emerging form psychology, sociology, economics, anthropology, ethics, and/or in the context of human development and poverty reduction, with poverty sometimes broadly defined as the "inverse" of human well-being.

Human well-being is both an ambiguous term and a multifaceted concept (Gasper, 2007). Related – although not always identical – concepts are e.g. those of the "quality of life" or "human welfare". Good overviews on the different ideas involved in describing human well-being have been given by Alkire (2002) and by Gasper (2007) (see also McGillivray, 2007). Gasper (2007, p. 30ff.) discusses and further develops a classic distinction of three conception of human well-being: hedonism ("well-being seen as pleasure"), desire theories ("well-being as preference/desire fulfilment"), and "objective list theories" (providing lists of the "elements that make a life well-lived", including theories of eudaimonic approaches in the tradition of Sen's and Nussbaum's "capability approaches").

Several indicators of human well-being have been developed, sometimes related to efforts to creating overarching metrics for human well-being, often as an 'antidote' to classical welfare indices such as GDP, which are perceived as being too narrow from both societal and environmental perspectives (Vemuri and Costanza, 2006, Summers et al., 2012). Significant examples here are the Human Development Index (HDP) or the Genuine Progress Indicator (GPI). The European Union has supported a study investigating means of measuring well-being and its importance for European social policy-making (Theodoropoulou and Zuleeg, 2009). The French Government also initiated a commission on the [alternative] "Measurement of Economic Performance and Social Progress" (Stiglitz et al., 2009); other studies on a European level are pursued and collected in the course of the Beyond GDP-initiative (http://www.beyond-gdp.eu).

Significant attempts to relate human well-being and/or quality of life to environmental dimensions have been made by Dasgupta (2001) and Costanza et al. (2007). Currently the most comprehensive review of the elements of human well-being in the specific context of ecosystem services is provided by Summers et al. (2012). They identify a set of strongly interrelated dimensions of human well-being different from the MA, namely: basic human needs, economic needs, environmental needs, subjective happiness. Happiness here refers not simply to a hedonistic well-being but to the idea of eudaimonia, (a good and flourishing life, not simple pleasure fulfilment as in hedonism), which also includes acting in a self-responsible (and even socially responsible) way. The latter idea has increasingly gained importance in the environmental ethics literature, and is significant because it has moved the discussion on from a dichotomy between a utilitarian vs. an intrinsic perspectives on nature (specifically with respect to ecosystem services; see Jax et al. 2013) to more comprehensive understanding of human-nature relationships (see also Muraca, 2011). In a similar vein, some authors (especially Ballett et al., 2013, Polishchuk and Rauschmayer, 2012) attempt to use the 'capability approach' of Sen and Nussbaum (Nussbaum, 2011) as a 'multidimensional framework' for analysing human well-being as 'an alternative to mainstream utilitarian and opulence frameworks' (Polishchuk and Rauschmayer, 2012, p. 103). A eudaimon(ist)ic conceptualisation of human well-being is especially (but not only) important when it comes to dealing with cultural ecosystem services (e.g. Chan et al., 2012), which is an important but still neglected field of ES research and management. At the same time, it can help to avoid a too narrow use of the ES concept, which could otherwise open up serious ethical problems (see Jax et al., 2013). One ethical problem that requires a better differentiation of human well-being relates to questions of

justice, namely whose well-being is at stake, and in which way the provision of particular services might effect the well-being of different social groups in different and even opposing ways (Daw et al., 2011).

While the recent literature, e.g. by Summers et al. (2012) has certainly started some useful discussion on conceptualising human well-being in the context of ES, this work has in fact just begun and needs further elaboration in an inter- and transdisciplinary discourse.

In fact, although the MA distinguished different components of human well-being (see above), the human well-being part of the ES framework was not developed much further. With very few exceptions (such as Summers et al., 2012; Polishchuk and Rauschmayer, 2012; Smith et al., 2013) explicit in-depth considerations on conceptualising and measuring human well-being in an ES context are largely missing. If at all, some more or less elaborate lists of components of human well-being are given in the literature on ES (e.g. Maynard et al., 2014), which are, however, not based on clear and theoretically sound ideas of human well-being. In very few cases, participatory approaches have been used to prioritise possible components of human well-being, based on the main distinctions given by the MA (e.g. Pereira et al., 2005).

2.3 Implications for the OpenNESS conceptual framework

A major task for the development of conceptual frameworks in relation to Challenge 1 is therefore to characterise human well-being in a clear way that can be measured and applied. This will be a precondition for assessing the links between well-being and ES in different contexts and at different scales, and for describing the evidence needed to map and analyse supply and demand relationships at different scales and in different contexts within Europe.

In the Conceptual Frameworks Briefing Paper elaborated by WP1 and presented at the OpenNESS kick-off meeting in Helsinki in March 2013 (Potschin et al., 2013, p.7), a preliminary definition of was proposed, namely that human well-being is that which arises from adequate access to the basic materials for a good life, that are needed to sustain freedom of choice and action, health, good social relations and security. While this is mainly based on the MA's characterisation of human well-being, the final conceptualisation in OpenNESS needs to go beyond the descriptions of the MA. As suggested above, it needs to use a broader, anthropologically, culturally, and philosophically substantiated understanding of human well-being.

As a next step, we suggest, following Alexandrova (2012, p. 697) a generic definition of human well-being for the project, namely to understand "human well-being" as *a state that is intrinsically and not just instrumentally valuable (or good) for a person or a societal group.*

Only from there we will move to more specific definitions. While a rigid specific definition of human well-being will neither be feasible nor useful, some characteristics of the concept, based on the above definition should guide the operationalisation of the definition. While this coarse scale definition should be binding for the whole project and be the basis for large-scale applications of the concept of human well-being, in place-based applications (see below) the specific components of human well-being will have to be determined together with the stakeholders. They must not contradict the general ideas but must leave room for place specific situations and cultural perceptions.

Two basic characteristics of the common OpenNESS understanding of human well-being should thus be:

- Human well-being should embrace both "objective" dimensions (such as basic material needs) and "subjective" dimensions (e.g. positive emotions, life satisfaction).

- Conceptualising and measuring human well-being is heavily dependent on specific cultural and social conditions. Especially in place-based applications (see below) this variety of conditions has to be taken into account by involving stakeholders into the operationalisation of the concept.

To account for these characteristics we opt for an approach along the lines of what Gasper (2007) called "objective list theories". The degree of specification on the general (large scale) level should, however, be rather low. The task here (to be tackled for Deliverables 1.2 and 1.3/1.4) is:

a) to develop, together with the consortium, a first short list of major aspects of human well-being, and,

b) to develop participative methodologies to fine-tune and weigh the relevant aspects of human well-being for place based studies, such as the case studies in OpenNESS.

The rich description of human well-being to be developed will also link to several ethical questions, namely:

- the relation of non-use values (and dimensions related to them in human well-being) to ecosystem services, a question that often arises in conservation, and specifically biodiversity, management (link to Challenge 2);
- issues of justice, in terms of weighing the different values and dimension of human well- being against each other, in order to address the question 'who decides?'; how can participatory elements be included in the definition of well-being? Questions of justice are part of most ideas of living a good life. This relates to WP2 (governance), WP 4 (evaluation methods) and WP 5 (relations between Europe and developing countries) as well as to positioning Challenge 4 in a broader context.

Testing the usefulness of the general concept of human well-being sketched above in an ES context and also a participatory approach to apply it in specific place-based situations is a challenge that should be tackled together with WP5 (and WP2), at least with some selected case studies.

In conceptual terms further open questions for WP1 involve to investigate more deeply the relations between the concepts of 'human well-being', 'values' and 'benefits', within the general conceptual ecosystem services framework, and also to the specific in more detail the place of human well-being within the cascade model (see also chapter 6.3). Currently the location within the model is only weakly specified, and so there is a need to further develop the framework.

At present human well-being is not explicitly referenced in the cascade model, but rather subsumed through the notion of goods and benefits, and values. Since ecosystem outputs and the values attached to them are likely to vary from one location to another, any conceptual framework must also take account of the influence of place. As said above, applying the concept of human well-being in place based context require to account for the specific social and cultural conditions of the region. Operationalising human well-being here must thus be linked to participatory approaches. This will require working closely with stakeholders, both in the case studies (WP 5) and beyond. Different aspects of human well-being, as well as different types of ES, will have to be dealt with on specific scales. While basic material needs (and provisioning services) will largely (but not always; see e.g. Polishchuk and Rauschmayer, 2012, p.106, and Hauck et al., 2013) be described across a range of scales from local to European, many other aspects will have to be handled at specific, local and regional scales. The latter will include things such as 'subjective happiness' and many cultural services (see Chan et al., 2012). This will obviously link to Challenge 3 and also to methods and data developed in WP 2, 3, and 4.

In terms of better representing the link to well-being and hence the relevance of the framework to this challenge, a recommendation that emerges from this discussion is that the cascade might be developed by: a) linking values and human well-being more explicitly, with values (understood as including more than just economic values) determining human well-being; and, b) emphasising the societal choices by which values and human well-being determine what constitutes benefits and final ecosystem services, i.e. by indicating that the cascade can be read from 'right to left' as well as from 'left to right'.

3. Ecosystem Services and Natural Capital and Sustainable Ecosystem Management

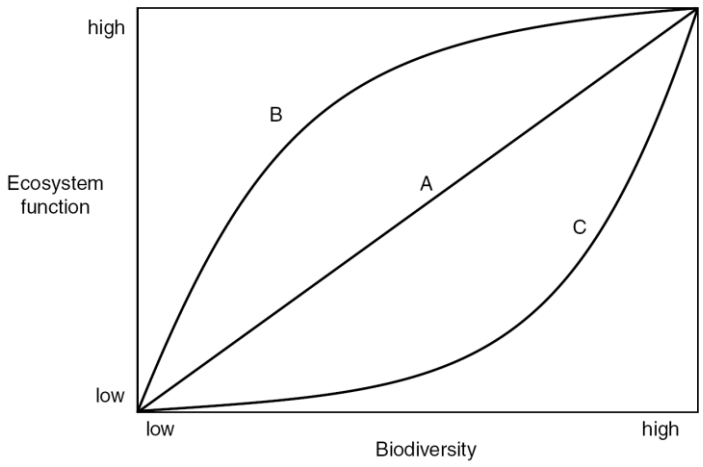
3.1 The place of sustainable ecosystem management in the OpenNESS Conceptual Framework

The extent to which the conservation of biodiversity and the sustainable management of ecosystem services are mutually supporting goals is an active area of debate within research and policy communities. On the one hand, the 'utilitarian perspective' on nature that seems to be embedded in the notion of ecosystem services had led some to question its value, because it seems to undermine arguments about the importance of conserving biodiversity *for its own sake* – whether it is useful or not (see for example, Mace et al., 2012). On the other, the complexity of the relationships between living ecosystem components, processes and the output of final ecosystem services, has meant that an understanding of how precisely the status of the underpinning ecological structures, processes and functions (i.e. biodiversity in its broadest sense) affects the contributions that ecosystems make to human well-being has been difficult to achieve. The cascade model (see Figure 1, and Potschin et al. 2013), for example, posits that the category of supporting services identified by the MA is best unpacked by differentiating ecological functions (or capacities) from ecological structures and processes, but an understanding of how these concepts can be used operationally is lacking.

3.2 State-of-the-Art: exploring the management challenge

A useful graphical representation (see Figure 3) of the dilemmas surrounding the relationship between biodiversity and the output of ecosystem services is provided by Schwartz et al. (2000) and Kremen (2005), who took stock of the evidence linking biodiversity and ecosystem function(ing) (see Jax 2010 for a clearer conceptualisation of the latter concept). They used the material to explore the implication of this work for the conservation debate. Schwartz et al. (2000) suggested that in order to argue that the conservation of biodiversity is important two conditions need to be met. We would need to show that the maintenance of

Figure 3.1: Potential relationships between biodiversity and ecosystem functioning (after Schwartz et al., 2000 and Kremen, 2005). For explanation see text.



ecosystem function and the output of ecosystem services are dependent on a wide range of *native* species. Moreover, while a number of different types of relationship between biodiversity and ecosystem function can be anticipated, we would need to show that there is a direct and positive association between some measure of biodiversity and ecological function. Thus in relation to the possibilities shown in Figure 3, there is an important difference between the curves A and B. With the former ecosystem function appears to be *highly sensitive* to variations in biodiversity, whereas in B, there is some kind of a saturation effect. In B there is, in fact, a rapid decline in ecosystem function at low levels of species richness, but that in more diverse situations there may be some kind of redundancy. The difficulty that a relationship like B poses is that if we can lose some level of biodiversity without eroding ecological function, then the conservation argument is potentially undermined. In contrast it would be greatly strengthened if the kinds of relationship shown in A or C were detected. Whatever type of relationship that exists, however, the models suggest that there is a certain minimum level of biodiversity that needs to be maintained if a particular level of ecosystem function is to be sustained.

The nature of the relationship between biodiversity and ecological function is likely to vary from one situation to another, and between different spatial and temporal scales. As a number of commentators have pointed out (e.g. Díaz et al., 2006; Jax, 2010) it is also likely to depend on how we characterise 'biodiversity' (see for example, Cardinale et al., 2012); do we take it to mean the variety of species or some other metric such as their biomass or productivity (cf. Balvanera et al., 2006)? Finally it is also likely to depend on whether we focus on a single ecological function or rather, consider the multifunctional aspect of ecosystems. In these situations there is evidence (see Hector and Bagchi, 2007; Gamfeldt et al., 2008) that while the saturation type of relationship is common, as we consider more and more functions, more distinctive groups of species emerge as significant.

Understanding the link between biodiversity and the output of ecosystem services is thus fundamental to realising the aims and objectives of OpenNESS. In the context of Challenge 3 (Governance), for example, we need to determine whether a focus on ecosystem services can contribute to the more sustainable ecosystem management, and if the maintenance of a sustainable flow of a broad range of services depends on conserving the ecological value and biological diversity of these systems. In relation to Challenge 4, competitive economies are also likely to be the ones that are most stable or resilient in the long term.

Within the field of biodiversity conservation, there have been attempts to integrate the traditional conservation of species and habitats, with ideas pertaining to ES and NC, and one major origin of the ES idea itself is in fact its use as an argument for species conservation (Ehrlich & Ehrlich 1981). On the practical level some studies have already reported on synergies between projects devoted to either biodiversity conservation or ES conservation (e.g. Goldman et al., 2008), but there are also justified concerns and examples where trade-offs occur (e.g. Ridder 2008, Reyers et al., 2012). A key task identified for WP1 is to review these models, identify common conceptual components, assess their contribution to sustainable ecosystem management and devise a new framework that can be tested through the case studies (WP5). The work will need to be integrated with that being undertaken in WP3, especially those aspects that concern the analysis of the structural and functional dependency of ecosystem service flows on natural capital stocks. The notion of natural capital stocks is implicit in the cascade model, in terms of the identification of ecological structures and their associated processes, however, it is unclear how this can be used analytically, and especially how these stocks are linked to service flows through some set of ecological functions.

The meaning of the 'function' box in the cascade has been the subject of some debate, especially during the preparatory stages of WP1 (see Potschin et al., 2013). A provisional definition was suggested, namely as *the subset of the interactions between biophysical structures, biodiversity and ecosystem processes that underpin the capacity of an ecosystem to provide ecosystem services*. It was noted that while this was consistent with the formulation in TEEB, which strongly reflected earlier work by De Groot et al. (2002), and the way it had been used to help define the service providing units (SPUs) in RUBICODE (see Harrison, 2010 and also Luck et al., 2009), there is ambiguity in the term for some audiences, which take it to refer to both 'processes' and 'purposes' (e.g. Jax, 2010; Bastian et al., 2013). In order to advance the state of the art, therefore, greater conceptual clarity is required. A valuable starting point will be the work proposed in WP3, which seeks to build on the research of Maes et al. (2012a, b) concerning the analysis of the spatial relationships between habitat conservation status and indicators for ecosystem function or capacity. This kind of analysis will also enable the link to the analysis of regulatory frameworks to be made. For example it has been suggested that in the context of the Water Framework Directive, it is assumed that achievement of a good status of ecosystems as required by EU environmental legislation will result in a higher potential supply and a higher effective delivery of ecosystem services, while at the same time securing the ecological integrity of aquatic systems. This is a proposition that can clearly be tested[3]. Through such work we may therefore begin to scrutinise how the concepts of ES and NC can obscure certain policy aims, such as biodiversity protection and/or the management of supporting services, as well as identifying where they can be productive in terms of fostering complementary approaches.

3.3 Implications for the OpenNESS conceptual framework

Ultimately, through the conceptual work in OpenNESS, we need to achieve a systematic understanding of how to characterise the relationship between different properties of ecosystems and the service outputs they support. A particular strength of the OpenNESS consortium is the expertise it has, through participation of its members in the EU FP6 project RUBICODE, in analysis of functional traits and their relationship to ecosystem services (see de Bello et al., 2010 and WP3). Elsewhere, in recent work by Lavorel et al. (2011) a new spatially explicit approach has been described that combines single ES models based on plant traits, and analysis of abiotic characteristics, to identify 'hot' and 'cold' spots of multiple ES delivery. The authors compare the trait-based approach with more traditional land-use approaches in a pasture dominated landscape in the French Alps, and show that it leads to improved understanding of ecological constraints and hence the opportunities for managing the delivery of multiple ecosystem services. More generally, other recent work by Kandziora et al. (2013) has used the cascade model to explore the interrelations between ecosystem properties, ecosystem integrity, biodiversity, ecosystem services, and human well-being qualitatively. In this work the concept of 'ecological integrity' is used to define a set of functions that could be aggregated and used as indicators of the service output. Elsewhere, Yapp et al. (2010) have suggested how assessments of vegetation type and condition can potentially be used as a 'surrogate' to define and map the performance of ecosystems in terms of their service delivery.

An interesting feature of the work by Lavorel et al. (2011) was the fact that they used participatory methods to relate ecosystem services to ecosystem properties according to indicators identified by stakeholders. Given that we have to understand better the extent to which ecosystem management is ultimately

[3] The EU FP7-funded MARS will investigate these relations further; see http://cordis.europa.eu/projects/rcn/110603_en.html

sustainable, some kind of engagement with potential beneficiaries seems essential. Thus while at the outset the analysis of biodiversity and ecosystem service relationships seems to be grounded in the natural sciences, current thinking suggests that it probably also has to be set in a social context. This point is made very forcibly by Bennett et al. (2009) in their discussion of relationships between multiple ecosystem services, in which they propose a typology that allows the relationships between ecosystem services to be classified according to whether they share common drivers, or whether they interact directly. They argue that by understanding the mechanisms behind these relationships will we be able to improve our ability to manage landscapes sustainably, and conclude by suggesting three propositions that can be used to take this kind of work further (Table 3.1). Their Proposition 1 arises from recognising that if we are to quantify the provision and use of multiple ecosystem services through space and time, then we need to understand how they are 'bundled together' and interact, and this can only be done by exploring the perspectives of the people who use or benefit from these services. Hence the need to approach the analysis of biodiversity service relationship from a *socio-ecological* perspective.

The second proposition suggested by Bennett et al. (2009) is focussed on synergies and trade-offs in bundles of services and highlights the importance of understanding how small changes in the relationships among services can be significant for management. This kind of analysis is highly relevant in the context of OpenNESS, which explicitly seeks to help decision makers evaluate management and policy options that are available to them. Such insights are essential if the goal of building resilient outcomes is to be achieved (Proposition 3, Table 1). They are also a vital component of the analysis being attempted under Challenge 1.

Table 3.1: Three propositions for managing relationships among ecosystem services (after Bennett et al., 2009)

Proposition 1: *Relationships among multiple ecosystems services are better identified and assessed by integrated social-ecological approaches than with either social or ecological data alone.*
Proposition 2: *Understanding the mechanisms behind simultaneous response of multiple services to a driver and those behind interactions among ecosystem services can help identify ecological leverage points where small management investments can yields substantial benefits.*
Proposition 3: *Managing relationships among ecosystem services can strengthen ecosystem resilience, enhance the provision of multiple services, and help avoid catastrophic shifts in ecosystem service provision.*

Our review of the literature relating to the link between biodiversity and the output of ecosystem services therefore suggests that any conceptual framework must emphasise the notions of threshold and limits more explicitly, in order to capture the idea that there may be a minimum level of biodiversity (or stock of ecosystem structures and associated processes) that are required to sustain some required level of service output. The preliminary discussion of the relationships between biodiversity and ecosystem services also suggests that the multi-functional character of ecosystems needs to be made explicit in order that the possibilities of trade-offs can be considered and the potential for sustaining bundles of services might be identified. The issues of trade-off are especially complex, and may also involve making the link to stakeholder values in order to understand how much of a reduction in service output can be tolerated or is acceptable given the increased benefits that might be gained by enhancing another.

4. The effectiveness and inclusiveness of governance in relation to Ecosystem Services and Natural Capital

4.1 The place of governance in the OpenNESS Conceptual Framework

An overarching aim of OpenNESS is to analyse how the design of regulatory frameworks can be improved by applying the concepts of Ecosystem Services and Natural Capital, and to mainstream these concepts into the policy process. The term mainstreaming is often used in a very unspecific way to denote the introduction of certain concepts in a variety of policy fields, e.g. using ES and NC outside the field of nature conservation or environmental policy. But to take the challenge of mainstreaming seriously requires an understanding of the meaning and the purposes of both concepts in policy terms, especially given the existence of diverging policy aims or regulatory systems in different sectors, such as those related to agriculture or urban development. Thus, to address this aim requires an analysis of the problems raised by introducing both concepts in new regulatory environments (Jordan and Russel, 2014; Turnpenny et al., 2014). This in turn demands an understanding of the complex issue of policy making and the multi-level governance system of the EU. Within this field a variety of actors with often conflicting interests and value systems are involved. Two features can be singled out to be especially important:

1. The first concerns the *effectiveness* of multi-level policy making within the EU. Effectiveness in general means the performance of policy making in relation to achieving a set of self-defined aims (see the OpenNESS Synthesis Paper on effectiveness, Heink et al., 2014). To analyse the effectiveness with regard to mainstreaming new concepts into the EU policy process two dimensions must be distinguished: vertical and horizontal policy integration (cf. Mickwitz et al., 2008). 'Vertical policy integration' concerns the nature of the multi-level governance system of the EU itself, and refers to the need to consider the interplay of different tiers of decision making and the competencies or authorities on these levels (on supranational, national or subnational levels). 'Horizontal policy integration' concerns the interplay of different policy sectors, such as agriculture, regional policy and environment and nature protection, which all may affect the status of ES and NC in different and sometimes conflicting ways. To support a sustainable management of ES and NC the complex linkages between these vertical and horizontal dimensions needs to be understood and addressed in the design of future regulatory frameworks and the conceptual frameworks on which they are based. This is particularly pressing in relation to the need for a placed-based approach to sustainable management that is being explored in several OpenNESS case studies; all places are affected by policies from other levels (e.g. the EU-CAP) or other policy fields (like infrastructure development), but in different ways.
2. The second issue concerns the extent to which decision making in a multi-level multi-sectoral system can be sufficiently *inclusive*, given that different actors or stakeholders at different levels may have different perceptions, values and interests, and may try to influence the policy system in different ways. Inclusivity in the policy process may be achieved through participatory approaches (see OpenNESS Synthesis Paper on Stakeholder Involvement, Hauck et al., 2014). However, we need to understand how to deal with the different kinds of values, cultural perceptions, socio-economic interests and power relations amongst stakeholders. If the concepts of ES and NC are to be mainstreamed in decision

making, then a better understanding is needed of how to deal with potential trade-offs and conflicts between policy fields and stakeholder groups (e.g. from different policy sectors). Moreover, such trade-offs and conflicts may arise at different spatial or temporal scales; for example, gains at European level may conflict with losses at local scale or vice versa, or short term profits may conflict with long term losses.

These two problems that arise from the system of multi-level governance in the EU are closely linked. Both raise concern about how mainstreaming ES and NC may lead to a better integrated kind of policy making, integrating not only several levels of policy making, but also several sectors and a broader variety of actors. Improving one element (e.g. horizontal policy integration), however, may conflict with other elements (like inclusiveness, as the example of the Water Framework Directive shows (see Schleyer et al. 2014). The task of unravelling this complexity is the principle focus of the work under Challenge 3, but this challenge is closely linked to the other three challenges, because governance is linked to the sustainable management of ecosystems, to the valuation of ES and NC for human well-being and to competitiveness.

4.2 State-of-the-art: exploring the governance challenge

It is widely accepted that environmental policy making within the EU can be viewed as a unique form of multi-level environmental governance (Jordan, 2005). Indeed, the notion of multi-level governance became a major focus of policy analysis within Europe in recent years (Bache and Flinders, 2004; George, 2004). Several issues have been considered in this debate, including: the particular institutional character of the EU as a specific kind of statehood (as a supranational entity beyond the member states which does not completely substitute the national level of policy making); the multi-level character of decision-making (Marks and Hooghie, 2004); and, the dynamics of policy networks operating across several policy levels (Dedeurwaerdere, 2005). Whereas multi-level decision making in a narrow sense is an ingredient of all federal states, it is more complicated within the EU because of its supranational character. The latter raises particular questions about national sovereignty and dispersed political competencies, and thus about the dynamics of political negotiations across complex policy fields and levels. Thus we need to consider the interplay of the 'vertical' and 'horizontal' dimensions of this multi-scale system more carefully.

The need for vertical policy integration challenges decision making about ES and NC in several ways. Competencies in certain policy sectors are distributed at EU and Member State levels; some, like agriculture are completely transferred to the EU level, while others important for ES and NC, like forest policy (Primmer et al. 2013), remain at the Member State level, while for others responsibilities are shared. Thus, competencies to address the management of ES and NC may be dispersed over several levels, and strategies to improve effective decision making on ES and NC must be balanced in a 'vertical' manner. Moreover, approaches to mainstream ES and NC must balance top-down and bottom-up strategies and deal with the information needs of stakeholders on these different levels (Hauck et al., 2013).

While the need to achieve effective vertical policy integration raises some general issues concerning policy making in the EU, the need to ensure horizontal policy integration addresses governance structures and regulatory frameworks which affects the provision of ES and NC more directly. As the management of ecosystems is affected by a number of policy sectors, within and beyond environmental policy, it is crucial to take into account policies designed to improve the functioning of ecosystem explicitly (environmental policy in a broader sense) but also other policies that depend on and impact ES and NC but often in an inadvertent

or unintended manner (e.g. agriculture, urban and regional development, infrastructure, trade policy). Thus, the aim of mainstreaming ES and NC into a variety of policy fields faces serious challenges that are more generally common to the problem of coherent policy integration. Policy integration in a horizontal dimension is a challenge for any kind of policy reform, from the reform of Common Agricultural Policy (CAP) to climate policy integration (Mickwitz et al., 2009). Tools and approaches to address this challenge for the governance of ES and NC include landscape planning (Plieninger et al., 2013) or scenario development (Palacios-Agundez et al., 2014).

The challenge of inclusiveness is closely related to both the notion of governance and the valuation of ES. If valuation is to some degree dependent on different stakeholder perceptions in economic, cultural and ethical terms (e.g. Sagoff, 2011; Kelemen et al., 2013), then it depends on the involvement of different groups or actors, and on ways of ensuring effective stakeholder participation in the management of ES. Contemporary notions of governance entail widening the inclusion of those involved in decision making beyond the traditional governmental actors (state institutions or administration), by taking in business or civil society (Pierre and Peters, 2000). The transition from government to governance as mode of steering, however, neither guaranties the success because here may be specific governance failures similar to market or state failures (see Jessop, 2004), nor does it imply the equal participation of all actors. Beyond the need for stakeholder participation in transdisciplinary research, participation in governance processes is seen as a way of improving decision making in a multi-level governance setting within the EU (Heinelt et al., 2002). However, as we have learnt from recent work, effective participation needs the careful consideration of aims, tools and framework conditions, and is no 'silver bullet' for effective decision making (Rauschmayer et al., 2009; Schleyer et al. 2014). Thus the use of participatory methods must be analysed and the advantages and challenges must be evaluated against the overarching question of how to improve decision-making within the EU through the concepts of ES and NC.

4.3 Implications for the OpenNESS conceptual framework

Mainstreaming ES and NC into governance processes is challenging for several reasons, as shown above. As a research project that combines certain scientific methods with a placed-based approach towards sustainable management, OpenNESS faces some additional challenges linked to the Cascade framework as conceptual starting point of our analysis.

During the first part of OpenNESS the consortium agreed that governance processes impact the cascade framework in relation to the biophysical components (structures, processes and functions), but also in relation to benefits and values. If policy integration and inclusiveness within governance processes are to be achieved, then we need to consider a broad variety of policy sectors that affect not only the biophysical processes but also impact the valuation of services and benefits (e.g. certain agricultural production patterns) and also human well-being. Important examples of the impacts of decisions on the biophysical structures or processes are nature protection policies for endangered species. Other policies impact ecosystem functioning (e.g. fragmentation of ecosystems by infrastructure projects) or the provision of services (like flood protection by infrastructure projects in floodplain areas, promoted by regional development policies). Sometimes, regulatory frameworks may affect the conditions necessary to realize potential ES, because socio-economic or technical requirements are undermined (as in the case of biocontrol and regulatory services by agricultural policy). Other policies affect the benefits people obtain from ES in a

positive or negative way (positive like e.g. green space in cities; negative like roadworks) or the values they obtain (higher real estate prices through green infrastructure or loss in values through new roads nearby).

Thus it is apparent that probably all steps of the cascade framework are affected by regulatory frameworks established in various policy sectors often far beyond environmental policy. Mainstreaming ES and NC into policy making thus means addressing policy frameworks which often have a long history of conflicts with environmental concerns. To achieve the aim of mainstreaming ES and NC, thus raises the question of *translation* and the question of *power*.

1. The question of *translation* raises the challenge of communicating ES and NC in languages and into policy aims which are related to issue areas with different objectives, actor constellations and regulatory frameworks (like agriculture). Here, the options for operationalizing the concepts of ES and NC are closely related to the need for appropriate communication strategies with experts from several other areas of expertise. Very often, it is difficult for decision makers within certain policy sectors to include the notion of ES into actual decision making and existing or upcoming regulatory frameworks (Hauck et al., 2012).
2. Although translation is one of the core challenges of mainstreaming ES, it is closely related to the question of *power*, because tensions or conflicts between different policy fields are not only an issue of language and communication, but also an issue of socioeconomic interests (such as interests on subsidies or the interference with laws), and the power relations associated with vested interest. The failure (or at least the slow progress) of the EU-CAP-reform over recent decades has to some degree been caused by the power of lobby groups to frustrate progress at several levels of the EU multi-level system.

The integrative nature of the concept of ES raises expectations that we might more systematically address potential trade-offs and synergies among policy fields; for example, by raising awareness of the value of functioning ecosystems for provisioning services in agriculture, the relevance of ecosystems for flood control, climate regulation or recreation and other cultural services may also be recognised. The idea of improving governance on ecosystems and biodiversity by raising awareness about the value and relevance of ES and NC for societal aims and human well-being also expands thinking beyond nature protection policies. Whether these expectations can be fulfilled depends to some degree however on whether the advantages of the concept to inform policy making can be realized – and thus on options of how to operationalize this concept. Because of the complexities of policy making within the EU it could be argued, that the operationalization must address the peculiarities of certain policy fields and the regulatory frameworks involved. Specifically, this means:

- That as a starting point we can formulate the hypothesis that preferences of actors and face-to-face dialogue, and polycentric forms of governance, are major determinants of good governance. This hypothesis may be expanded to suggest that in face of the multi-level governance system of the EU, polycentricity also represents a major difficulty for both face-to-face dialogue and communication on ES, and thus for incorporating the preferences of different actors. This hypothesis will be addressed by WP2 by analysing information needs of and communication options for several policy sectors; in a first step a selection of important regulatory frameworks for further in-depth analysis has been made, which could also inform conceptual considerations on WP1 and the way certain options for operationalizing ES and NC are developed.

- If it is correct, that valuation of ES is to some degree dependent on different stakeholder perceptions in economic, cultural and ethical terms (and thus not the least on their concepts of human well-being), it is necessary to reflect on effective ways of achieving stakeholder participation for the coproduction of new or the reform of existing regulatory frameworks (see the OpenNESS Synthesis papers on: "Stakeholder Involvement", Hauck et al, 2014; "Non-monetary valuation", Kelemen et al., 2014; and "Institutional Analysis", Primmer et al., 2014). More precisely, for effective governance processes to be achieved, it is not only important to involve a variety of stakeholders from EU and member state level, but also from the case study tier. Moreover, we must consider carefully how participatory approaches and the development of regulatory frameworks could be informed by conceptual work on ES and the cascade framework, which means in practice: bridging different kinds of knowledge types or expertise. This issue could be addressed by appropriate methods like focus group discussions etc., together with WP2, WP 5 (case studies) and WP6.

During the preliminary work on the Governance challenge the issues of complexity and coherence were considered and the question was posed of whether inclusiveness is covered by governance approaches. In terms of the meaning of effectiveness, it is important to note that the effectiveness of policy measures, of governance strategies or instruments, should be measured against their self-proclaimed goals such as the cost-effective provision of agricultural products. At the same time, however, each measure may have side-effects, which may undermine the effectiveness of other policies, or negatively affect other, non-targeted, ecosystems, ecosystem services, or resource management systems more generally. The most important example for such side-effects is perhaps the effectiveness of agricultural subsidies. While they might be effective in terms of supplementing the income of farmers, they sometimes conflict with wider environmental goals. Thus, effectiveness is always relative to stated aims, and even though effective governance is achieved in some sectors, it may be accompanied by non-intended side-effects. Moreover, we cannot assume that all groups within a society agree on the effectiveness of such measures. Farmers may value agricultural subsidies as effective but conservation groups may not, considering them as waste of public funds. There is usually a variety of social values and preferences which affects what is perceived as effective. From these problem dimensions, two further notions emerge:

- First, effectiveness is closely related to the notion of coherence of policies. Whether or not a policy has positive effects on ES and NC depends to some degree on its relationship to other policies in the same or other policy field(s) and the ES and NC those policies are affecting (whether intended or not). This is meant by the notion of coherence and analysed in approaches of policy integration and coherence as discussed above. Here, the challenge(s) of complexity and uncertainty emerge(s), as side-effects might be difficult to identify and to measure and, thus, are often not very well analysed or even ignored.
- Second, the notion of inclusiveness is also relevant, and it is important to analyse to which degree the values and preferences of social groups are (systematically) involved by the definition of specific policy aims, and to what extent these groups have been involved in the definition process. Particularly relevant are those groups affected by specific policies.

It is expected that the concepts of ES and NC may provide useful frameworks to address the concerns outlined above: as the concept of ES deals explicitly with trade-offs between different ecosystem services (targeted explicitly by a specific policy, or not) and, thus, may improve the coherence of policies within and between different sectors. Moreover, the question of inclusiveness can be addressed when applying the

concept of ES in participatory approaches. As the SP on stakeholder involvement clearly states, a stakeholder analysis is required from the beginning. It must be analysed carefully which social groups are able to – and effectively do – influence relevant decision-making processes, and which are not. This includes also the question whether and to what extent, and in which direction, decisions on certain policy aims are biased towards powerful actors (as often experienced when trading-off agricultural and biodiversity policy objectives).

Until now governance issues have been addressed explicitly only in terms of the biophysical components aspects of the cascade in terms of policy action to limit the pressure on ecosystems emerging from its use. But implicitly governance issues impact the whole cascade, including services, benefits and values. Governance is relevant as framework for sustainable management practices and as factor that impacts human well-being and competitiveness. Thus further development of the cascade must consider carefully how to incorporate these linkages. This work can build upon and must be linked to work in WP2 and WP5, and in particular the institutional analysis at European and at case study level. The challenge is to generalize findings from these analyses in conceptual terms while keeping the CF flexible for these different conditions.

Moreover, the overall aim of OpenNESS to support management of ES by mainstreaming the concepts of ES and NC into policy and decision making requires conceptual elaboration for governance purposes. The very nature of mainstreaming as a process directed towards implementation in policy processes requires careful analysis of the options and challenges available. Such an attempt again builds upon work of WP2 (some elements are now available, see Schleyer et al. 2014) and on WP5 (and its cooperation with WP2 during the institutional analysis). However, this work should also be linked to work of WP1 on testing the cascade. Testing the cascade requires examining its applicability under specific decision making conditions at case study and European levels. It will need to explore the usefulness of the conceptual framework for better articulating the link between science and decision or policy making, and may generate recommendations on how to link several components the framework to specific requirements of policy making (e.g. awareness raising, measurements for dealing with trade-offs, strategic or regional planning processes).

5. Ecosystem Services, Natural Capital, Competitiveness and Innovation

5.1 The place of competitiveness in the OpenNESS Conceptual Framework

In relation to competitiveness, OpenNESS seeks to explore whether, through the sustainable management and restoration of ecosystems, we can reduce societal and business risks and costs, create new skills, jobs and business opportunities, and boost innovation. The analysis of these issues is especially timely given the emphasis that policy makers at all levels in the EU now give to the 'growth' agenda. In its preamble to *Europe 2020* the Commission states that they are seeking to move 'decisively' beyond the current economic crisis to create the conditions for a more competitive economy with higher employment[4]. They go on to describe the need for growth that is 'smart', 'sustainable' and 'inclusive'. The challenge for OpenNESS is to identify and demonstrate the role that attention to NC and ES can play in realising such a goal.

This fourth challenge is particularly complex, because it cuts across a number of issues. On the one hand it provides an opportunity for developing a better understanding of the how we assess the value of ecosystems, and to factor these values into more conventional economic analysis. Whether we subscribe to the belief that it is appropriate to ascribe monetary value to nature or not, we cannot escape the fact that the assertion that we can has stimulated great interest outside the normal policy sectors that deal with the environment. If OpenNESS is to contribute to this debate then it needs certainly to show how and when such monetary values can be used in decision making. However, it needs to move beyond this narrow discussion to consider how the management of natural capital and ecosystem services can contribute more generally to (economic) well-being by stimulating competitiveness and innovation, but also the other way round: how competitiveness and economic growth can be designed that adverse effects on ecosystems and their capability to provide these services are minimized.

The analysis of well-being is the focus of Challenge 1, and in this sense there is obvious overlap. However, it is useful to focus explicitly on the relationship between ES and NC and the growth agenda, precisely because of its current relevance. Challenge 1 is partly based on the premise that we need to go beyond simply looking at well-being in terms of economic prosperity and well established, but misleading, measurements of macro-economic success like the GDP. It thus seeks to broaden our understanding of well-being, how we might measure it, and how we might factor those measures into decision making. However, while this transformation in thinking may be essential for the goals of sustainable development to be achieved, in the short to medium term, the importance of the economic dimension of well-being cannot be overlooked. **Thus if OpenNESS is to mainstream the concepts of ES and NC, then it needs to show how they speak to notions of economic competitiveness and innovation.**

[4] http://ec.europa.eu/europe2020/europe-2020-in-a-nutshell/priorities/index_en.htm

5.2 State of the Art: exploring the competitiveness challenge

Despite widespread interest in making monetary valuations of ecosystem services, the implications of the broader economic role that natural capital and ecosystem services play has received less attention. The issue is, however, one that has been seen as relevant by policy makers. Indeed, in the restatement of its vision for biodiversity, the EU specifically references the importance of ecosystems to economic prosperity. Thus the EU biodiversity strategy to 2020 states that we need to ensure that *'by 2050, European Union biodiversity and the ecosystem services it provides … are protected, valued and appropriately restored for biodiversity's intrinsic value and for their essential contribution to human wellbeing and economic prosperity, and so that catastrophic changes caused by the loss of biodiversity are avoided'.* It goes on to argue that by fully recognising the value of nature the new strategy can contribute to a number of the EU's wider objectives, including the development of an economy that is: more resource efficient; based on sustainable low carbon technologies that enable it to be more 'climate-resilient'; that is a leader in research and innovation; and that is capable of delivering new skills, jobs and business opportunities. The EU initiatives for a *Resource-Efficient Europe*[5] and the related *Road Map to a Resource Efficient Europe*[6] also make similar points in relation to materials and energy use.

The relationships between 'economy' and 'environment' have, of course, long been the focus of debate and many writers (e.g. Wackernagel and Rees, 1997) have noted that current conventions and practices, and current 'economic rationalities', tend to accelerate the depletion of natural capital stocks rather than encouraging investment in them. For Wackernagel and Rees (1997) and others (e.g. Edens and Hein, 2013; EEA, 2006; Weber, 2012) the solution lies in direct biophysical measurement and management of natural capital stocks and flows. These approaches are consistent with current attempts to develop integrated methods of environmental and economic accounting; a review of these methods will form part of WP4. For others (see Gómez-Baggethun, 2013) the answer lies in developing methodological approaches that allow biophysical, socio-cultural and monetary value-domains to be explicitly considered and integrated into decision making and governance processes. What seems clear, however, that for any approaches and metrics to be relevant in relation to competitiveness, then they must be capable of providing some way of assessing the comparative advantage of one area over another, or within a single area, of comparing one policy options against another.

There is, for example, a growing literature on the importance of ecosystem service and natural capital for business (e.g. Houdet, 2008; Houdet et al. 2009, TEEB for Business and Enterprise[7]). By way of illustration, in the UK the 2011 Environment White Paper for England established an Ecosystem Markets Task Force that has recently reported (see Ecosystem Markets Task Force, 2013). In *Realising Nature's Value* the Task Force argued that there was a need for a 'new model for business' that integrates the real value of nature into its thinking, and identified 22 opportunities for business to take this forward. In its conclusions it prioritised five areas:

- Biodiversity Offsetting, designed to achieve a 'net gain' for nature through planning and development;
- Bio-energy and anaerobic digestion on farms, is designed to use farm waste to generate energy;

[5] http://ec.europa.eu/environment/resource_efficiency/index_en.htm
[6] http://ec.europa.eu/environment/resource_efficiency/about/roadmap/index_en.htm
[7] http://www.teebweb.org/publications/teeb-study-reports/business-and-enterprise/

- Sustainable Local Wood-fuel, in order to promote active and sustainable management of ecosystems and support local economies
- Nature-based Certification and Labelling, to better connecting consumers with 'nature' and highlighting its value in the marketplace
- Water Cycle Catchment Management, designed to integrate nature into water, waste water and flood management.

Although these recommendations were developed at a national scale, they may also be relevant elsewhere at least as a starting point for discussion. They certainly have some resonance with initiatives at the EU level, concerning the need to link help business understand the importance of the environment, and to promote the restoration of ecosystem function though investment in green infrastructure to improve the standing of particular places or areas. Thus, as part of the EU's Vision to 2020 for Biodiversity and Ecosystem Services, a Business and Biodiversity Platform has been established to bring together businesses from six different industrial sectors: agriculture, extractive industries, finance, food supply, forestry, and tourism. The aim is help them share their experiences and best practices. The Platform will also encourage greater cooperation between businesses in Europe, and especially SMEs, and help them to link to other national and global initiatives.

Elsewhere in the 2020 Vision it is noted that the innovation potential of ecosystem restoration and green infrastructure development is 'largely untapped'. The policy objective that *by 2020, ecosystems and their services are maintained and enhanced by establishing green infrastructure and restoring at least 15% of degraded ecosystems* therefore represents a considerable opportunity for realising some of these potentials. The review by Blignaut et al. (2013) confirms that benefits of restoration are not presently being recognised by business. The need to target restoration spatially, to where the greatest social or economic return can be achieved, further emphasises the comparative natures of any analysis of competitiveness, and the need to look at it in a place-based context.

In terms of understanding the kinds of condition that might improve competitiveness, it is likely that a particular focus of future work must be the kinds of governance structures that will be needed to achieve ecosystem restoration, both in the form of providing incentives and in terms of regulation. The EU *Vision to 2020* makes a commitment to the promotion of 'innovative financing mechanisms' including market-based instruments, such as Payments for Ecosystem Services (PES) schemes that will 'reward public and private goods from agricultural, forest and marine ecosystems'. It also commits the EU to encouraging private sector investment in green infrastructure and exploring the potential of biodiversity offsets as a way of achieving 'no net loss'.

In the wider international arena, the World Resources Institute with others have also attempted to identify and communicate the importance of understanding the relationship between business and ecosystems, from a risk perspective (see Hanson et al., 2012). They propose a Corporate Ecosystem Services Review (ESR) Tool to help businesses identify the risks they face from the degradation of ecosystems in relation to: their operational activities; the legal and regulatory environment in which they operate; reputational issues; market opportunities; and, financing. In its publication, UNEP-FI quotes a briefing by to CEOs, which suggests that as a result of lack of attention to such issues *financial stability may already be affected by environmental phenomena that manifest themselves through 'slow failures and creeping risks' in the context of ecosystem loss and degradation'* (UNEP-FI, 2010).

There is clearly an advantage in helping business understand that it is in their own interest to manage the environment sustainable and indeed to invest in its maintenance and restoration. Such motivation may ensure that interventions have commitment and are successful. A feature of much of the current material that is emerging at the interface of business and environmental policy is therefore to emphasise the importance voluntary action or actions that make sense in the 'market place'. It may well be that voluntary action may also need to be supported by stronger regulatory processes, and the issue here is that they may impose additional costs or responsibilities on businesses in Europe that may disadvantage them internationally. Thus any analysis of competitiveness and innovation cannot ignore the role that the introduction of new types of environmental regulation might have. The issue is illustrated by the discussion of biodiversity offsetting in the UK by the Ecosystem Markets Task Force. They argue that the idea of offsetting must not be looked at as a set of new burdens on developers, nor is it a 'license to trash nature', rather it is about 'better regulation' achieved through the creation of a well-defined market which can deliver the kind of "net gain" for nature that current spatial planning systems generally fail to do.

5.3 Implications for the OpenNESS conceptual framework

In terms of developing a conceptual framework that identifies the links between natural capital, ecosystem services and competitiveness, the wider connections to well-being, sustainable management and governance clearly need to be emphasised. The comparative aspect of competitiveness also needs to be examined, in that probably any measure of competitiveness can only be done in relative terms, as one place is compared to another. As with assessing different modes of governance by looking at outcomes, using notions of effectiveness and inclusivity, competitiveness probably can only be determined by looking at the comparative advantage of particular areas. Although evidence-based metrics on performance are likely to be useful, analysis of competitiveness is also likely to involve eliciting the views of different peoples, groups and organisations about the contribution made by natural capital in particular places.

A contribution of the work being undertaken in OpenNESS WP4 will be to better understand the different dimensions of value. The work will explore both how to measure these different dimensions and how those values shape action or decisions in different contexts. An understanding of the conceptual 'sub-components' that need to be considered in relation to the competitiveness challenge will clearly contribute to the design of the 'hybrid evaluation frameworks' being developed here. Given the comparative nature of the task it seems that the best opportunity for taking this forward would be to explore the ideas through the case studies that make up WP5. An essential first step must be to ensure that any conceptual framework can capture the way competitiveness and innovation issues play out in the case studies, and in particular how they link to governance, regulatory and incentive mechanisms at other scales and in other places.

A place-based focus for exploring the concept of competitiveness is clearly limited, insofar as the focus will be on issues at the local scale. However, by grouping the studies thematically or biogeographically, then some general lessons might be identified. These discussions could include decision makers drawn from the regional, national and EU levels. Such work would need to be complemented by dialogue with business leaders and organisations (that may or may not be identified through the case studies) so that a balanced and comparative picture can be achieved. The involvement of the Environment Bank in OpenNESS is a particular strength of the Consortium, and a dialogue in relation to the work planned in relation to their work is an important next step.

6. Operationalising the four challenges in a conceptual framework

6.1 Identifying commonalities and linkages

Having reviewed the conceptual issues that are relevant to each of the four OpenNESS challenges, we can now identify the common themes and distinctive elements in these different areas of concern. One important conclusion to emerge is that while human well-being probably has to be at the core of any framework, it is important to consider it both at the individual and collective levels. The discussion on competitiveness in relation to human well-being, for example, opens up the debate about the criteria and the measurement of macro-economic success, and what this means for different components of well-being such as 'freedom of choice' and action', 'material for a good life' and 'good social relations'.

The need to facilitate comparative assessments is also an important feature to emerge from the discussion of the challenges. For example, the conflicts and synergies between the different policy frameworks across different policy sectors needs to be looked at across different spatial scales, so that performance of governance approaches can be assessed. Assessment in terms of expected or desired outcomes was found to be of importance for governance, and in fact this also emerged as a common theme across the challenges. Thus while notions of inclusiveness and effectiveness were identified as important considerations in the context of governance, comparative advantage in terms of attracting investment or inward migration of talent was a feature of any analysis of competitiveness. The effectiveness of management strategies to secure the sustainability of natural capital stocks and ecosystem services flows, or of measures of to achieve the different components of human-well-being, represent further examples, of this 'output-orientated' approach to conceptualising the challenges. A future conceptual framework might therefore usefully identify the pre-conditions that are required to such things as good governance, sustainable management or competitiveness, as well as the outcomes in terms of such things as well-being or the effectiveness or inclusiveness of different modes of governance.

A further key theme to emerge from the discussion of the four challenges was the need to conceptualise the existence of trade-offs and synergies across all components of the cascade. The uni-directional character of the cascade was noted as a limitation. While, in the context of NC and ES, trade-offs are more conventionally approached by looking at how bundles of services relate to the characteristics of a given place, compromises between different types of benefit and value are also likely to be significant in terms of shaping management and policy responses. Thus in addition to indicating that changes in ecological functions might impact on different services in different ways, one other way to develop a more multi-functional framework might be to look at the feedbacks between the different components of the cascade model. This can accommodate the fact that influences might go from the social to the biophysical as well as from the biophysical to the social, and that trade-offs can arise in relation to different components within the cascade, and can potentially set up conflicts between them.

6.2 Ground testing the cascade model[8]

6.2.1 Background and first results

As noted in the introduction to this document, in OpenNESS the cascade model (Potschin & Haines-Young 2011) was intended as the entry point for discussion and as a template for developing and testing different application or problem specific implementations with case study partners, and, where appropriate, different conceptual frameworks. Being an entry point also means that it must be critically analysed, to ensure that it is capable of being used in different problem contexts. In order to ensure that this is achieved, we have in addition to the conceptual discussion presented above, undertaken a practical exercise with the OpenNESS case study partners to discover whether the cascade model captures, and hence generalises, the important aspects of their work.

Consultation with the wider OpenNESS community was undertaken in two ways. During the initial phase of the project, a small workshop was held in March 2013, in Garmisch Partenkirchen (see Potschin et al. 2013), which sought to clarify and further elaborate the basic components of the cascade, in order to make it amenable for discussion, application, and testing by the case study partners. As a result of that early work the concept was discussed in a general way within the consortium; the process was formalised through the publication and review of the Synthesis Paper[9] "Conceptual frameworks and cascade model" (Potschin and Haines-Young, 2014). The outcome represented a preliminary agreed understanding of the model for the project.

In a second phase of work an effort was made to test the applicability of the mode more actively with the case studies during the OpenNESS cross-WP meeting in Loch Leven, Scotland in October 2013. In this session, the cascade model was used as a framework for unpacking the links between biophysical structures or processes, ecosystem functions, services, benefits and values derived from these services in different social-ecological systems. There were five groups with around 15 participants in each, organised by forest ecosystems, urban and peri-urban areas, fresh water bodies, and two groups on mixed rural landscapes. Each group selected one specific OpenNESS case study as the basis of their test of the usefulness and applicability of the cascade model, and possible graphic representations of the respective case study based on it (see Appendix 2 for more details).

The discussions demonstrated that the model was useful for stimulating discussion, but also revealed some open questions. The main points that where mentioned in the reporting session were, inter alia:

- Some participants felt that the project should develop a ‘standard model’ for each social- ecological system type, following the CICES categories, so that each case study should not ‘reinvent the wheel’, while other participants felt that there is no single model that is applicable for all situations; instead, the ecosystem services and particularly the benefits that people derive from the services were context dependent. Furthermore, it is not the model itself but the process of constructing it that has an awareness raising function
- The approach can be helpful in participatory settings, for illustrating the linkages between ecological structures and/or processes and services derived from them. However, if researchers are uncertain of

[8] The authors thank all the case studies partners for their highly valuable detailed contributions to testing the model, both in written and oral form.

[9] http://openness-project.eu/library/reference-book

the elements of the model (as they partly were), how can we expect stakeholders to organise and name the elements of the model?

- A 'frequently asked questions' page on the Cascade model in the OpenNESS extranet would be useful. A first set of questions have been collated in Appendix 3 – a more thorough analysis of frequently asked questions and the groups responses will be delivered in the second half of 2014 and placed on the OpenNESS website linked to the related Synthesis Paper.
- A new element in the Cascade was seen in linking people and their values with ecological structures and processes. However, the work did not elaborate human behaviour, and it was concluded that the link between values and human behaviour is not straight forward, because it might involve the role of markets, structures, institutions, etc.
- A question that came up was as to whether, one should start either with ecological structures or with benefits when building the model. One suggestion was: with stakeholders, start with the benefits whereas with scientists, start with the ecological structures; choose the area that the participants are most comfortable with.
- Some case studies (e.g. Loch Leven) have already used the approach in identifying ecosystem services in their case studies.
- Some groups were debating whether the model should be used for forecasting the impacts from drivers of change or for describing the situation as it is; it was noted that it might be easier to start with the current situation and use this base-line situation for analysing the impacts from drivers of change, or management alternatives; these are also missing from the model.
- The cascade model is helpful for conceptualising the links between ecosystems and benefits that people derive from them but it is of limited usefulness in thinking about the institutional context and decision-making processes concerning ecosystem service. However, it is a heuristic tool for illustrating the links between ecosystems and human well-being, not an all-encompassing framework for integrating ecosystem services into decision-making.

As a follow-up it was decided that by the first Annual Meeting in Budapest in March 2014, each case study would have at least a preliminary model of their own, to be compared within the case clusters as well as across case clusters. The response was very good, and models from almost all case studies were prepared. In some organisational schemes based on the cascade model were available as part of Deliverable 5.1 and could be used directly.

The exercise showed that a variety of different conceptual schemes were being discussed and adapted in to the specific needs of the case studies. Some of them were close to the original cascade, and some modified it significantly (see examples below, Figures 6.1 and 6.2). Both types of response are useful in the context of the present work. In addition to the graphical representations, the feedback on the *process* of developing the conceptual framework by the case study teams was especially valuable. So successful was the process that in fact, one of the Finnish case studies went on to submit a paper describing the experiences of applying the cascade model to their specific local situation and research questions (see Saarikoski et al., submitted).

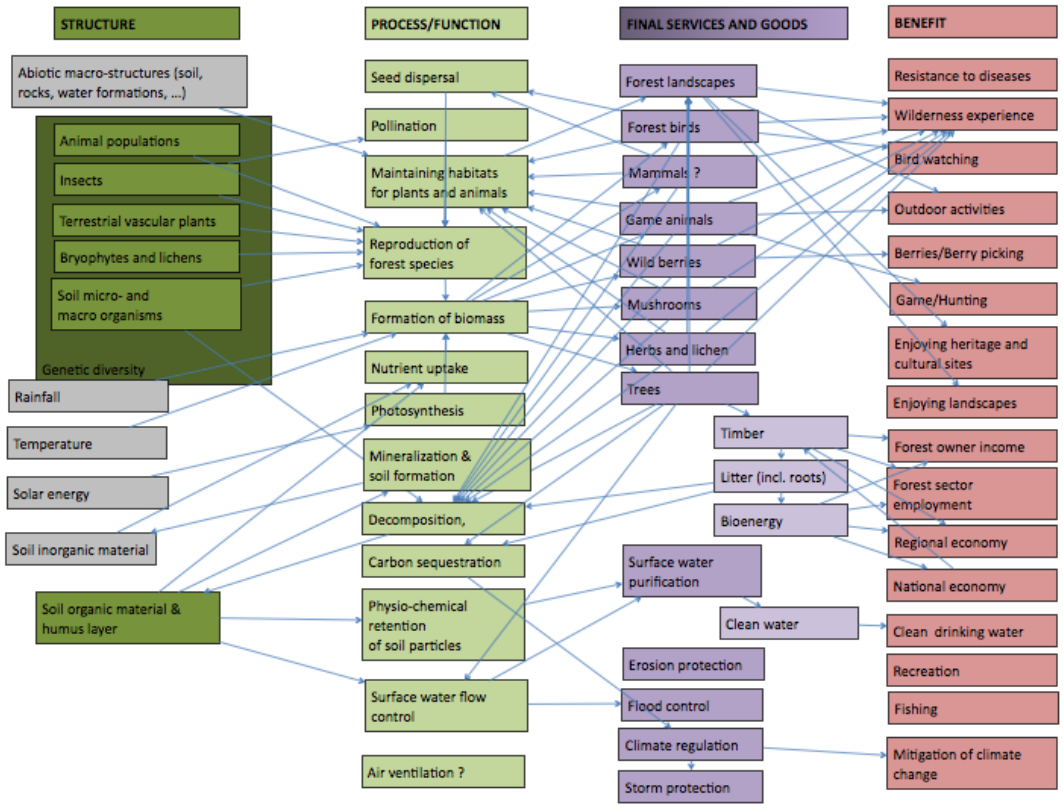


Figure 6.1: Cascade model developed by Case study 6: Finnish forest case study

A preliminary analysis suggests that the following conclusions can be drawn from the work:

- As indicated above, the Cascade model is valuable for clarifying the problems and the specific relations between the biophysical components leading to ecosystem services and the benefits and values deriving from them. It also helps to structure research processes and clarifying the local/regional situation.
- Its use as a tool for comparison of the application of the ecosystem services concept is important for OpenNESS and the general conclusions that the project aims at. For example, the urban case cluster decided to use the cascade model in this way and elaborate means for a comparative use.
- The number of elements ("boxes") of the model to be used varies, was sometimes reduced (e.g. by omitting "function" or merging "benefits" and "values"); sometimes (see Figure 6.2) also additional elements (e.g. "ecosystem services beneficiaries", but also social and management components) were introduced to better capture the specific situation and research approach. The reasons for these modifications can are partly be found in the lack of understanding of the components, partly in deliberate decisions that changes are necessary to adapt to the specific case.
- The precise place of human well-being within the general framework was partly identified as an open question.

- Some cases studies felt that the complexity of the model soon became very high in specific local situations, especially when considering multiple services; as a result one case study produced a graphic model separately for each of the services identified.
- In practical terms there was discussion of how the cascade should be read and applied: should it be traced starting from the left (supply side) or right (demand side)?
- The concept of "value" still needs some elaboration.
- A question was also as to whether and, if yes, how "harms" (or "dis-services") should be included.

The overall conclusion was that the cascade model has already proved its usefulness, not the least as a communication and structuring device. It also has proved to be flexible enough to be modified for specific purposes. A major challenge for the future and the development of guidelines (Deliverable 1.3) will be to use and further encourage this flexibility while at the same time keeping a common core that allows for a comparison of the different models so that generalisations become possible

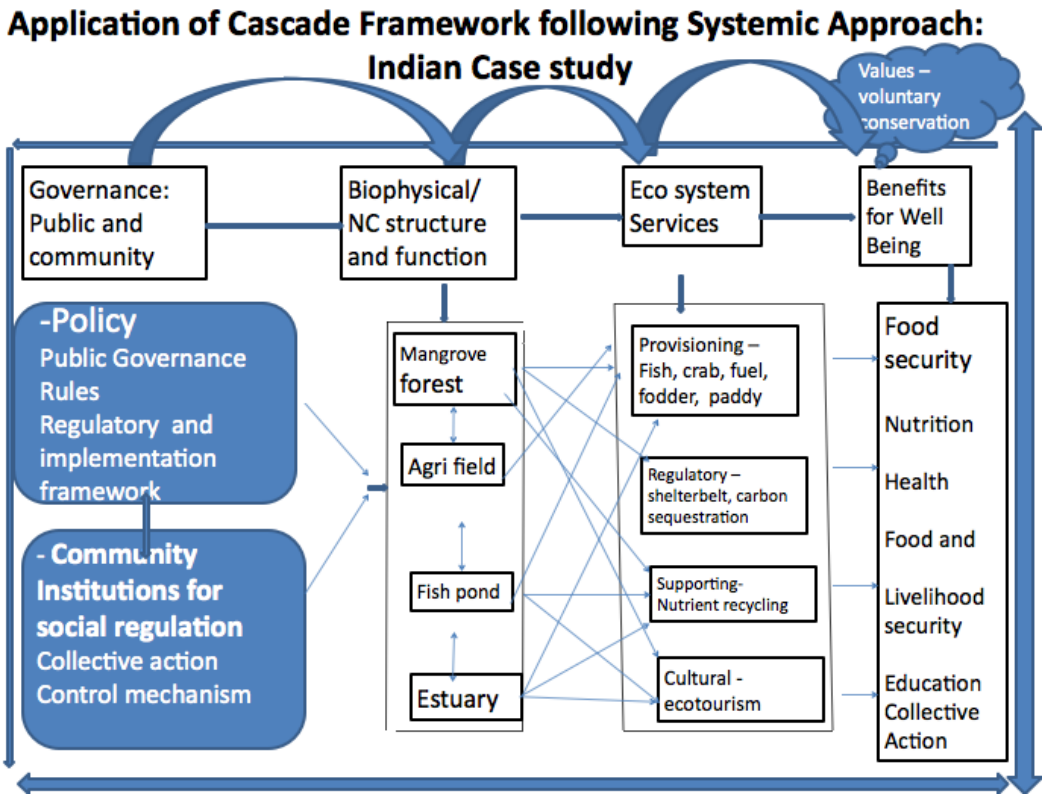


Figure 6.2: Conceptual framework/cascade model developed by Case study 23: Indian case study.

6.2.2 Next steps

For creating guidelines on the application of the cascade conceptual (Del. 1.3), the experiences gained through the case studies represent a valuable resource. The responses will therefore be further analysed in detail to: a) create a set of 'frequently asked questions' on the use of the cascade model can be applied and modified (see appendix A3 for a first draft); b) fed the experiences into potential modifications of the CF, together with those described above for the four challenges (see also Chapter 7); and, c) to build on work from WP2 and WP5 on institutional analysis, and the use of the CF in relation to real world decision-making processes, so that the usefulness of different options for the conceptual framework can be tested.

The goal is that the Project should develop a common core that can be used in all the case and issue-specific applications that are being explored within OpenNESS, to allow comparisons between different place-based studies to be made. This will assist in deriving generalities, while at the same time suggesting modifications and extensions of the cascade into a set of broader conceptual framework tailored to specific situations but also to types of situations and applications. One approach could be a kind of decision tree for ES and NC applications, which should be developed in cooperation with WP6. This would be helpful for the planned 'menu of solutions' and the 'common information platform' to be developed jointly by OpenNESS and OPERAs.

7. Conclusions and Outlook

On the basis of the discussion of the implications of the four OpenNESS challenges, and the outcomes of the 'cascade ground testing exercise', it is clear that while the cascade model captures many of the basic elements in these debates, there are various additions and modifications that might be considered, both to communicate ideas clearly and capture different theoretical understandings. During the remaining phase of OpenNESS these opportunities will evidently be examined and tested. One important, preliminary finding to emerge, however, is that in order to accommodate the challenges within the cascade model more explicitly, it might be useful considering them as 'outputs' or 'performance characteristics' of the socio-ecological system represented by the cascade, and using the latter to trace the implications of a given situation (represented by a case study, for example) for specific aspects of human well-being, governance, sustainable management and competitiveness. A possible graphical representation of this idea is shown in Figure 7.1.

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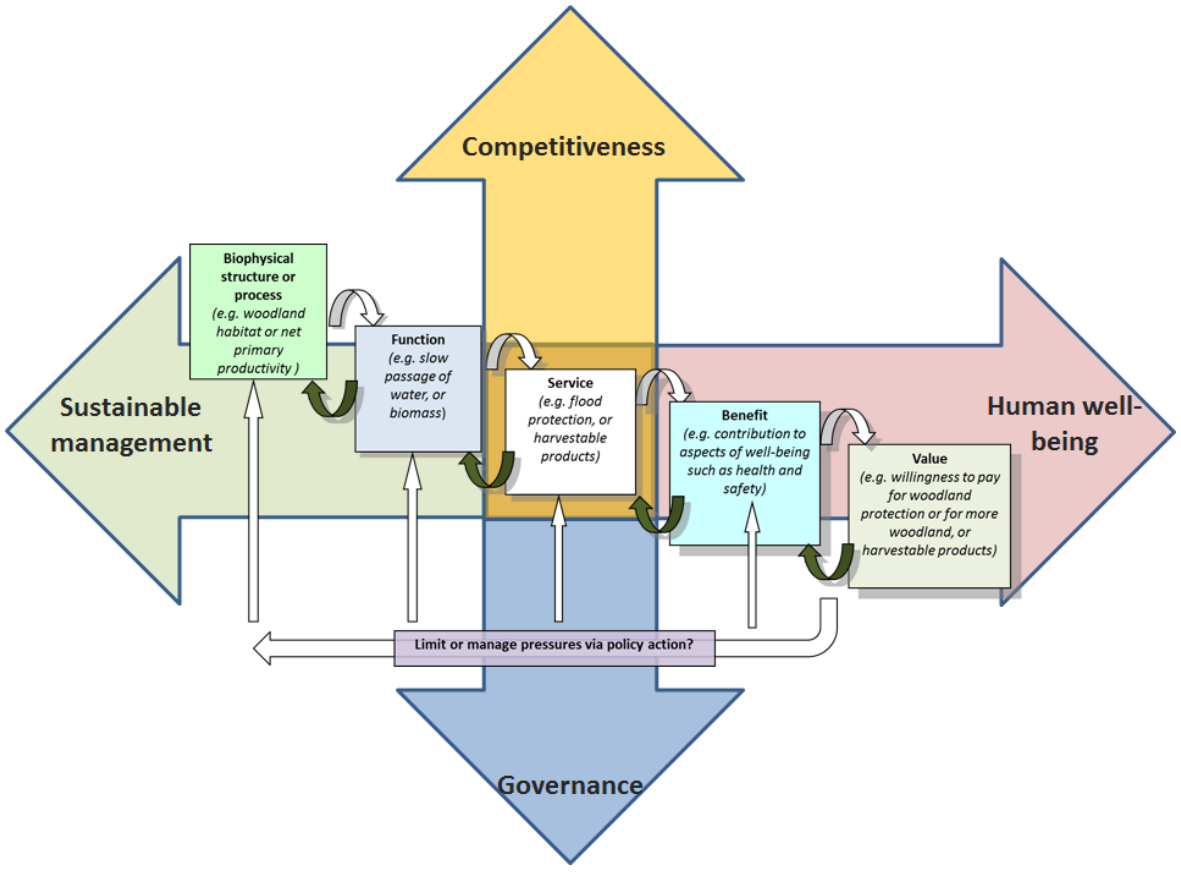
Figure 7.1: The four challenges and the cascade

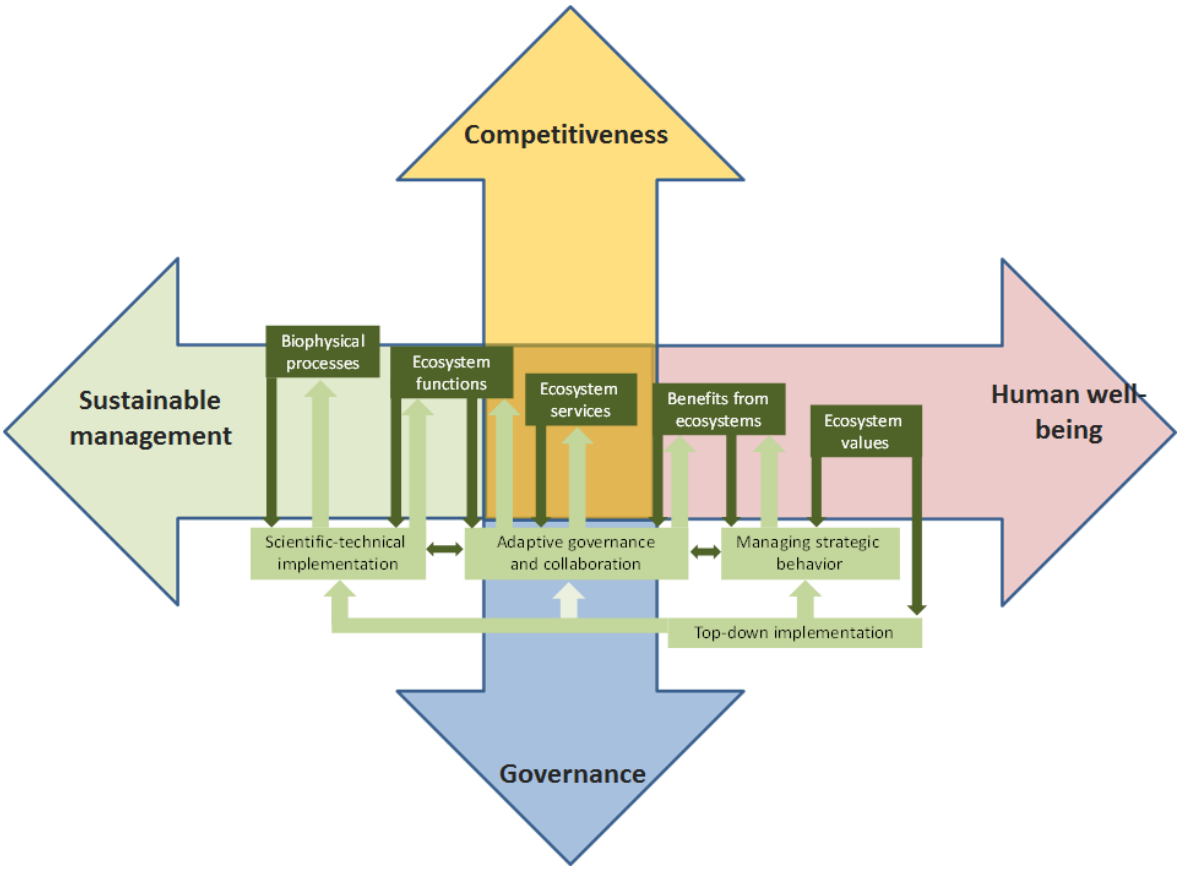


The diagram has been constructed to suggest that in any situation issues of human well-being, sustainable management of natural capital, governance and competitiveness are relevant, and that the available natural capital and the way it is valued and used by people have implications for each of these four axes. Clearly they may not all be relevant in all locations, or there may be some situations where one or more may be the priority. The point is, that in any specific instance, the cascade can be unpacked to reflect the particular characteristics of the application, and the consequences for one of the more challenges traced through the

system. Figure 7.1 has also been constructed to suggest that ecosystem services are at the centre of any analysis; it has been argued elsewhere that they are critical in terms of understanding the interface between people and nature (Potschin and Haines-Young, 2011), and building on this idea, we suggest that they are a useful 'entry point' for any discussion of the challenges.

A further modification of the 'original cascade' suggested in Figure 7.1 is that directionality can be 'two-way', that is in different situations the cascade can be read from the biophysical through to the socio-economic and vice versa, in the latter case emphasising "societal choices" as partly determining what counts as an ES (see chapter 2 and Jax 2010, pp. 66f). Part of the task of unpacking the arrows linking the five key elements will involve specifying what the 'influences' indicated by the arrows actually are – because they may vary from place to place. For example, the utility of the cascade model was explored recently by Primmer et al. (pers. comm.) as part of their work on governance. They argued that little, if any empirical attention is paid to ways in which the actual decisions are made or ecosystem services are governed , and suggested ways of representing different types of intervention or governance process by associating them with the various elements of the cascade. Combining their ideas with the approach suggested in Figure 7.1, a modification of their original suggestion might be that shown in Figure 7.2.

Figure 7.2: Governance Issues incorporated into the modified conceptual framework (modified according to Primmer et al, in prep.)



What is valuable to note about the representation of the work of Primmer and her colleagues is that the bi-directional nature the links used to described the links that structure the governance processes. Clearly for a

specific application, in a case study say, the details of the governance regime can be described in detail, and while the focus might be on this challenge, the links to the other areas of concern to OpenNESS can be made. Thus, for example, issues of “strategic behaviour” (See Figure 7.2) can be looked at from the perspective of questions about human well-being and inclusiveness. Similarly the scientific and technical implementation of specific governance strategies (See also Figure 7.2) can be considered from the stand-point of achieving the sustainable management of natural capital stocks (i.e. biophysical structures and associated processes) and ecosystem service flows (via functions, etc.).

An interesting feature of the representation of governance issues by Primmer and colleagues is that they further develop ideas about cross scale governance processes and how they are related to different levels of decision making. The representation of these influences clearly needs to be developed in any future representation. A further development of the framework must also be how to flag-up the question of trade-offs and synergies between ecosystem services, and the rather uni-dimensional picture that the cascade seems to present. One idea might be to view the service and function box as a bundle of services, rather than a single service, and trace the implications of any trade-offs and synergies via the implications for one of the four challenges.

In taking the work on conceptual frameworks forward, and using it to help people operationalise their thinking about natural capital and ecosystem services, would be to move beyond the cascade as a simple static representation to develop a multi-media approach, that would allow people to unpack the elements via a set of questions (or “decision tree”) and comments using some kind of web-based presentation tool. We therefore suggest that as we work through the ways in which the OpenNESS case studies have used the different elements of the cascade in representing their work, we consider how the commonalities and unique features of their work can be represented in a unified way than can provide guidance to others.

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OpenNESS

Operationalisation of Natural Capital and Ecosystem Services

Appendices

A1: Matrix of concepts and the four OpenNESS Challenges

A2: “Cascade Ground Testing Exercise” at OpenNESS Project Meeting, October 2013

A3: Cascade: Frequently asked questions

A1: Matrix of concepts and the four OpenNESS Challenges

Concept	Human Well-Being	Sustainable Ecosystem Management	Governance	Competitiveness	SP Source
Link between Biodiversity and Ecosystem Services	The relation between biodiversity and ecosystem services provides an understanding of how biodiversity contributes to human well-being (see Cascade model).	Information on the relationship between biodiversity and ecosystem services can help to determine carrying capacity and sustainable use levels, which is essential information for sustainable ecosystem management.	Awareness about the importance of biodiversity for the provision of ecosystem services is crucial for good governance (and vice-versa), and for encouraging integration of biodiversity conservation in sectoral policies.	Collection of new, empirical data and data-storage on the relation between BD and ES, and development and testing of methods to clarify if BD and ES evaluation are complementary or overlapping, gives competitive advantage to the partners and EU in the rapidly developing field of ecosystem service assessment. This information can help to improve the use of ES to highlight dependency of markets, and businesses, on biodiversity and make them aware that protecting biodiversity (and its supporting ecosystems) can give a competitive edge for European SMEs and companies as well as regions.	De Groot, Jax and Harrison (2014)
Typology/Classification	If ways of measuring changes	If ecosystem functioning is to	The design and evaluation of	Advocates of the importance	Haines-Young

of Ecosystem Services	in well-being are to be developed then we need to understand how services map onto the different components of well-being via the benefits they generate. Hence a consistent set of classifications linking all aspects of the cascade are probably needed.	be restored then we need a set of consistent metrics that measure service output; thus any classification of services has to support a consistent, tractable and responsive set of measures of service output that allow changes to be monitored over time.	regulatory frameworks and policies needs to be based on a clear and measurable set of targets so that progress towards policy or management goals can be measured. This will require a consistent and accepted typology of services which is defendable in the public arena.	of ecosystem services to the green economy suggest that investment in natural capital can assist in the development of new economic sectors and activities. Thus a 'mapping' of services onto economic sectors and activities is important if fully integrated economic and environmental accounting is to be developed and implemented. This will require the careful alignment of different classification systems. Gains and losses of competitiveness is also dependent on understanding the trade-offs between sectors. Trade-off analysis will require consistent definitions and classification typologies if it is to be effective and defendable.	and Potschin (2014a)
Conceptual Frameworks and the Cascade Model	How can trade-offs, synergies, and conflicting interested be valued, and assessment of changes in well-being made in different decision making contexts?	How is service output functionally related to the underlying biophysical structures and processes, and how can supply be managed sustainable?	What governance structure and regulatory frameworks are effective maintaining and restoring ecosystem functionality and sustaining ES at levels required by society?	What are the costs of interventions and/or regulation and how do they impact on competitiveness. Do Ecosystem Services offer opportunities for realising new forms of value or wealth creation?	Potschin and Haines-Young (2014, draft)

Thresholds, tipping points and limits	Conceptions of human well-being must take into account e.g. lower limits of human needs and vice versa define threshold for ES provision.	Must take into account biophysical thresholds that influence ES provision and define limits of sustainable use.	Governance mechanisms must take into account the consequences of possible threshold behaviour and assess the effects of policy setting limits and of abrupt policy changes on ES and NC.	Uncertainties about threshold and tipping points can impede planning processes and thus competitiveness.	Jax (2014, draft)
Stakeholder involvement in ecosystem service decision-making and research	As the contribution of ES to human well-being is variable from person to person and from group to group, it is necessary to integrate the manifold perspectives on human needs to advance the conceptual understanding of the contribution of ES and natural capital to different dimensions of human well-being.	The necessity to include perspectives from various stakeholders is important for understanding potential strategies for sustainable ecosystem management. It is common that stakeholders with a different stake have different perspectives on management strategies.	Ecosystem governance deals with the management of not only the ecosystem, but also of related social aspects such as decision making, social interaction and power relations. A common denominator and key question of management approaches is how to deal with uncertainty and the complexity that comes with it? Dealing with complexity inherently faces normative choices due to limited knowledge. A key question for the design of context-fit governance arrangements therefore is who has a stake in governance and who is entitled to be involved in deciding which approach to enforce?	The understanding of how changes in ES impact on issues related to competitiveness and social justice includes understanding the synergies and trade-offs in competitiveness, i.e. if the competitiveness via the enhancement of particular ES is enhanced for some individuals or groups of people, it may be decreased or increased for others. Involving stakeholders and their knowledge in identifying 'losers' and 'winners' in a new land-use setting, provides the opportunity to uncover and tackle directly these issues.	Hauck et al. (2014, draft)
Non-monetary valuation of ecosystem	Non-monetary valuation methods are able to grasp	Results of non-monetary valuation can be integrated	Non-monetary valuation can contribute to decision making	Non-monetary valuation promises a deeper insight into	Kelemen et al. (2014, draft)

services	how ESs contribute to different well-being dimensions (including e.g. material, physical, social, spiritual aspects). Some methods are also capable of inferring subjective well-being by discovering how local stakeholders define well-being and what the locally relevant aspects are in relation to ESs	with supply side indicators in integrated methodologies (i.e. mapping, MCDA or BBN) that provide key information for ecosystem management. Sustainable ecosystem management can be enriched with local and traditional ecological knowledge which can be discovered by some non-monetary methods. Non-monetary methods can also help understand the beliefs, motivations and socio-demographic factors of stakeholders that influence their choices and actions in relation to ecosystem management. This helps understand the unsustainable management practices of the present and identify potential intervention points. Non-monetary methods could explore bundles of ecosystem services from a holistic viewpoint	processes by providing useful information on multiple and often incommensurable value dimensions (i.e. social-cultural, ethical and spiritual values in addition to the total economic value concept). Non-monetary approaches (especially deliberative valuation) could increase social support and engagement to certain environmental policies which is one of the keys of effective and successful policies. Methodological decision making	human-nature relationship, which allows doing business more sustainably than nowadays. Since a key strength of non-monetary methods is to value cultural ESs in a comprehensive way, a major business oriented target group of non-monetary valuation could be the SMEs dealing with ecotourism, recreation, cultural heritage etc. Building business upon cultural ecosystem services can be an inclusive, economically viable and ecologically sustainable development strategy in isolated areas.	
Institutional Analysis	Formally and informally defined rights of different	Formal regulations and informal practices condition	Institutional design and the rights of different actors are	Clarity about the allocation of rights allows improved self-	Primmer et al. (2014)

	actors to benefit from ecosystem services are institutions. Without recognising these institutions, we cannot influence them. Formal and informal institutions condition allocating and redistributing benefits to different groups in the society.	ES management and also the supporting knowledge systems. It is essential that these institutions are identified, so that informed decisions about developing management tools can be made, and institutions can be designed to support sustainable development.	the starting point of governance. In addition to formally defined governance mechanisms, also existing informal practices shape governance. Identifying both formal and informal govern-ance mechanisms provides an essential basis for further developing governance.	coordination by different actors and might improve opportunities for learning, innovation, and better coordination.	
Effectiveness	Enhancement of human well-being is the final outcome of managing ecosystem services. The extent to which goals related to human well-being are achieved is therefore a fundamental measure of effectiveness	Ecosystem management aims at sustainably delivering ecosystem services. If this is actually the case is a question of effectiveness.	Policy coherence and integration as well as stakeholder integration can be tackled from the perspective of effectiveness: Are ecosystem services mainstreamed in policy and do participatory processes enhance legitimacy?	is a double-edged sword with regard to effectiveness. On the one hand effectiveness certainly enhances competitiveness by saving costs for ineffective activities, on the other hand competitiveness is a driver for ineffectiveness, e.g., by competing policy sectors with opposing policies.	Heink et al. (2014, draft):
Ecosystem Service Bundles	Little is known about how changes in ES bundle delivery will affect human well-being (Reyers et al., 2013), but it is a component of the CBD Target 14.	Synergies in ES bundles may represent opportunities for more sustainable management, through maintaining a stock and enhancing a sustainable flow of a broad range of services from ecosystems while preserving their ecological value and biological diversity.	Cross-sectoral policies and governance will be needed to ensure the delivery of ES bundles+ stimulate desirable synergies, and mitigate undesirable trade-offs.	Great? use of the synergies in ES desirable bundles may enhance competitiveness.	Berry et al, (2014, draft)

Good Governance	How is HWB addressed (e.g. inclusion of a broad variety of cultural perceptions?) and balanced with other aims (e.g.biodiversity protection)?	Depends on inclusive and effective governance processes: what does the mean in practise?	How are normative considerations linked to the analysis of governance processes?	Represent a specific policy goal which must be balanced with other goals and must be addressed by appropriate processes.	Görg et al. (2014, draft)
Indicators for ecosystem services	The concept of indicator levels along the cascade helps to operationalize the abstract notions of natural capital and human well-being (both NC and HWB can be directly addressed by using appropriate indicators). Applying a consistent system of indicators along the cascade helps to develop a detailed and quantitative insight in the way natural capital and service flows exert influence on well-being – the main focus of Ch.1	Quantifying natural capital and ecosystem services in different geographical, environmental and management contexts may improve understanding on how management can be optimized for a sustainable flow of services.	Information conveyed through indicators can be an effective means of communication and comparisons, supporting strategic decision making.	?	Czúcz et al. (2014, draft)
Natural Capital Accounting	Natural capital accounts can be used to determine the balance between the demand and supply of ecosystem services and hence the extent to which needs in relation to human well-being are met.	Natural capital accounts would be essential in determining whether natural capital stocks and associated ecosystem flows were being managed sustainably, and whether the levels of reinvestment in natural capita were sufficient to compensate for degradation.	Natural capital accounts are an important governance tool insofar as they can inform decision makers about the state of natural capital, the consequences of change over time, and the effectiveness of policy interventions.	Spatially disaggregated natural capital accounts would be essential for the analysis of the comparative advantage or disadvantage of areas in respect to their natural assets and the flows of ecosystem services, and tracking the contribution that ecosystems make to regional economies.	Haines-Young and Potschin (2014b, draft)

Scenario Building	The OpenNESS case studies focus on different contributions to human well-being, from ecosystems influenced by different drivers of change. The participatory approach ensures that these drivers are addressed in the scenarios	In the scenarios very different types of ecosystem management are assumed to assess advantages the range of their potential positive and negative impacts.	The participatory prioritisation and evaluation of policies and regulatory frameworks ensures the relevance and usefulness of the scenarios for the intended users. Beyond, the common framework of scenario assumptions facilitates testing the robustness of policies e.g. via comparative analyses across OpenNESS case studies.	The OpenNESS scenarios make explicit assumptions about changes in different sectors of the economy, lifestyles, urban and rural areas and so forth. Case studies and modellers will analyse the multiple impacts on NC, ES and human well-being in the different scenarios. It is expected that at least partly the before mentioned impacts can be linked to consequences for competitiveness.	Priess and Hauck (2014, draft)
Valuation of Ecosystem Services	Monetary and non-monetary valuation play a critical role in measuring the contribution of ecosystems to human welfare and well-being, by informing indicators such as Green GDP, the genuine development index and various happiness indexes.	Valuation is critical in setting priorities for sustainable ecosystem management. For example, extended cost-benefit analysis is often used to inform decisions involving land-use change involving impact on ecosystems services supply.	Valuation has been often used to inform the design and implementation of emerging governance tools such as Payments for Ecosystem Services (PES), and also top target priority areas for the implementation of such tools.	In the long run, economic competitiveness can be undermined by declines in quality and quantity of natural capital and ecosystem services, especially in the context of peak oil and a low carbon economy in which importing goods will become more expensive.	Gómez-Baggethun (2014, draft)
Human Well-Being	self-evident	sustainable ecosystem management must be in accordance with the aim of fostering human well-being	Good governance must reflect the aim of enhancing human well-being and harmonise different interests and ideas of human well-being involved	Competitiveness concepts should include an accepted idea of a good life (human well-being). The role of human well-being as an aspect of competitiveness needs to be clarified.	Jax and Heink (2014, draft)

References to the Synthesis papers referred to above in Table A1.

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OpenNESS
Operationalisation of Natural Capital and Ecosystem Services

A2: "Cascade Ground Testing Exercise" at OpenNESS Project Meeting, October 2013

Organised by Heli Saarikoski (SYKE) and Marion Potschin (UNOTT) together with Kurt Jax (UFZ), Roy Haines-Young (UNOTT) and Francis Turkelboom (INBO)

In this session, we will use the Cascade model (Figure 1) as a framework for unpacking the links between ecosystem structures and processes, functions, services, and benefits derived from these services in selected OpenNESS case study. **The aim of the session** is to give the case studies a space to create a 'rich picture' of the problem situations they face. A further aim is to develop a shared understanding of how concepts are used and linked to each other in order to carry out comparative analysis across the case studies in later stages of the project.

The group exercise

8 to 10 groups of 6 to 7 people will be assembled around specific case clusters such as forest, fresh water bodies and coastal zones, etc. Each group will select one or two OpenNESS cases and start developing an influence diagram or graphic model that captures the causal links within the system, along the lines of cognitive mapping (e.g. van Kouwen et al 2009) or rich picture modelling[10].

We will use large white board and coloured cardboards to write the names of the services, functions, etc. on them, and connecting these with arrows; these can be shuffled around as the model develops. The rich picture or influence diagrams that the groups produce don't need to look like the cascade model. However, we would like each group to look at the diagrams and identify some of the basic components, such as:

- biophysical structures and processes (green cards);
- ecological functions (blue);
- final ecosystem services (white);
- the benefits that people derive from ecosystem services (yellow); and,
- the values that people assign to the ecosystem services (red).

Proposed steps for the exercise

1. List most important ecosystem services in the selected case study;

[10] a brief (17 min) video on different types of graphic models can be found at http://www.youtube.com/watch?v=TQwA9krV8EA

2. Develop a rich picture or a cognitive map linking the listed ecosystem services with underlying ecological structures, processes and functions and start also identifying the benefits from the ecosystem services (using different colour cards – colour as above & Fig.1);
3. If a diagram lacks some of the elements of the cascade, we suggest that you have a discussion why they are lacking and vice versa! Are they not relevant or has something been overlooked?
4. A further discussion topic is the helpfulness of the cascade model as a framework in representing and thinking about the problems we face: When does it work well – when do we need to think in other ways?

In the reporting session, each group presents their graphic model and reports the group discussion and learning points. We will end the session with a general discussion of the different ways of constructing the models and different terminologies used as well as the ways to apply the graphic modelling approach in the case studies.

After Loch Leven

The rough models created in the group exercise can be used as a starting point for developing more detailed models for each case study. The case study leaders might want to use a similar kind of exercise in their own cases with their Case Study Advisory boards (CAB).

The plan is that by the next Annual Meeting (AM) on March 25-27, 2014 in Budapest, each case study leader would have at least a preliminary model of their own case, to be compared within the case clusters as well as across case clusters. The case study leaders are also asked to reflect on their experiences in using the cascade model as a heuristic tool to name ecosystem services and link these to the ecological structures and processes that give rise to these services. These experiences will be reported to WP1, which can use the feedback in further developing conceptual frameworks in OpenNESS.

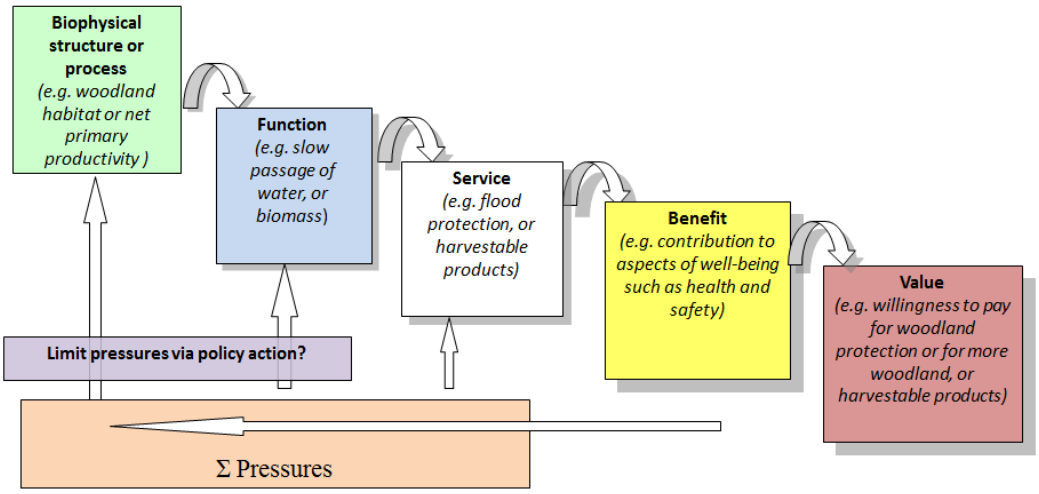

Figure 1. The Ecosystem Service Cascade Model (Potschin and Haines-Young, 2011, in Potschin et al., 2013)

References (Available from OpenNESS extranet, Loch Leven background materials.)

Potschin, M.; Jax; K.; Haines-Young, R.; Görg, C. and U. Heink (2013): Review of the existing information for the key challenges. OpenNESS Milestone 1, May 2013, 25 pp.

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A3: Cascade: Frequently asked questions

What is the basic idea of the cascade model?
The cascade model clarifies how ecosystem services are embedded in a socio-ecological system. It links ecosystem structures and processes with human well-being via different steps. It seeks to clarify both the importance of sustainable management of ecosystems and the necessity of evaluating ecosystem services in their contribution to human well-being.

Why do we need the cascade model?
We need a conceptual framework of some kind to provide a common set of understandings within the Consortium. Such a frameworks are helpful in different ways (Rounsevell et al., 2010; IPBES, 2014), namely as:

- Tools to describe complex systems as simply as possible by retaining and making explicit the key information needed for a certain purpose. A conceptual framework therefore helps understanding the context of ecosystem service evaluation and management and serves for communicating the idea of ecosystem services across disciplines and between science and policy.
- Ways to think about complex relationships, to structure work and to create a common basis to compare different applications of the ES concept (e.g. OpenNESS case studies). Specifically it facilitates tackling the four OpenNESS challenges (human well-being, sustainable ecosystem management, governance, competitiveness).
- Showing how the basic concepts included in the framework relate to each other, and to provide some standardization of terminology for OpenNESS.
- A hypothetical model which can be tested in terms of usefulness for decision-making in socio-ecological systems. The conceptual framework can be iteratively applied and refined. The testing allows buy-in from stakeholders, and thus increases policy relevance.

How are the basic parts of the "cascade" linked?
On the one hand, ecosystem processes and functions are the "raw material" which are transformed in a cause-effect chain into benefits valued by individuals or society. On the other hand, the immediacy of use or desire increase from structures and processes to benefits.

The cascade model includes a lot of concepts related to ecosystem services. Where do I find the definition of the concepts?
In OpenNESS a synthesis paper on the cascade model summarises the main concepts included in the model. Further, a comprehensive glossary of concepts used in OpenNESS also lists the concepts included in the cascade model.

In which way does OpenNESS (the work packages and case studies) apply the cascade model?
The cascade model (or the conceptual framework developing from the cascade model) is still work in progress. It is certainly convenient if all OpenNESS partners use the cascade model as a guidance, so that smooth communication and comparability between different WPs and case studies is provided for.

However, it will be necessary to adapt the cascade model to specific contexts. An important goal of OpenNESS is to test the cascade model and to find out how it needs to be adapted for different situations.

Is the cascade model also applicable for projects on ecosystem services outside the OpenNESS project?
The cascade model is a starting point for developing conceptual frameworks on ecosystem services. However, as there are different topics related to ecosystem services and different research issues in other projects, the conceptual framework may be developed in a completely different way. For example, in an analysis for frameworks for ecosystem services linked to poverty alleviation, Fisher et al. (2013) show that the cascade framework has some strengths while it neglects some issues which are referred to in other conceptual frameworks.

How does the cascade model relate to other models reflecting the embedding of ecosystem services in a broader context?
There are a lot of conceptual frameworks on ecosystem services which share many similarities with the cascade model. According to the purpose for which the framework is being used, it can be more detailed in relation to the biophysical part of the cascade (e.g., van Oudenhoven et al., 2012) or the policy-related, normative aspects (e.g., by highlighting institutional aspects, IPBES, 2014). Other models may use a different terminology (e.g., goods instead of benefits, or benefit understood as the enhancement of well-being in contrast to "products" contributing to well-being, good quality of life instead of human well-being).

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