



**Final conceptual frameworks for the analysis of ecosystem services and natural capital in relation to the challenges of well-being, sustainable management, governance and competitiveness, and how these issues can be communicated and resolved in different place based-contexts**

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**Authors:**

Marion Potschin (UNOTT), Roy Haines-Young (Fabis Consulting), Christoph Görg (UNI-KLU), Ulrich Heink (UFZ), Kurt Jax (UFZ), Conor Kretsch (UNOTT) and Christian Schleyer (UNI-KLU)

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## Executive Summary

OpenNESS aims to operationalise the concepts of Natural Capital and Ecosystem services and to examine how they link to, and support, wider EU economic, social and environmental policy initiatives. Work Package 1 (WP1) has focused on the conceptual frameworks that underpin this broad aim. If concepts are to be used operationally, then methods must be theoretically robust, relevant and easily understood by those seeking to apply them. Moreover, common understanding of key concepts is essential if an integrated approach is to be achieved. Thus, development of effective and understandable conceptual frameworks is needed to 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 ecosystem services and natural capital concepts for promoting **human well-being** in different geographical contexts;
- contribution of the ecosystem services and natural capital concepts to strategies for **sustainable ecosystem management**;
- relevance of ecosystem services and natural capital concepts to notions of **good governance**; and,
- the role of ecosystem services and natural capital in supporting EU **competitiveness** at different geographical scales.

In this work, we have therefore explored how they are linked and what the implications of interactions between them are.

Although each of the challenges overlap with each other, they were devised as a way of helping to identify and communicate the way in which the concepts of ecosystem services and natural capital could be ‘mainstreamed’ in management and policy in different problem contexts. The topics are significant in their own right, and are of a kind that must be addressed if the concept of ecosystem services and natural capital are seen to have wider relevance. As a result the aim is that our findings will be of interest beyond the concerns of 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 programme of work. To look at how such frameworks might be constructed, the ‘cascade model’ was used as a starting point for discussion. It was selected because it captured something of the transdisciplinary nature of the work related to the four challenges, and has been shown to be a way of transferring thinking across different problem areas related to ecosystem services.

We found that to a large extent ideas about the four challenges could be accommodated by reading the cascade in different ways, and that given their overlapping nature it was helpful to bring them together into a common conceptual framework. The cascade was tested in a practical way with OpenNESS case study partners, and this confirmed the adaptability of the model and the basis it provided for discussion and comparison. Our analysis of the outcomes of this work suggest that the process of building conceptual frameworks is probably as important as any final product, in terms of social learning, and so we concluded that a deliberative approach to constructing the conceptual guidelines required as an output of WP1 was to be adopted. 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 problem situation. Thinking about the four challenges of human

well-being, sustainable ecosystem management, governance and competitiveness from the perspective of developing a common conceptual formwork has shown that we are dealing with a network of related ideas, theories and abstractions. If these concepts are to be useful, i.e. used operationally, then we need to find ways to help people navigate this 'nexus' in an efficient and creative manner. The work presented here provides the foundation for the design of the set of operational guidelines that are described in Deliverable 1.4.

## 1. Introduction

The aim of this deliverable is to report on our findings about the conceptual frameworks that underpin the ‘Four Challenges’ that are a focus of OpenNESS. These Challenges were designed as a way of examining how the concepts of ecosystem service (ES) and natural capital (NC) concepts could be used operationally 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.

Thus, the Challenges were devised as a way of helping to identify and communicate the way in which the ideas of ecosystem services and natural capital could be ‘mainstreamed’ into management and policy work. 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 ecosystem services and natural capital 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 contribution of WP1 therefore sits on the left hand side of Figure 1.1, which shows how the OpenNESS project as a whole has sought to employed iterative cycles of methodological development linked to case study applications. The aim of WP1 has been to advance conceptual understanding of ecosystem services and natural capital and provide operational frameworks for the application of the concepts in real-world management and decision-making situations.

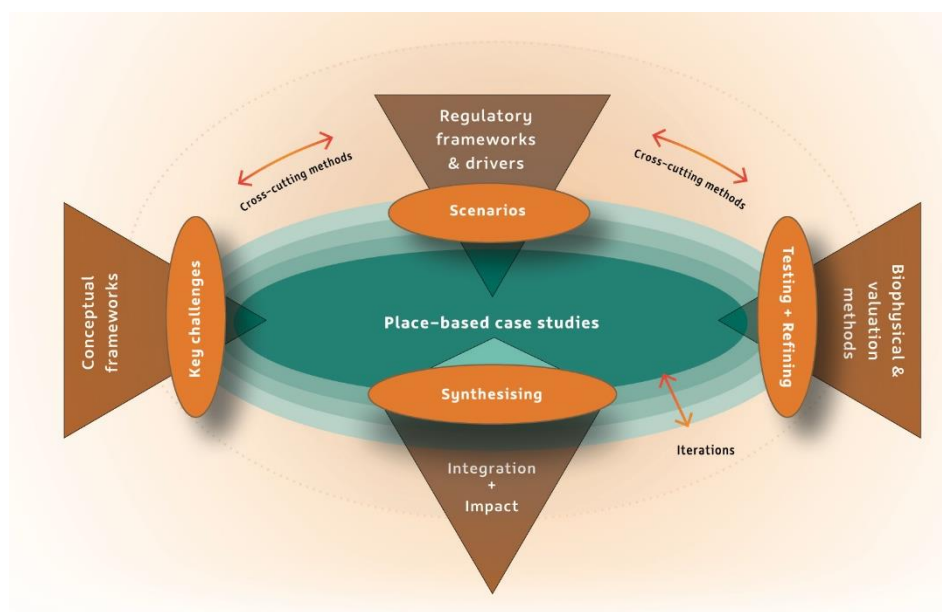


Fig. 1.1: The “OpenNESS-Approach” (modified according to OpenNESS DoW, p.12)

## 1.1 The Role of Conceptual Frameworks

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 (Potschin and Haines-Young, 2016 a & b). Some of the issues are illustrated by the debates that shaped the conceptual framework for the Intergovernmental Platform for Biodiversity and Ecosystem Services (IPBES<sup>1</sup>). 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; Hauck et al., 2016a). 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 need to be solved, and hence serve to prioritise and structure work.

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), Brand and Vadrot (2013), and Díaz et al. (2015) 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.

<sup>1</sup> <http://www.ipbes.net/>, e.g. the document on conceptual frameworks (IPBES, 2014).



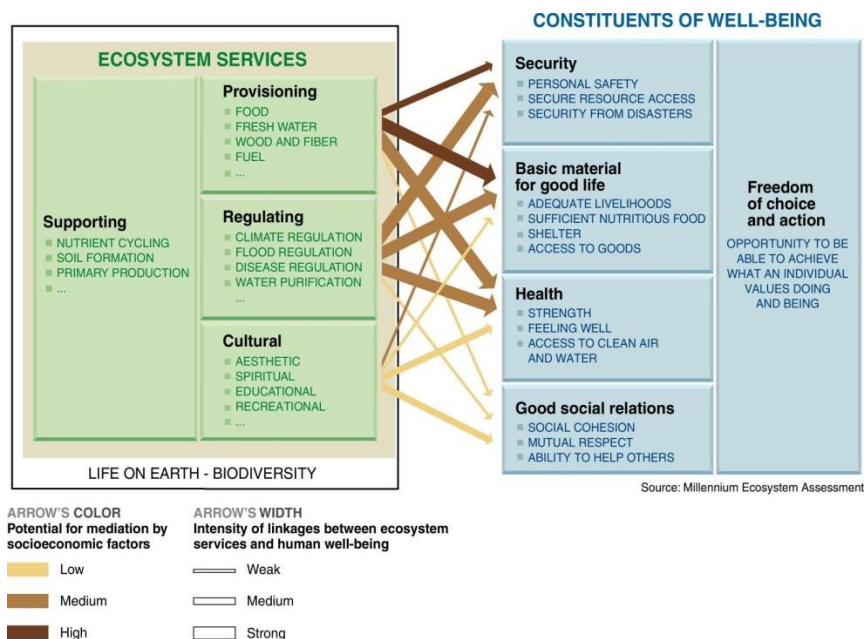


Figure 1.2: Ecosystem Services and Human Well-Being (MA, 2005)

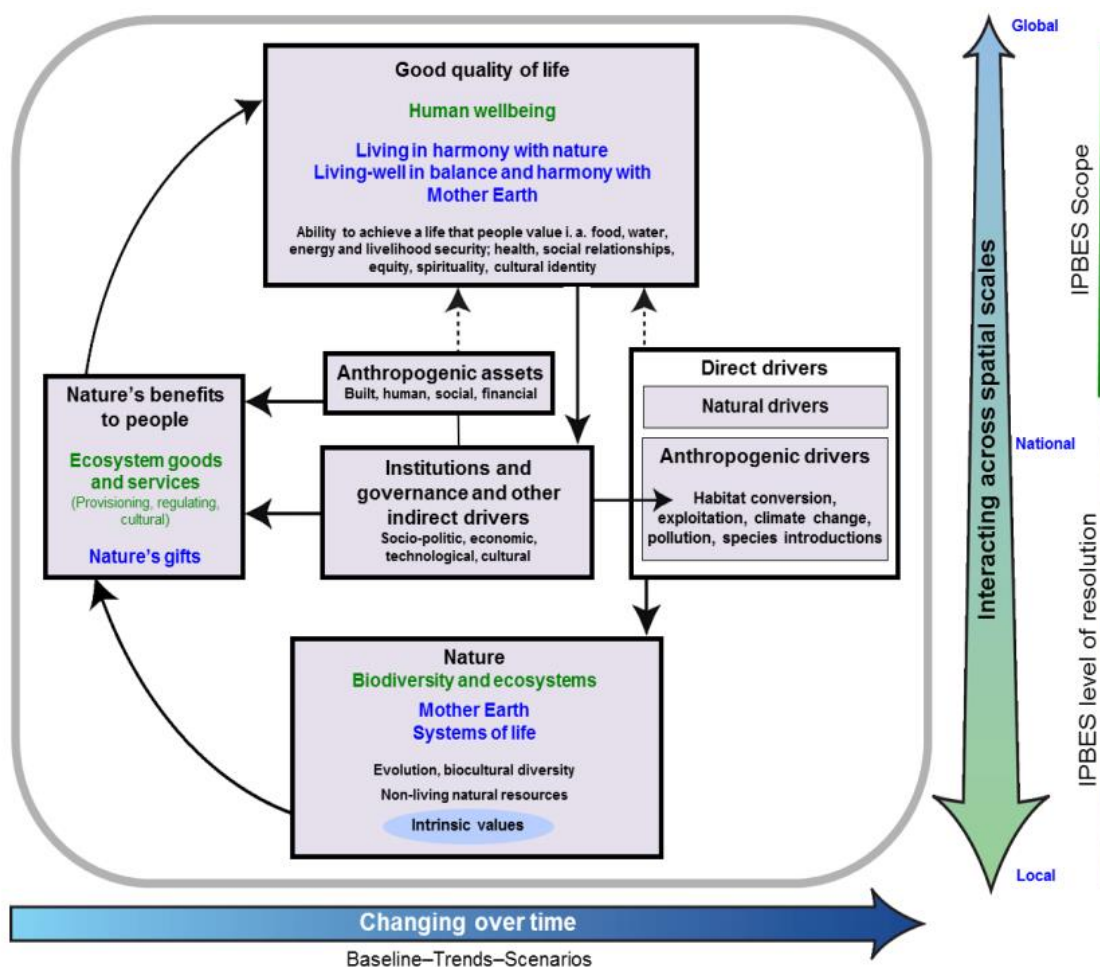


Figure 1.3: IPBES conceptual Framework (IPBES, 2014)

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* albeit in a deliberative way.

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 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 a communications tool, if we see them as provisional and open to challenge. It is, in fact, on these grounds where many (e.g. Karl 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. If the goal of OpenNESS is to operationalize the ecosystem services 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, and understandings of where limitations of current thinking are apparent. These are both theoretical and practical issues – and both aspects have been reflected in the work to develop 'operational guidelines' in WP1.

## 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 transdisciplinary 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.

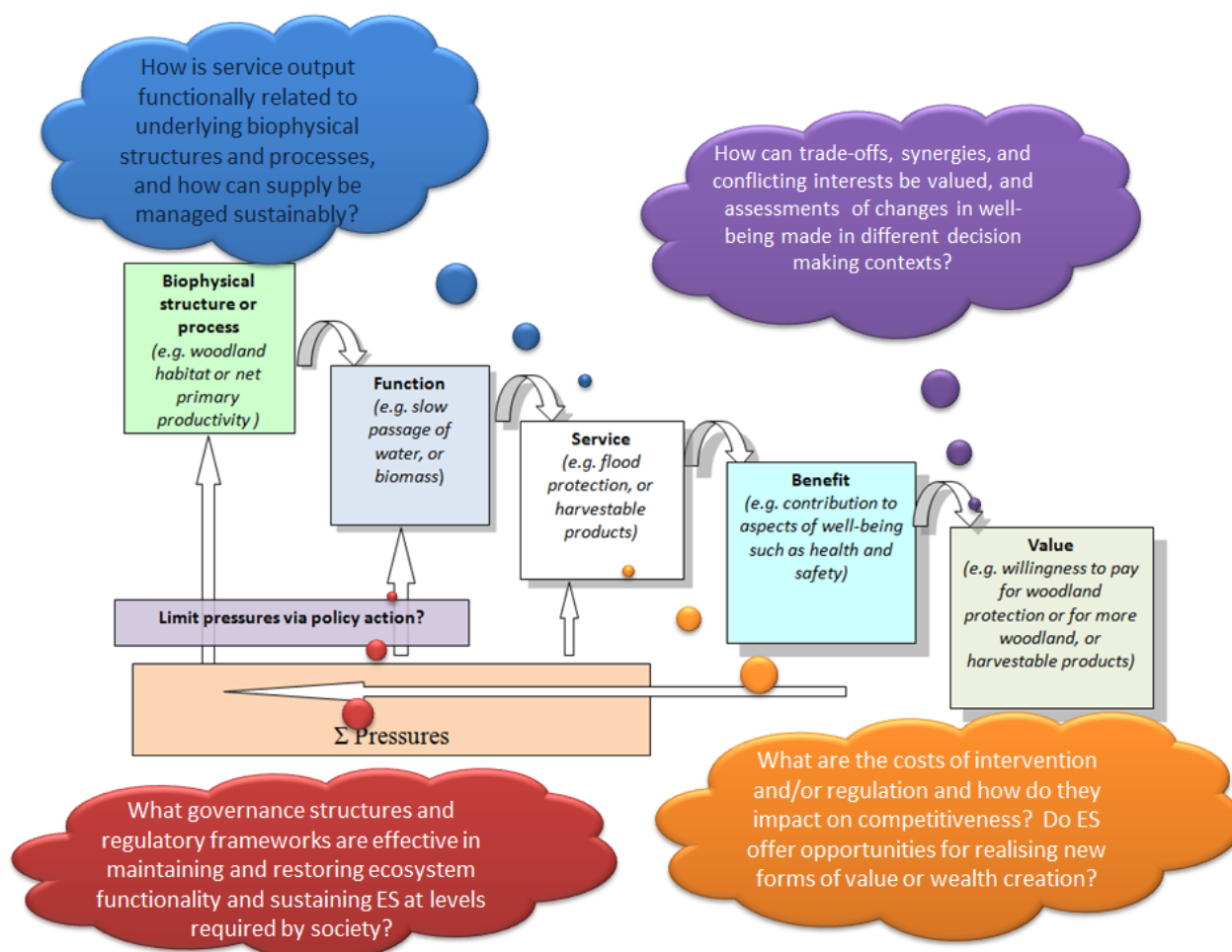


Figure 1.4: The Cascade model and the four challenges (Potschin et al., 2013)

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 ecosystem services 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 shaped the design of OpenNESS.

In the cascade ecosystem services are defined as the contributions that ecosystems (whether natural or semi-natural) make to human well-being; their fundamental characteristic is that they retain the link to

underlying ecosystem functions, processes and structures. By contrast, ecosystem functions are seen as the subset of the interactions between biophysical structures, biodiversity and ecosystem processes that underpin the capacity of an ecosystem to provide ecosystem services. They are the characteristics or behaviours of ecosystem services that directly determine the flow of services to people. In the cascade ecosystem services are seen as being distinct from benefits, in that the latter are defined as direct and indirect outputs from ecosystems that have been turned into products or experiences that are no longer functionally connected to the systems from which they were derived. Benefits are therefore things that can be valued either in monetary or social terms. In OpenNESS, the term natural capital is used to refer to all the elements of nature that directly or indirectly produce value for people, including ecosystems, species, freshwater, land, minerals, air and oceans, as well as natural processes and functions. The term is often used synonymously with 'natural asset'. Although it is not directly referenced in the cascade, in aggregate terms the elements of the cascade covering ecosystem structures and processes and their functional characteristics are clearly part of 'natural capital'.

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, 2016b). 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, it has its 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 makers 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 the aim was 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 The purpose and structure of this deliverable

This deliverable reports on the work that explored the role of conceptual frameworks in relation to the four OpenNESS challenges. In particular, it seeks to examine the suitability of the cascade model as a way of framing the issues linked to the challenges, so that it could be used as a communication device and a general conceptual framework. As such the document provides the platform for developing a set of 'operational guidelines' that can help people the key conceptual issues that make up the ecosystem service paradigm. The outcome of the work on these guidelines is reported in Deliverable 1.4 (EU FP7 OpenNESS project Deliverable 1.4, 2016).

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 Parts 2 to 5 of this document we review the challenges in more detail and take from the discussion what is needed to develop the OpenNESS Conceptual Framework. The aim in each of the four substantive sections is to develop an initial framework of questions that can be used to interrogate how the four challenges relate to the work of the OpenNESS case studies. They provide the platform for the empirical work reported in Part 6, which reports on the extent to which the cascade provides a way of comparing work across a diverse set of applications, and on how their research links to the four challenges. The concluding part of the deliverable then identifies the major lessons that can be taken from this work that can inform the preparation of guidelines that can support the operationalisation of the concepts of ecosystem services and natural capital.

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

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

Human well-being is widely regarded as a central component of the ecosystem service paradigm. Stimulated by the emphasis given to the issue in Millennium Ecosystem Assessment (MA, 2005), it has in fact become a major topic in policy taken up, for example, in the Strategic Plan for Biodiversity 2011-2020 and the Aichi Biodiversity Targets which aim to enhance the *benefits to all* from biodiversity and ecosystem services (Perrings et al., 2011). The concept is pivotal in understanding the link between human society and nature, because it allows considerations of how environmental issues relate to other factors that influence individual and societal well-being such as infrastructure, culture, or even the financial system. However, while it is generally recognised that notions of human well-being go beyond economic wealth, to include dimensions such as health (see Kretsch and Keune, 2016) or good social relations (Philipps 2006), the concept is somewhat poorly conceptualised in the ecosystem service literature. Polishchuk and Rauschmayer (2012, p. 109) argue, for example, that “identifying the ways in which ecosystem services contribute to human well-being essentially depends on how we define human well-being in the first place”.

Within the Cascade model, which is the basic point of departure for the OpenNESS conceptual framework, 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 ecosystem service. In order to explore the empirical links between ecosystem services 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 noted in Part 1 of this document, in developing ideas about human well-being, it is important to note that it is intimately linked to the other three OpenNESS challenges as, for example, good governance or increasing competitiveness *ultimately* aims at securing (or increasing) human well-being. To be consistent within the ecosystem services 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 our thinking in these other areas within OpenNESS.

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

Summers et al. (2012) have argued that even though what constitutes human well-being is of major importance in any application, the concept has been poorly elaborated in the ecosystem services literature. However, attempts to relate human well-being to environmental concerns have been made by Dasgupta (2001), Costanza et al. (2007), and most recently by King et al. (2014), Liu and Opdam (2014) and Breslow et al. (2016). This situation contrasts with fields beyond the environmental sciences such as psychology, philosophy, social, and political science, where there have been and are extensive and interrelated debates on what human well-being means, how it can be measured, and how these insights could be made operational, especially in development research. A review of the literature suggests that these debates have only partially been linked to ecosystem services, and empirical studies connecting ecosystem services in a



differentiated manner to the multiple dimensions of human well-being have rarely been carried out. ‘Human well-being’ remains, we suggest, both an ambiguous term and a multifaceted concept (cf. Gasper, 2007).

The MA characterised human well-being in terms 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, *Voices of the Poor*, commissioned by the World Bank (Narayan et al., 2000) in which people from 23 developing countries were asked about their ideas of a good (and bad) life (MA, 2003, p. 74)., but the MA did not develop the idea further. Indeed, most existing treatments of human well-being continue to neglect environmental concerns and focus more on perspectives from 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.

Overviews on the different ideas subsumed in the concept of human well-being have been given by Alkire (2002) and Gasper (2007). Gasper (2007) makes the distinction between thinking that involves ideas of: hedonism (‘well-being seen as pleasure’); desire theories (‘well-being as preference/desire fulfilment’); and, so-called ‘objective list theories’ (providing lists of the ‘elements that make a life well-lived’). A further important distinction that is useful concerns that between ‘subjective’ and ‘objective’ well-being (Gasper, 2005, 2010); these ideas differentiate *what* is measured in terms of feelings (subjective) or conditions (objective), and *how* it is measured (self-reported vs. nonself-reported), or if ‘private’ or ‘public’ values are taken into account.

Currently, the most comprehensive review of the elements of the different dimensions of human wellbeing in the context of ecosystem services is provided by Summers et al. (2012) (see also Smith et al., 2013, for a review of existing well-being indexes and the dimensions of human well-being). They identify a set of strongly interrelated dimensions that differ from those of the MA, namely: basic human needs; economic needs; environmental needs; and, 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 away from a dichotomy between a utilitarian vs. an intrinsic value perspective on nature to a more comprehensive understanding of human-nature relationships (see also Chan et al., 2016 and Jax et al., 2013). Other authors (e.g. Ballet et al., 2013; Polishchuk and Rauschmayer, 2012) have attempted to use the *Capability Approach* of Sen and Nussbaum (e.g. Nussbaum, 2011), which is seen as a multidimensional framework for analysis that is “an alternative to mainstream utilitarian and opulence frameworks” (Polishchuk and Rauschmayer, 2012, p. 103).

An eudaimon(ist)ic conceptualisation of human well-being is especially important when it comes to dealing with cultural ecosystem services (e.g. Chan et al., 2012), because many issues cannot be conceived as a resource but rather as a contribution to a well-lived, flourishing life; for example, the contribution of a landscape to someone’s personal identity. A further problem that requires a better differentiation of human well-being also relates to questions of justice, namely whose well-being is at stake, and how the provision of particular services might affect the well-being of different social groups in different and even opposing ways (Daw et al., 2011). This also relates to the question of power: who defines human well-being of a society? Which viewpoints and interests are included and which are excluded? Are also the interests of minorities accounted for? How much are the relations of humans to nature part of well-being concepts? In an operational context, definitions are clearly of high practical and even normative relevance.

## 2.3 Indicators of human well-being

Looking at these different viewpoints how to get hold of “human well-being” it becomes evident that there is no simple and general concept and measure for human well-being. Even though there are some dimensions (such as basic needs for food or shelter) which are always valid, many dimensions of human well-being are dependent on place, culture, and history. Therefore, it is a great challenge to develop universally valid indicators for human well-being.

Several indicators for human well-being have been developed, sometimes related to efforts to creating overarching metrics for human well-being, often as an ‘antidote’ to classical indices such as Gross Domestic Product (GDP), which are perceived as too narrow from both societal and environmental perspectives (Vemuri and Costanza, 2006; Summers et al., 2012). Prominent examples here are the Human Development Index (HDI) or the Genuine Progress Indicator (GPI). The European Commission, together with the European Policy Centre has initiated a project (*Well-being 2030*) investigating means of measuring well-being and its importance for European social policy-making (Theodoropoulou and Zuleeg, 2009). Other studies on a European level are pursued and collected in the context of the Beyond GDP-initiative<sup>2</sup>. It is important to note that human well-being concepts need to be adapted for specific contexts and often are determined individually and in interactions within social groups. Ideas of human well-being within societies (or societal groups) are thus to a large degree the result of shared and even deliberated values (Kenter et al., 2015) and also subject to diverse societal interests. Given the influence of specific cultural and historical circumstances mentioned above, specific concepts of human well-being must be considered as the outcome of a social process, and vary with space and time. Measuring human well-being needs to account of these dynamics and variability.

## 2.4 The place of human well-being in the cascade

As is apparent from the overview of the cascade model given above, ‘human well-being’ does not appear as a specific element in the conceptual framework. Given the importance of understanding the link with ecosystem services, the question of how to read or modify the cascade becomes a highly pertinent one.

Given our review of the literature it was agreed that for OpenNESS human well-being should be viewed generally as a *state that is intrinsically and not just instrumentally valuable (or good) for a person or a societal group* (cf. Alexandrova, 2012, p. 697). This generic definition was seen as sufficiently open to accommodate the different perspectives that many of the place-based case studies involved in the Project brought to the table. To provide some boundaries to the multiple possibilities still possible with this very broad definition, in terms of framing human well-being in a way was that ‘operationally’, its conceptualisation and measurement should follow a pluralistic approach and embrace both objective and subjective dimensions. The pluralistic perspective also implied that the way the concept is framed must also take account of the specific cultural and social condition of the application context. Nevertheless, despite endorsing an open and flexible approach it is assumed that the identification and measurement of components of human well-being can and should be done in a systematic way, rather than in an *ad hoc* one,

<sup>2</sup> The initiative is a project organised jointly by European Commission, European Parliament, Club of Rome, OECD and WWF. “The Beyond GDP initiative is about developing indicators that are as clear and appealing as GDP, but more inclusive of environmental and social aspects of progress.” See <http://www.beyond-gdp.eu>



and that the specific focus adopted can be justified on theoretical grounds using, for example, what Gasper (2007) calls "objective list theories"<sup>3</sup>. An alternative or complementary template might be that of the 'capability approach' derived from the work of Sen (1999) by Polishchuk and Rauschmayer (2012).

When viewed in this pluralistic way, it is therefore clear that 'human well-being' cannot simply be accommodated in the cascade by the addition of a further graphical element, but rather seen as an 'entry point' for discussion of all the components as a whole. Potentially, all the parts of the cascade can link to one or more dimension of human well-being. It is, however most closely linked to the right (social) part of the cascade (see also below), from where it indirectly e.g. effects what we consider an ecosystem service. Moreover, notions of well-being provide the baseline for assessing the significance of the current state of ecosystem services for people, and the importance of past and future change for them.

To illustrate how the cascade can be used to develop a richer picture of the ways in which human well-being links to ecosystem services, it is useful to focus on the notion of benefits as it is framed in the model. In the cascade 'benefits' are seen fundamentally as satisfiers of well-being; examples include 'recreational angling' as a benefit resulting from the presence of fish populations in an ecosystem, or 'flood control' as a benefit resulting from water flow regulation. Benefits can therefore relate to human well-being in different ways. Thus if well-being is conceived as a personal physical or mental state or abilities (*subjective* well-being) benefits are external conditions and circumstances which contribute to well-being. However, in conceptions of *objective* well-being benefits consist of an improvement of these conditions and circumstances themselves, such as an increase in food risk.

In general, subjective states include personal physical or mental states while objective well-being refers to conditions which are instrumental to achieve these intrinsically valuable states, like sufficient income as an external condition affecting mental or emotional states of well-being (Summers et al., 2012). Both subjective and objective well-being therefore provide a baseline for the evaluation of benefits and hence indirectly of services. Moreover, if objective well-being dimensions are related to intrinsically valuable states it is important to make this relationship clear; for example, while it is apparent in the case of food, shelter, or income it is more difficult to identify in the case of aesthetic experiences.

An understanding of the way 'benefits' link to different dimensions of human well-being in the cascade further enriches an understanding of what constitutes *value* in relation to ecosystem services. 'Values' like 'benefits' are also multi-dimensional. It is important, for example, to make the distinction between 'held values', which are based on the enduring beliefs concerning ultimate, preferred end-states of existence (Rokeach, 1973, Wallace, 2012) and the 'things in the world that are valued by people'. Things being valued are often referred to as a 'valued objects', and the relative worth given to these objects is referred to as their 'assigned value' (Ives & Kendal, 2014). In a valuation procedure, held values thus provide yardsticks for assigning values to objects of interest like benefits resulting from ecosystem services. The question in valuation is to what extent these benefits meet held values. Human well-being is in itself a held value, albeit one encompassing a multitude of factors; in reading the cascade questions therefore arise concerning both *which* values and *whose* values need to be taken in to account. Thus drawing on Chan et al. (2012) and Kenter et al. (2015), the cascade can be expanded by exploring different dimensions of value in relation to human well-being, including those related to: the concept of values/ ethical theory; the consideration of individual and collective values, and value elicitation; and the recipient of benefits. These different dimensions will produce different and sometimes contrasting results. For example, a market-based

<sup>3</sup> The term "objective list theories" refers to lists reflecting shared, not individual values. Some authors are uneasy about the qualifier "objective" for these theories. Scanlon (1993, p. 189), for example, would rather call them "substantive good theories" because "unlike desire theories, they are based on substantive claims about what goods, conditions, and opportunities make life better."

assessment of a national park's cultural value (for example, measured in terms of visitor numbers) may lead to other findings than a valuation of its natural heritage or its scenic beauty. Although individual preferences and subjective well-being are important aspects of human well-being, they do not capture it in their entirety. In contrast to preferences, values can be imposed from outside or by collective agreement. Since values can be influenced by cultural, social and political factors, a reading of 'value' alongside that of 'benefits' potentially opens up other perspectives via the cascade.

### A preliminary analytical framework for human well-being

In order to understand better how these theoretical consideration play out in the context of 'real world' applications, the following two questions were proposed as an initial way of investigating the conceptual thinking of the case studies and how their work related to that of the four challenges:

- What are the relations between specific ecosystem services (types) and specific components/types of human well-being (both positive and negative)?
- What are the trade-offs in terms of well-being effects of different ecosystem services between the stakeholders (i.e. is there a gain of some aspect of well-being for some stakeholders at the expense of other stakeholders and/or other components of well-being brought by ecosystem services); what are the appropriate scales (local, EU, global)?

The first question is especially important given findings such as those of Raudsepp-Hearne et al. (2010) who noted the findings of the MA, for example, are paradoxical in that it seems that at global scales human well-being has increased while ecosystem services have declined. As a result one might question the supposed dependency of well-being on the integrity of nature. The purpose of the first question posed here is therefore to explore the multifaceted nature of both services and well-being as a way of untangling the complexity of the relationships that may, in fact, exist.

The observation that different aspects of well-being may relate to different ecosystem services in different ways naturally leads on to the second question posed, concerning trade-offs. That there can be trade-offs and synergies within bundles of ecosystem services is well known. What is less well understood is how these patterns of trade-off and synergy map on to different stakeholder groups and how these play out in terms of, for example, social justice at different spatial and temporal scales. The implication and meaning of 'trade-offs' therefore needs to be looked at from an ecological and social perspective. This second question was therefore formulated to gain some insights into the ways that the OpenNESS case studies were unpacking such issues.

### 3. Ecosystem Services and Natural Capital and Sustainable Ecosystem Management

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

Like ‘human well-being’, the concept of ‘ecosystem management’ is often a central concern for those dealing with ecosystem services. Indeed the motivation for turning to the notion of ecosystem services is often prompted by needing to make stronger, more socially and economically grounded arguments in favour of conserving or sustaining the environment. However, also like ‘human well-being’ the concept is a broad and ill-defined one, and so can be approached in a number of ways.

For example, the extent to which ‘sustainability’ is a part of ecosystem management is itself a moot point. Smith et al. (2016) have reviewed the concept of sustainable ecosystem management in the context of OpenNESS, and, following Chapin et al. (2002), concluded that it is appropriate to view ecosystem management as *‘the application of ecological science to resource management to promote long-term sustainability of ecosystems and the delivery of essential ecosystem goods and services to society’*. However, experience suggests that the resources provided by ecosystems have been managed in ways that do not achieve these long-term goals and so understanding what steps are needed to achieve such outcomes remains an important and significant challenge.

While interest in the issues surrounding ecosystem management and environmental sustainability predate much of the work on ecosystem services, it is nevertheless the case that the concept of ecosystem services has brought a new and potentially useful dimension to the debate. Smith et al. (2016) argue that it has encouraged people to see that people and nature are part of a single, ‘socio-ecological’ system, and that ‘successful’ ecosystem management requires sustainable and equitable governance. Drawing on the work of Brussard et al. (1998), Slocumbe (1998), Szaro et al. (1998), McLeod and Leslie (2009), and Chapin et al. (2011) they suggest that the key characteristics of ‘ecosystem management’ are that it:

- considers entire ecosystems, with their complex connections, rather than individual sites or species;
- aims to balance human social, economic and cultural needs (the delivery of essential ecosystem services) with ecosystem sustainability (maintaining healthy, productive, and resilient ecosystems in the long term);
- involves all stakeholders in collaborative decision-making, including scientists, national and local government, NGOs, business, local residents, and the public;
- resolves conflicts arising from different stakeholder needs through negotiation;
- is interdisciplinary in its approach, bringing together science, resource management, planning, economics, sociology, law, and politics;
- involves co-operation between different agencies, crossing political and organisational boundaries;
- is place-based, but also considers wider objectives such as cumulative environmental, social or economic effects at regional, national or global scale; and,
- uses a flexible adaptive management approach, with continual monitoring, learning, feedback, and adjustment of goals and strategies to meet changing needs and incorporate new information.

When looked at in this way the concept of ecosystem management is more a description of a process than a specific outcome of some management intervention, and in the context of OpenNESS therefore its role is

more to define what needs to be achieved operationally in terms of the way management systems are designed and applied. This procedural characteristic clearly means that much of what needs to be considered is in fact part of the wider discussion of governance; the style, purpose, and ultimately the success of ecosystem management depends on the composition, organisation, and responsibilities of the formal and informal institutions that seek to intervene in relation to some issue, or act to shape some desired outcome (see Part 4).

As important as this procedural dimension of ecosystem management is for OpenNESS as a whole, in terms of the conceptual work being done in WP1 has sought to focus more on *what* is being managed with sustainability in mind, rather than *how* the goals of management are being achieved. An exploration of these procedural aspects is in fact more the focus of Deliverable 1.4, which deals with operationalising our conceptual guidelines. Instead, work for this Deliverable started from the pragmatic viewpoint that even if the eight ideal characteristics of ecosystem management outlined above are met, we would still need to ask *what evidence would we need to collect to inform management decisions* and *what would we need to observe as an outcome to make a judgment about sustainability*.

### 3.2 State-of-the-art: Exploring the sustainable management challenge

In order to develop the initial conceptual work on ‘sustainable ecosystem management’ in OpenNESS we have focussed particularly on the relationship between biodiversity and ecosystem services. This decision was based on two considerations: First, given the fact that arguments for *sustaining biodiversity* are increasingly being made in terms of the contributions that living systems make to people’s well-being, it is appropriate to be clear what this relationship entails in conceptual terms. Second, many judgements about sustainability rely on assessing the balance between the ability of ecosystems to supply services and people’s demand for them, and understanding of the factors that determine the capacity of living systems to provide different kinds of output that people find useful or valuable is essential.

Part of the difficulty of conceptualising the role of biodiversity in the supply of ecosystem services comes from the ambiguity of the term itself (de Groot et al., 2016). When used in a rigorous way it concerns the *variety* of living things at, for example, the habitat, species, or gene level. However, in the expanding literature around ecosystem services, the term biodiversity is increasingly used as a shorthand for living things, and interest focuses as much on their particular characteristics and behaviours and the way they lead to the output of ecosystem services, as on the importance of the actual variety or diversity of living things and their characteristics. Further ambiguity is added in the context of ecosystem services, for, as Mace et al. (2012) point out, biodiversity can be taken to mean at least three things, since it can be used to describe the role of living things as a regulator underpinning ecosystem processes, as a final ecosystem service, and as a good that is subject to valuation, whether economic or otherwise. These authors usefully go on to describe the kinds of management implication that follow from these three distinct types of contribution (Table 3.1).

Table 3.1: A preliminary assessment of the nature, management priorities, and implications of biodiversity playing its three different roles in ecosystem services (Mace et al., 2012)

Biodiversity acting as:		
A regulator of ecosystem processes	A final ecosystem service	A good
<b>What kind of organism?</b>		
Microorganisms: decomposition and nutrient cycling Primary producers (plants on land and in water): biomass production and carbon capture Top predators, parasites: population regulation Pollinators: stability of nonagricultural ecosystems	Wild crop and livestock relatives: ensuring genetic diversity to provide resilience of food production systems against future climate change/diseases and so on Organisms with secondary compounds: potential for commercial exploitation, for example novel pharmaceuticals Pollinators: security of many food crops	Large vertebrates, especially birds, mammals and conspicuous flowering plants: recognised for their charisma and aesthetic appeal Flagship or umbrella species: providing protection for wider communities and habitats Phylogenetically distinct species: maintaining evolutionary diversity Endangered species: maintaining taxonomic diversity
<b>What kind of ecosystem management?</b>		
Inputs need to be managed to achieve productivity and maintain nutrient cycles and decomposition but with the risk of reducing the ability of the system to deliver other services Importance of maintaining diversity for resilience, and resistance to predictable and unpredictable future environmental change	Management to maintain the necessary range of species groups and habitat or landscape types; has had, and will continue to have, profound implications for management practices; often potential conflicts, especially if the maximising of one service is a management goal	Directed and often very focused management for enhancing viability of individual target species or species groups
<b>How do humans benefit?</b>		
Healthy fertile soils, clean air, clean water, disease and pest regulation, climate regulation, and food and fibre production	Enhancing genetic variability for goods such as novel pharmaceuticals, crop strains, livestock breeds and pollinators.	Cultural services, recreation, tourism, aesthetic enjoyment, inspiration and education
<b>How important is 'diversity' compared with biomass or composition?</b>		
For some services and over the short term, composition and biomass might be more important attributes but little is known of the functional roles of most soil organisms and there is no reason to assume a lesser role for biodiversity here than elsewhere Biodiversity provides resilience (an 'insurance' role)	Diversity within and among relevant groups of species is essential; might be possible to preserve some elements of this diversity in gene or seed banks but these are unlikely to conserve the full range of diversity	Preserving species richness is primarily about diversity

Mace (2016) has argued that, given the complexity of the issues surrounding ecosystem services, greater 'coherence and clarity' might be achieved by making a clear distinction between the concepts of ecosystem services and natural capital. She suggests that rather than treating them as synonymous as many commentators have done, it is helpful to regard natural capital as the stock from which ecosystem services flow. She suggests that this idea has resonance with understandings in other fields, "such as between the capital held in the bank and the flow of interest payments, or between the size of a fishery stock and the flow of sustainable catch" (Mace, 2016, p. 602). In the context of resolving the ambiguity around the concept of biodiversity this may also be useful, because compositional variety can be seen as one of the properties of the stock of natural capital that regulates the output of ecosystem services, alongside other properties such as its bulk in terms of biomass or the abundance of particular species or species groups.

In terms of the cascade it is important to note that neither biodiversity nor natural capital appear as an element in the model. However, the structure is consistent with the thinking set out above, in the sense that the underpinning role of living things as a source of ecosystem service flows is captured in the twin notions of 'structures and processes of ecosystems' and their 'functional' properties. Although some have argued that the term 'ecosystem function' is unhelpful (Jax, 2016) others have suggested that it is valuable as a way of identifying the particular properties or behaviours of ecosystems that determine the level and quality of

the service. As such, it is often (but not exclusively) by managing these functional properties (of natural capital) that the output of ecosystem services can be sustained.

Given the ambiguity that surrounds the idea of biodiversity in the discussion that follows, we seek to make this distinction between the role that *variety* plays in the output of services and as opposed to the other properties of the natural capital stocks themselves.

### 3.2.1 The relationship between the diversity of living things and ecosystem services

A useful graphical representation of the dilemmas surrounding the relationship between biodiversity (sensu variety) 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 functions’ more than a decade ago. 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 ecosystem functions and the output of ecosystem services are dependent on a wide range of *native* species. Moreover, while a number of different types of relationships between biodiversity and ecosystem functions can be anticipated, we would need to show that there is a direct and *positive* association between some measure of biodiversity and ecological functions.

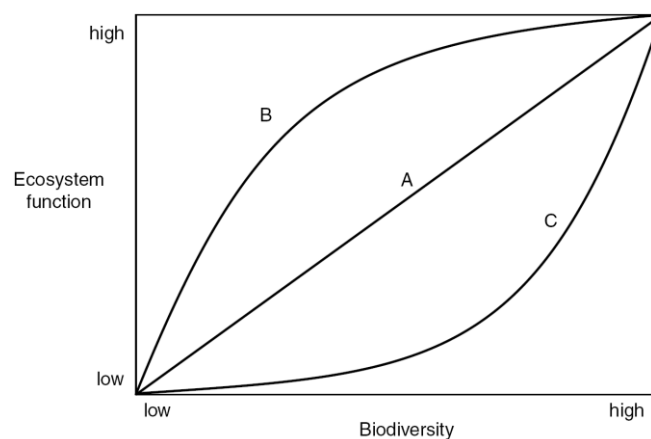


Figure 3.1: Potential relationships between biodiversity and ecosystem functions (after Schwartz et al., 2000 and Kremen, 2005).

Thus, in relation to the possibilities shown in Figure 3.1, 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 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 functions, then the conservation argument is potentially undermined. In contrast, it would be greatly strengthened if the kinds of relationships shown in A or C were detected. Whatever type of relationship exists, however, the models suggest that there is a certain minimum level of biological diversity that needs to be maintained if a particular level of ecosystem functions is to be sustained.

The nature of the relationship between biodiversity and ecological functions is, however, likely to vary from one situation to another, and between different spatial and temporal scales. Nevertheless, there is an



increasing body of evidence to suggest that there is a direct relationship between species diversity and ecosystem functions (as opposed to no dependency at all).

Early work includes the review of Balvanera et al. (2006) which used a systematic review of experimental studies to show that higher species diversity has a positive effect on a range of functional properties of ecosystems. Soliveres et al. (2016) note that while there is indeed a body of experimental evidence to suggest that the loss of biodiversity impacts on the capacity of ecosystems to provide services, it is important to also test the existence of such relationships in the ‘real world’. Thus, these authors investigated 150 grasslands from sites in Germany, using a ‘multi-trophic approach’. This involved measuring richness and abundance of species in nine trophic groups: primary producers, above- and below-ground herbivores and predators, detritivores, soil microbial decomposers, plant symbionts, and bacterivores. They found that high species richness in multiple trophic groups (multitrophic richness) had stronger positive effects on ecosystem services than richness in any individual trophic group, and argued that, as a consequence, by focusing on single species groups researchers have underestimated the functional importance of biodiversity. In a complementary study, Allen et al. (2105) also investigated the same sites in Germany and showed that biodiversity loss and changes to functional composition could explain the impacts of land-use intensification on the output of ecosystem services in managed grassland ecosystems. They concluded that restoration of biodiversity in these systems might offset some of the negative effects of intensification and promote ecosystems that deliver a wider range of services, especially cultural services. The need for such restoration has, for example, been argued elsewhere by Benayas et al. (2009).

A strong relationship between species diversity and ecosystem function have been also been found for ‘production forests’ ecosystems by Gamfeldt et al. (2013). Using data form the Swedish Forest Inventory , they demonstrated that species richness appears to show ‘positive’ to ‘positively hump-shaped’ relationships with a range of ecosystem services, such as tree biomass, soil carbon storage, berry production, and game production. They also found that that no single-tree species was able to supply all services, and, indeed, that some services were negatively correlated to each other. The conclusion that they drew was that such forests would benefit if management focussed on planting multiple tree species so as “to sustain the full range of benefits that the society obtained from forests” (Gamfeldt et al., 2013, p. XXX).

Isbell et al. (2014) have suggested that biodiversity loss is potentially creating an ‘ecosystem service debt’, which they characterise as a gradual loss of biodiversity-dependent benefits that people obtain from the remaining fragments of natural ecosystems. While they have gone on to suggest an approach for quantifying such ecosystem service debts, we are perhaps still a long way from understanding how much diversity needs to be maintained or restored; in such circumstances a precautionary approach is probably required, involving, they suggest, the conservation of both the quantity of ecosystems in terms of their area, and their the quality, in terms of biodiversity. This may be especially important when we consider the ability of ecosystems to supply multiple ecosystem services where, as Balvanera et al. (2014) argue, the relationships between diversity and service output may be even stronger.

### 3.2.2 The relationship between the properties of ecosystem services and natural capital

An analysis of the relationships between natural capital (or ‘biodiversity’) attributes and ecosystem services within OpenNESS has been the focus of WP3, which has undertaken a systematic review of 690 journal articles and other peer-reviewed literature across four provisioning, seven regulation and maintenance, and two cultural ecosystem services (see EU FP7 OpenNESS Deliverable 3.1, 2015). This research builds on an earlier study by Harrison et al. (2014) who looked at the links between ecosystem services and so-called ‘biodiversity attributes’ across eleven ecosystems as part of the EU-funded BESAFE project. The work in

OpenNESS refined and extended the earlier effort by increasing the number of articles considered and also by using the literature to identify indicators measuring actual or potential ecosystem service delivery, information about the impact of human activities and policies on the relationship, the positive and negative interactions between services and reports of the existence of any biophysical thresholds.

Most of the biotic attributes identified in the review by EU FP7 OpenNESS Deliverable 3.1 (2015) were found to have beneficial impacts on the output of ecosystem services. Three groups of attributes could be identified. First, the physical amount of vegetation within an ecosystem, measured in terms of habitat area, vegetation productivity, above- and below-ground biomass, stem density, species size/weight, growth rate, and successional stage. These properties tended to have beneficial impacts on ecosystem functions and their related services, such as carbon storage (atmospheric regulation), water flow regulation (flood protection), mass flow regulation (erosion prevention), water quality regulation (water purification), and air quality regulation. The second group highlighted the importance of the presence or abundance of particular species or functional groups within the ecosystem, which favoured services and benefits such as freshwater fishing, timber, species-based recreation, pollination, and pest regulation. This group demonstrated the value of identifying species-level traits (such as size or predation behaviour) as a way of understanding the properties of natural capital that contributes to service output. Finally, this research showed that a third group of services related more directly to species diversity could be found. The services in this group included timber production, atmospheric regulation, pest regulation, and pollination. The explanation for these kinds of relationships were based on notions of *niche complementarity*, where efficiency is maximised because different organisms occupy different ecological niches, and the *selection effect*, where the presence of a wide range of different species improves the chance that one of them will be a high performer. Overall, however, although the relationships between all three groups of attributes (diversity included) and service output were positive, there was little evidence at present of any clear threshold effects (cf. Figure 3.1).

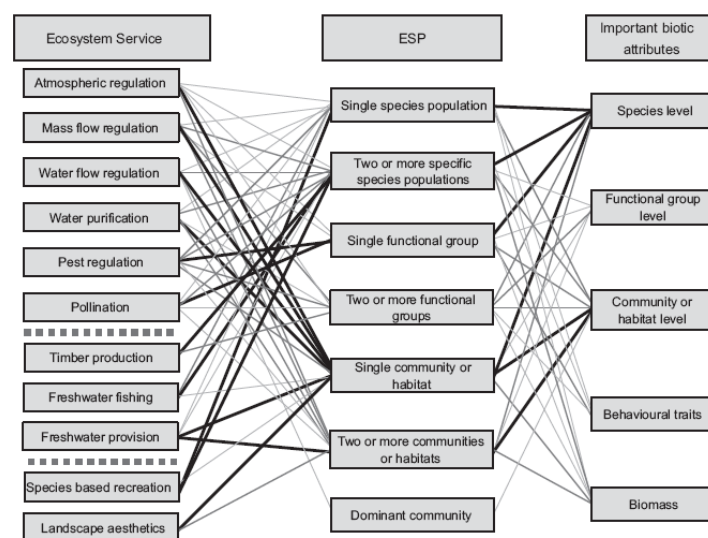


Figure 3.1: Potential relationships between biodiversity and ecosystem functioning (after Schwartz et al., 2000 and Kremen, 2005).

The implications for research on ecosystem management are that given the complexity of a multitude of linkages, interventions may need to focus on both diversity itself and the properties of particular species or groups. Some aspects of this challenge was illustrated by Harrison et al. (2014) in the earlier study, where



they examined how the relationship between the different biotic attributes and services could be understood in terms of a range of different ‘ecosystem service providers’ (ESPs) (Figure 3.3). When dealing with multi-functional ecosystems they emphasise that it is important to consider a range of organisational levels involved in the overall relationship between biodiversity and ecosystem services with each service being linked to a number of ESPs and biodiversity attributes that together span multiple spatial scales. The way the ESP concept developed from earlier notions of ‘Service Providing-Units (SPUs) has been reviewed in OpenNESS by De Groot et al. (2016), who also emphasised the importance of *adopting a ‘nested approach’* in order to understand the way in which ecosystem structures, processes, and functions link to services and, ultimately, to human well-being.

### 3.3 The place of sustainable ecosystem management in the cascade

Although the cascade expresses the idea of a dependency of services on the different attributes of natural capital, the simple linear structure of the model clearly belies the complexity of real work systems, especially when we consider how they change over space and time. The importance of thinking about the spatial variability of ecosystems has, for example, been demonstrated by Lavorel et al. (2011) who combined single ecosystem services models based on plant traits, and analysis of abiotic characteristics, to identify ‘hot’ and ‘cold’ spots of multiple ecosystem services delivery across the pasture-dominated landscape in the French Alps. The authors found that the trait-based approach combined with more traditional analysis of land use can lead to a better understanding of ecological constraints and, hence, the opportunities for managing the delivery of multiple ecosystem services.

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 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, we need to understand how they are ‘bundled together’ and interact with each other, and this can only be done by exploring the perspectives of the people who use or benefit from these services. Hence, there is a need to approach the analysis of biodiversity service relationship from a *socio-ecological* perspective.

The second proposition suggested by Bennett et al. (2009) focussed on synergies and trade-offs within 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 3.1). They are also a vital component of the analysis being attempted under the well-being challenge.

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

<i>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.</i>
<i>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.</i>
<i>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.</i>

### A preliminary analytical framework for governance and institutions

In order to understand better how these theoretical considerations play out in the context of ‘real world’ applications, the following questions were developed as an initial way of investigating the conceptual thinking of the case studies, namely:

- How does biodiversity and the attributes of natural capital contribute to ecosystem service provision, and vice versa?
- What are the trade-offs and synergies between biodiversity conservation and ecosystem service provision?
- How can ecosystems be managed sustainably to support biodiversity and ecosystem service provision?
- How do value assumptions influence biodiversity and the assessment of trade-offs?
- Can ecosystem management for biodiversity conservation support the adaptive potential (resilience) of ecosystem service provision to long-term environmental change?

Our discussion of the literature relating to ecosystem management suggests that any conceptual framework must explicitly include reference to notions of thresholds and limits, to capture the idea that there may be a minimum level of biodiversity or a set of natural capital attributes required to sustain some targeted levels of service output; these issues therefore form the background to the first three questions posed. Our discussion also suggests, however, that given the multi-functional character of ecosystems, this type of analysis may be complex. Nevertheless, for issues of trade-off between services are to be understood and managed, this will require insights into the relationships between stakeholders and the values they hold, and how their actions impact on or shape ecosystems. These kinds of issue form the background to the last three questions posed above; they also provide key entry points for a discussion on the links to the other three challenges.

## 4. Ecosystem Services and Natural Capital and Governance

### 4.1 The place of governance and institutions in the OpenNESS Conceptual Framework

Governance of ecosystem services and natural capital is the third major challenge addressed by OpenNESS, its relevance underlined by the aim to ‘operationalise’ or ‘mainstream’ the concepts. Although notions of operationalisation and mainstreaming are often used in quite unspecific ways, we take it as a starting point that they imply the introduction of concepts such as ecosystem services and natural capital into a variety of policy fields, not just those focussed on nature conservation or environment. Moreover, we take it as an assumption that to fully understand the extent to which integration of thinking about ecosystem services and natural capital has been or can be achieved, and to identify what barriers to future progress exist, we need to investigate what governance mechanisms exist *and* the wider institutional arrangements in place within which ecosystem management and policy are carried out. Thus, developing the OpenNESS conceptual framework for this challenge, notions of governance and institutional context will be explored. Since they are so closely connected it is often difficult to systematically distinguish between them in real-life situations. However, to better see what consideration of institutions brings to the debate, it will be helpful to initially discuss governance and institutions separately.

### 4.2 State-of-the-art: understanding governance and institutions in relation to ecosystem services and natural capital

#### 4.2.1 Governance

Discussion of governance generally involves seeking to understand how organizations or countries are managed at the highest level, and the systems for doing this; the governance arrangements that prevail determine who has power, who makes decisions, how other actors make their voices heard and how account is rendered. In the multi-level policy making context of the EU, the effectiveness of regulatory frameworks and other policies is strongly dependent on the vertical and horizontal integration of the respective policies and processes of policy making. There is less evidence, however, that vertical and horizontal policy integration is effectively supported in other areas of environmental policy such as sustainable development strategies or climate mitigation and adaptation strategies (Casado-Asensio and Steurer, 2014). Further, given that different stakeholders at different levels may have different perceptions, values, and interests, and may try to influence the policy system in different ways, the issue of inclusiveness of policy making, i.e. the form and degree of stakeholder involvement, is an important concern that needs to be addressed.

There is no consensus in the literature about the exact meaning and operationalization of governance across different (sub-)disciplines and different conceptual approaches within these disciplines (e.g., Jessop, 2002; Hajer and Wagenaar, 2003; Pierre and Peters, 2000; Rhodes, 2007). What is particularly contested is whether the term itself has a normative connotation, i.e. whether the shift from government to governance is favourable per se, or just a matter of fact. This last issue is important for the governance of ecosystem services and natural capital in general (e.g., concerning the inclusion of stakeholders). Even more so as there are very different modes of governance, including market-based mechanisms, networks, and cooperatives; all having context-specific advantages and disadvantages (Driessen et al., 2012). This debate becomes even

more controversial, however, by the fact that many scholars assume that the concept of ES is in favour of market-based modes of governance, which also challenge state regulations (Gómez-Baggethun and Ruiz-Pérez, 2011; Sikor, 2013). Thus, market-based Instruments (MBI) are often perceived as ‘better’ compared to other governance mechanisms. But what are appropriate criteria for the evaluation of governance modes? What is more, the precise (set of) normative criteria for evaluating governance may vary over time and may be disputed between different stakeholder groups and, thus, need to be reflected carefully.

Effectiveness in general means the performance of policy making in relation to achieving a set of self-defined aims (Heink et al., 2016). 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 ecosystem services and natural capital in different and sometimes conflicting ways. To support a sustainable management of ecosystem services and natural capital 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 place-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.

The effectiveness of governance can only be measured against self-defined aims or purposes, be it nature protection or improving agricultural productivity. However, as a cross-cutting concept, which is not restricted to environmental aims like nature protection, aims of ecosystem service and natural governance may vary across a broad spectrum and stimulate trade-offs. What is good for nature protection may not be good for provisioning services or human well-being. In particular, the quality of governance processes may be measured differently whether a specific aim is considered, such as the protection of biodiversity, or whether a broader approach is taken into consideration addressing the balance between biodiversity conservation, agriculture production, and human well-being, among others. This broader approach is the reason why the ecosystem service and natural capital concepts raise high expectations for mainstreaming the ideas in different policy fields. At the same time, it significantly complicates the search for ‘Good Governance’; and being aware of this complexity is important. One often ignored implication of the notion of mainstreaming ecosystem services and natural capital is that aims from several policy fields must be balanced and that there is a need for policy integration or policy coherence between different policy fields (Ring and Schröter-Schlaack, 2011; Primmer et al. 2015; Primmer and Furman, 2012). We can expect that this will raise conflicts of aims (policy trade-offs), but also conflicts of interests and thus is linked to the power relations involved.

Conflicts between aims also raise normative concerns, such as how to balance, for example, biodiversity protection and human well-being. The reasons behind the conflicting aims under scrutiny and the expectations involved should be recognised. Identifying the interests underlying such conflicting aims can reveal underlying power structures; yet, rearranging them is likely to reveal the limits of certain governance modes in place, but also of governance in general. Dominant interests may impede a solution where ecosystem service trade-offs and conflicting aims need to be balanced. These kind of conflicts usually emerge between (often) private economic actors, but are transferred also towards the state administration and other organisations, leading, for example, to conflicts between ministries and other (non-)governmental bodies about their influence on and their competences within a certain decision-making process. Unequal

power relations are an important source for potential governance failures, and probably also one major reason for the degradation of ecosystems and the decline of biodiversity. For the governance of ecosystem services and natural capital, this implies that we have to address also the power relations related to existing or emerging modes of governance (Turnpenny et al., 2014; Keune et al., 2013).

Several criteria for measuring the quality of governance are used in the literature, often with divergent interpretations: should the quality of governance be measured in terms of the outcome (e.g. effectiveness in reaching a certain target), the output (e.g. whether any policy measure is established, regardless of its effects), or the throughput (i.e. concerning the quality of the governance process, see Rauschmayer et al., 2009)? For ecosystem services and natural capital, effectiveness and inclusiveness (e.g., in terms of broad stakeholder participation) are often required; but also efficiency is sometimes mentioned. For evaluating the effectiveness of ecosystem services and natural capital governance, first of all we need to further identify its goal(s) (see next section). The notion of Good Governance needs clarity whether we expect a good result (outcome) or a good process, or both - and how both expectations are linked to each other. This challenge can be addressed through participatory evaluation, as the quality of such processes is very hard to objectify and to grasp empirically. Moreover, one-size-fits-all approaches to governance may not be the best answer to all kinds of environmental problems and may create specific governance failure (i.e. failure emerging from the specific governance mode of steering, distinct from market or state failures; see Jessop, 2002). For example, sometimes governance instruments like Payments for Ecosystem Services (PES) are questioned for such kind of problems because they may not only undermine pre-existing regulations and produce negative outcomes, but also may violate resource users' rights and ethical values due to the often non-participatory process of implementation (Gómez-Baggethun and Ruiz-Pérez, 2011; Kronenberg and Hubacek, 2013; Sikor, 2013). Thus, to avoid governance failures, additional measures (e.g., participatory processes, forms of adaptive governance, and institutional learning) are required (e.g., Dietz et al., 2003).

Moreover, effectiveness used as a criterion in policy evaluations often addresses only the practical implementation of specific policy targets, i.e. the implementation of national policy targets in an action plan or in regional or local policy measures (e.g., integrating land-uses in spatial planning). Effectiveness in a broader sense, however, should also address the final outcome of the policy, in our case the socio-ecological impact (see the SP on effectiveness). To analyse these real impact of the underlying governance processes, however, a different approach is required which must include an analysis of ecological consequences of certain policy measures. The expectations in terms of 'good' or successful governance – and, consequently, which methodology and what evaluation criteria to apply – differ depending on which stakeholders, at which level, drive the changes in governance. A national political organisation, a local level administration, and a scientific research project are likely to use different evaluation criteria for governance. For policy makers, existing modes of regulation and the strategies or political organisations involved may be seen as given entities, whereas scientists may question the established procedures (e.g., the European multi-level governance system) and suggest alternatives. This, in turn, raises concerns how to organise adequate participatory processes, but also about the scope of Good Governance. Is the quality of governance related to the implementation of predefined criteria (like the criteria of 'good ecological status' in the EU Water Framework Directive), or are we looking for a new approach to water governance using the concepts of ES & NC to identify 'better' forms of governance?

Because of the characteristic features of normative implications of the terms ecosystem services and natural capital (e.g., trade-offs, importance of local knowledge), stakeholder involvement and inclusive participatory processes are required for the governance of ecosystem services and natural capital as a rule (Menzel and Teng, 2009). This includes serious reflections about range, type, and degree of stakeholder involvement. Stakeholder involvement can vary from information and consultation up to co-design and joint control over

the whole process. Additionally, the notion of inclusiveness and inclusive governance raises concerns about who should participate (Hauck et al., 2014, 2016b). One opportunity is to involve the responsible administration and some representatives of the most influential stakeholder groups only. At the other extreme, the process may engage all potentially affected people personally (to name only the extremes in a gradient). Involving everyone directly affected is often not feasible, but including only those with vested interest may tend to ignore concerns from a broader audience. Thus, finding an appropriate balance for a certain case is required, but not easy to achieve. In any case, an appropriate level of stakeholder involvement is a must and, thus, is an important feature of the governance component of the OpenNESS conceptual framework

#### 4.2.2 Institutional context

To understand governance issues generally, it is important to recognise the institutional context of ecosystem management and governance, and this needs to be reflected in the OpenNESS conceptual framework. Institutions can be taken as regulatory framework that condition action and allow coordination. Because of their conditioning character, institutions are often called ‘rules’, whether they are formally designed or have evolved as informal customs (Ostrom, 1990; North, 1991). They are distinct from, yet intimately linked with organisations (e.g., corporations, governmental authorities, universities, political parties), i.e. “[i]nstitutions define certain organisations or social programs, but these programs and organisations are best thought of as not being institutions, but as being defined by institutions” (Bromley 1989: 43).

Formal institutions include laws and legal principles that define, for example, property rights or market transactions. Breaking formal rules is at least in principle followed by a sanction. Institutions are often formalised in processes that can involve much politics and confrontation but the formalization might also be a mere stating of a practice that has gradually been taken up by the actors. Institutional evolution, where the formal laws and informal customs are in interplay and influence each other, can be exemplified by new biodiversity policies that introduce legal changes but their implementation is conditioned by pre-existing norms, which, in turn, might be formalised later (Le Prestre 2002; Primmer et al., 2013).

Informal institutions are norms embedded in interactions between groups or individuals. They can consist of codes of conduct and norms about appropriate behaviour in the society or within particular organisations or professions. Just like formal institutions, informal institutions shape and condition what actors can do, should, and should not do (Ostrom, 1990; Scott, 2001; Primmer, 2011). They differ from the formal ones in that they are not explicitly stated or written and their control is social; breaking against informal rules triggers disapproval. As an example of informal institutions organisations or policy processes might give certain actors a decisive role, even if all actors formally hold similar roles. Informal institutions about biodiversity conservation can include customary rights to access a resource, shared norms about as what rights humans or animals have, or ways that phenomena are understood, framed and categorised in everyday practice.

The stability of institutions and the clarity of rules contribute to predictability and efficiency. However, because institutions incorporate and express the power relations in societies and organisations, they may constrain the available management options. For this reason, institutions might cause tensions, trade-offs, and conflicts. Identifying the institutional context allows us to understand what has produced the current governance and management systems and which institutions will condition the future recommendations. Accordingly, institutions need to be yet another component of the OpenNESS conceptual framework,



intimately linked to governance, or as an integral part of governance arrangements in a broader sense (see also the IPBES CF, where institutions are at the centre, IPBES, 2014).

The regulatory frameworks at the EU level as well as at the national and lower governance levels, rest on broader national state and supranational institutions. Moreover, place-based management of ecosystem services can be strongly conditioned by local informal institutions. For this reason, we have to consider and analyse institutions at several governance levels and pay attention to their interplay. Institutional analysis can be carried out in a general and qualitative fashion, or it can be developed into detailed hypotheses and subjected to empirical testing.

### 4.3 The place of governance and institutions in the cascade

There is no single entry point for governance and institutional issues within the cascade. Policies and regulatory frameworks and the institutions related to them influence the composition and functioning of ecosystems as much as the provision of services and benefits and the valuation systems they depend on. However, the way these influences are exerted and whether they are deliberative actions, explicitly dedicated to govern certain ecosystem functions or services, or whether there are implicit side effects of certain measures or policies (perhaps from policy fields beyond environmental policy like infrastructure or trade policy), makes a difference. Thus, we need to discuss not one single place, but several entry points for governance and institutions within the cascade separately.

#### 4.3.1 Linking governance and institutions to ecosystem structures and processes

Institutions determine the ways that ecosystems are managed and governed currently and condition new management systems. The functions embedded in the complex ecosystem structures and processes as well as the social-ecological systems, which the ecosystem approach is aiming to make more explicit, cannot be managed as separate entities (Vatn, 2005). The inter-related ecosystem functions are however influenced by people and organizations whose behaviour might be targeted at a limited number of functions at a time, ignoring the systemic effects of the behaviour. Ecosystem functions, such as slow passage of water or biomass accumulation, are inter-related and influenced by complex societal processes. For example, the simple indicators of land use and land-use change are inter-related with markets and technological advances driving water and biomass extraction. The water use regulations and the management practices on agricultural and forestry lands used for biomass production influence ecosystems and ecosystem services beyond changes in land-use classes. Moreover, the rights and mandates to govern ecosystem structures and functions do not rest with one sector only, as the water and biomass examples demonstrate. The relevant institutions governing ecosystem structures and functions span also across governance levels, from international agreements to local level practices (Young, 2002). As a result of this complexity, governance of biodiversity and ecosystems faces several challenges including coordination and assigning rights as well as problems of uncertainty and ignorance.

For the analysis of institutions and governance, it is important to keep in mind the complexity and uncertainty about biophysical structures and ecosystem functions. The analysis should start by identifying those institutions that address ecosystem structures and functions, **explicitly** in the form of laws and policies at different governance levels, or **implicitly** in the form of dominant practices in administration,

management, and research. Here, the analysis might also seek to unravel the institutional interplay between different regulations and practices.

Finally, it should be noted that policies and management approaches, and the embedded institutions and governance modes, sometimes focus specifically either on ecosystem structures or functions. For example, EU regulatory frameworks like the Habitats Directive and the Green Infrastructure Strategy, but also landscape-oriented conventions and policies aim at conserving or improving certain, spatially determined ecosystem structures rather than individual functions. These targeted ecosystem structures are then hoped to trigger specific functions that provide highly demanded bundles of ecosystem services (Berry et al. 2016). Such a structural approach is, however, challenging from an institutional and governance perspective since it implies that – at least ideally – all activities of all stakeholders at all governance levels that (potentially) affect a particular ecosystem structure have to be influenced in such a way that they do not harm this structure. On the other hand, the majority of policies related to ecosystem services and the concrete measures they entail targets individual – or at least restrictive sets/bundles of ecosystem functions, such as soil fertility, or services (clean water, improved pollination).

#### 4.3.2 Linking governance and institutions to ecosystem services<sup>4</sup>

Institutions condition the way ecosystem services are perceived and actually used or enjoyed (Norgaard, 2009). Ecosystem services are framed and defined in various decision-making and analytical processes that are embedded in institutions. Tangible, extractable ecosystem services are governed by various natural resource sector administrations and organisations, while ecosystem services that rely on larger landscapes can be governed by land-use planning and particular ecosystem services can be governed with specific instruments (Primmer and Furman, 2012). Some policies, for example, payments for ecosystem services, assume that rights to the use and production of the ecosystem service can be defined. However, ecosystem services differ in terms of whether there are governance systems in place and whether the rights to the services have been – or can be – determined. The right of fishermen to a fishing quota has been determined much more clearly than the rights of local inhabitants to clean water or beautiful landscape. Some ecosystem services fall between governance systems, partly because the services are products of multiple ecosystems interacting. Flood prevention might depend on vegetation cover and pollinators might need other habitat than agricultural areas. These ecosystem services fall between governance systems because the services are products of multiple ecosystems interacting. The analysis of institutions and governance related to ecosystem services need to identify: the institutions that are in place to govern ecosystem services and those ecosystem services that are not covered by formal or informal institutions; and, the potential mismatches between these institutions. Additionally, the analysis would benefit by being sensitive to those institutions that condition the way we perceive ecosystem services (Primmer et al., 2016). Thus, when assessing / accounting for ecosystem services as part of the OpenNESS conceptual framework, the implications for the design and performance of governance and institutional arrangements have to be made explicit, and, vice versa, the limits of existing arrangements in taking ‘effectively’ into account particular, in particular ‘wicked’ features of the ecosystem services under scrutiny.

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<sup>4</sup> Largely, this section draws on Primmer et al. (2016).



### 4.3.3 Linking governance and institutions to benefits and values

When the focus shifts from ecosystem services to the benefits that humans experience and the value that humans ascribe to them, the scope of policies and organisations involved – and, thus, the related governance modes and institutions – goes far beyond the area of environmental or land management and includes, for example, health issues, infrastructure development, or economic policy. Similarly, it might relate to and account for very different dimensions but also different notions and interpretations of human well-being. Whereas values are related to an explicit ascription of a positive or aspired goal, benefits may not be recognised as such by certain actors (e.g., health services provided by ecosystems within urban areas, currently ignored or even not known by the inhabitants). Thus, formal and informal institutions that govern the benefits derived from ecosystem services may have a broader scope than those valued positively within a certain society, and they may ignore these benefits, or value other benefits not derived from these ecosystem services higher. Moreover, valuation takes place in several institutional contexts, the most apparent ‘value articulating’ institution in capitalist societies, but by far not the only one, is the market. Whereas religious or cultural ecosystem services are often not formally regulated, markets are based on clear property rights, measurable units, and sufficiently frequent transactions that capture the essential information about the traded units in prices. The association of ‘valuation’ with ‘money’ and ‘economics’, while a powerful language to some in certain contexts, is thus alienating valuation to others in many situations. Whereas ‘integrated valuation’, allowing for a (decision-making) context-dependent choice of valuation objectives and methods including individual or deliberative frameworks (Keune and Dendoncker, 2014) – is intended to provide a more inclusive frame and language for discussing the importance of ecosystem services (EU FP7 OpenNESS Del. 4.3; Gómez-Baggethun et al., 2014; see Dendoncker et al., 2013 for ‘inclusive’ ecosystem service valuation), we cannot expect that this kind of information creates a sufficient foundation of decision-making on ecosystem services and natural capital.

In contrast, these differences in valuation articulating institutions preferred and/or in place create additional challenges for the governance of ES and the definition of ‘accepted’, and thus effective, institutions and stimulate conflicts concerning the economic valuation and commodification of ES (Gomez-Baggethun and Ruiz-Perez, 2011). Many ecosystem services and benefits are not commensurable or tangible, so they are difficult to determine and they cannot be clearly appropriated to some actors (Chan et al., 2012). Therefore, the market is very often not the appropriate mechanism (or governance mode) to refer to when identifying values and when allocating benefits. Other governance modes that support identifying and allocating benefits include political and other decision-making processes. In practical terms, the distribution of the rights to benefit from ecosystem services – as well as the related duties or obligation to provide or preserve them – should be identified prior to analysing policies for reallocating the benefits and values.

The issue of finding and applying appropriate and widely-accepted valuation approaches topic is important for the relevance of research on ecosystem services and natural capital and how this research can inform (political and other) decision-making processes. On the one hand, there are strong expectations on part of many policy makers (e.g., Schleyer et al., 2015) and scientists alike that research can improve the governance of ecosystem services and natural capital while communicating their ‘proper’ economic value. Much research was stimulated by this belief, not at least the TEEB-report (TEEB, 2010). On the other hand, pure economic valuation cannot capture all benefits ecosystems provide and thus the prominence – in the scientific literature, but also in policy documents – of those ecosystem service benefits where economic values are available is misleading. This tension creates an important challenge for the interaction of science and policy within the research field. While the concept of ecosystem services stimulates high expectations towards a better governance of ecosystems and landscapes, other actors/stakeholders observe an increasing

commodification of nature leading to an increasing overuse and a deterioration of ecosystems (Turnhout et al., 2013, Unmüßig, 2014). This is particularly relevant at the EU level, where economic arguments are considered as important tool in the negotiations across DGs and units (Schleyer et al. 2015). In general, economic valuation may be helpful in cases where certain, limited trade-offs are concerned (TEEB, 2012). However, such economic valuation often fails in cases where a variety of ecosystem services are used for different purposes and the complexity of socioeconomic and ecological processes involved cannot be addressed as a whole due to methodical or other scientific reasons (e.g., lack of knowledge for some ecosystem functions, uncertainties in evaluation measures, the complexity of information or divergent cultural expectations; Spangenberg et al., submitted). One way to respond to this bias towards economic valuation approaches is to develop integrated valuation methods (EU FP7 OpenNESS Project Deliverable 4.3, Kelemen et al., 2015) and to critically reflect the use of the ecosystem services concept in conjunction with, or as part of, neoliberal policies (Dempsey and Robertson, 2015).

#### 4.3.4 A preliminary analytical framework for governance and institutions

In order to explore the conceptual issues discussed above the following questions were developed as a preliminary analytical framework for exploring the way the case studies were framing governance and institutional issues:

- What do people mean by effectiveness and coherence of policies?
- What are the determinants for policy effectiveness?
- How does the ecosystem services concept affect the determinants of effectiveness?
- How does socio-economic valuation and modelling have an impact on policy and action?
- What is the appropriate method for integrated valuation of ecosystem services?

The first question reflects the different perspectives on effectiveness, i.e. whether the focus is on environmental effectiveness, producing outputs (e.g., produced plans, farmers taking up a particular scheme), cost-effectiveness or the quality of the process of policy design and/or implementation. Further, we were interested in the case studies' perception on the level of coherence in terms of objectives and measures with, for example, policies in the same or related sector(s) and/or relevant policies at different scales. We also wanted to learn about ecosystem-related or socio-economic factors affecting – positively or negatively – the various dimensions of a policies' effectiveness. The last two questions were then addressing the concrete effects of actually used/applied or planned valuation and modelling methods on the design or implementation of targeted policies or management practices. Finally, we were keen to learn about the perception of case studies' on preferable valuation methods, how different methods performed in terms of acceptance, practicability/feasibility, and appropriateness given the very diverse regional contexts.

## 5. Ecosystem Services and Natural Capital and Competitiveness

### 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 stated, for example, that they are seeking to move ‘decisively’ beyond the current economic crisis to create the conditions for a more competitive economy with higher employment<sup>5</sup>. 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 natural capital and ecosystem services can play in realising such a goal.

This fourth challenge is particularly complex, because it cuts across a number of issues. Moreover in the minds of many the goal of ‘competitiveness’ seems to come from an opposing world view to ideas about sustainable development: while sustainability is, for example, presented as taking the long-term view, competitiveness is often seen as being about gaining short-term advantage and succeeding now, with little regard to future consequences. Certainly, within the EU and elsewhere, ideas about competitiveness entered the public discourse chiefly in terms of economic interests. ‘Competitiveness’ being presented as something to be actively encouraged, because it sparks innovation, generates trade, enhances market share, creates employment, and fosters growth. Economic competitiveness thus appears to require access to resources and markets, and an appropriate pro-business regulatory framework that supports economic development and innovation, and minimises obstacles to productivity. From such a perspective environmental conservation and regulation is often seen as the enemy of economic growth.

By no means all would, however, agree that sustainable management of natural capital and competitiveness are polar opposites. In developing the OpenNESS conceptual framework we will so that despite this apparent contradiction the thinking about competitiveness 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 also needs to move beyond this narrow discussion to consider how the management of natural capital and ecosystem services can contribute more generally to well-being by stimulating competitiveness and innovation; sustainable ecosystem management may not be inimical to growth but an essential prerequisite.

As we have discovered in relation to the other challenges, there is a good deal of overlap between them (Table 2.1). Given the place-based perspective taken in OpenNESS, the standing of particular localities

<sup>5</sup> [http://ec.europa.eu/europe2020/europe-2020-in-a-nutshell/priorities/index\\_en.htm](http://ec.europa.eu/europe2020/europe-2020-in-a-nutshell/priorities/index_en.htm)

relative to others is often an important consideration in tackling issues that confront them. A stable and functionally intact environment may be necessary both encourage business investment but also for attracting and retaining the people needed in the local economy. And the well-being of those people may depend not just on economic security, but also the fact that the environment they live in is healthy and attractive. The extent to which the goals of policies dealing with economic, social, and environmental development are properly aligned are also likely to affect the standing of one locality relative to others, and so governance issues are also relevant when we begin to explore 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 by the research community. 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*<sup>6</sup> and the related *Road Map to a Resource Efficient Europe*<sup>7</sup> also make similar points in relation to materials and energy use.

## 5.2 State of the Art: exploring the competitiveness challenge

As early as 1991, Porter argued that environmental stewardship and competitiveness could go hand in hand. The so-called ‘Porter Hypothesis’ which claimed that competitiveness and productivity could actually be enhanced by environmental regulation became a cornerstone of environmental economics and policy. Whilst more recently the hypothesis has been contested, there is evidence that environmental regulation can reduce capital expenditures and investment in research and development in some situations (Ambec et al., 2013). Other studies have also shown that ecosystem degradation can be anti-competitive with a recent study from Finland (Mattila, 2013) finding that sectors that damage the natural environment do not drive economic growth.

Thus today, there is a wider acceptance that the environment (and living natural resources in particular) underpin all economic activity. As a result of initiatives such as the MA and TEEB, for example, and other follow-up projects (e.g., Hanson et al., 2012; WBCSD, 2011) many in business have come to recognise both their impacts and their dependence upon biodiversity, natural capital, and ecosystem services, and that this knowledge can be used to generate significant competitive advantage (Duke, 2016; Houdet et al., 2016). Indeed, many now argue that economic competitiveness cannot be achieved while social and environmental factors influencing human well-being are compromised. There is a sense that we must go beyond measuring our wealth by Gross Domestic Product (GDP) (EC, 2009).

The idea of going ‘beyond GDP’ has been echoed in recent work on social competitiveness indicators as used by the UN Development Programme (see also WEF, 2010), and World Economic Forum’s (WEF) discussion of

<sup>6</sup> [http://ec.europa.eu/environment/resource\\_efficiency/index\\_en.htm](http://ec.europa.eu/environment/resource_efficiency/index_en.htm)

<sup>7</sup> [http://ec.europa.eu/environment/resource\\_efficiency/about/roadmap/index\\_en.htm](http://ec.europa.eu/environment/resource_efficiency/about/roadmap/index_en.htm)

‘sustainable competitiveness’, the latter being seen as “the set of institutions, policies and factors that make a nation remain productive over the longer term while ensuring social and environmental sustainability” (Bilbao-Osorio et al., 2013, p. 55). It is argued that measures of sustainable competitiveness need “to gauge not only whether a country has the potential to grow over the medium and long term, but whether the national development process is producing the kind of society in which we want to live” (Bilbao-Osorio et al., 2013, p. 60). These wider perspectives thus lead us to consider future threats to competitiveness arising from climatic and demographic change, or issues related to health, migration, and urbanisation, and hence start to address notions of social, economic, and ecological resilience (Bristow, 2010).

Whilst economic concerns still dominate the competitiveness narrative at global, regional, national, or local scales, it can be argued that it needs to be considered against, or balanced with, social competitiveness (e.g., support for social innovation, strong social networks, social justice and equity) and environmental competitiveness (e.g., conservation and sustainable use of heritage, community engagement in conservation, and equitable access and benefit sharing of ecosystem services). Indeed, this view is promoted under the Lisbon Treaty, which sets out the goal of a highly competitive social market economy founded on social progress and “a high level of protection and improvement of the quality of the environment” (EU, 2007, p. XY). Recognising, however, that the Lisbon Strategy for Growth and Jobs (2000-2010) did not give sufficient importance to social and environmental dimensions of development, the Europe 2020 Strategy now aims to work towards a more sustainable competitiveness, with “a resource efficient Europe”. Natural capital is one of the seven flagship initiatives under the Strategy (EC, 2011), which also commits to an industrial policy which reduces resource use and promotes sustainability in resource management. Most recently, research within Horizon 2020 has linked sustainability and competitiveness across its societal challenges as a means of promoting raw materials security, improving well-being, and enhancing resilience to future social and economic shocks<sup>8</sup> (EC, 2014).

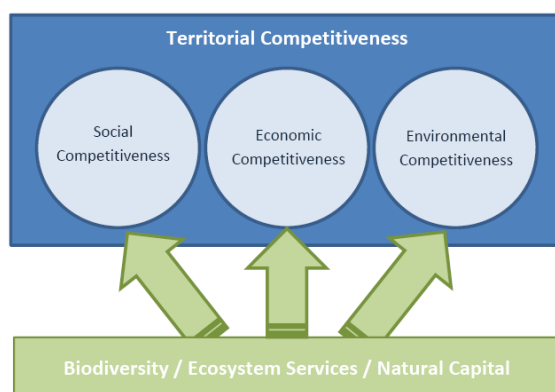


Figure 5.1 Ecosystem services and natural capital, and the elements of place-based competitiveness

Competitiveness in Europe is therefore increasingly viewed in this holistic framework. A useful exploration of this approach is the EU LEADER programme. LEADER aims to strengthen connections between urban and rural areas, building on the notion of *territorial competitiveness* (i.e. competitiveness of regions and their component businesses) to highlight the unique traits and elements of social, human, economic, and natural capital which differentiate regions, and may encourage innovation and development (Figure 5.1).

<sup>8</sup> <http://ec.europa.eu/programmes/horizon2020/h2020-sections>

The outputs of the LEADER programmes suggest an even greater complexity in the relationships between social, environmental, economic, and cultural aspects of productivity. For example, social competitiveness includes notions of good health status and access to health services, as well as the strength of civil institutions and civil society/non-governmental bodies, and also accounts for issues of social justice and equity such as gender roles, mobility, and social care. Being socially competitive can confer not only social but economic advantages for a region and its business interests, for example, by providing a more socially sustainable environment for investment. Similarly, environmental competitiveness includes recognition of the importance of natural capital, of cultural and archaeological heritage, and environmental quality. Recognising the intimate linkages between ecosystems and human well-being, including issues of health, justice, and quality of life, makes clear that the conservation and sustainable use of living natural resources – biodiversity and ecosystem services – are important aspects of competitiveness. This is perhaps particularly true for businesses or regions whose economies are closely linked with certain ecosystem services. These issues were recently explored by the EU CLAIM project, which examined the contribution of landscape management to socio-economic development and agricultural competitiveness in rural areas and included a specific focus on the connections between ecosystem services from landscapes and competitiveness (CLAIM, 2014). The project examined several definitions of competitiveness in the literature and from various policy contexts, and determined that regional competitiveness should be defined by both regional economic performance and by regional social welfare; for CLAIM, the social element includes standards of living and quality of life, which is linked to issues of environmental quality, natural and cultural heritage, and equality. If the competitiveness challenge is to be explored in OpenNESS, then we must unpack these different elements to understand how these relationships work, and can be leveraged across policy domains.

Building on the CLAIM Project (see also Bilbao-Osorio *et al.*, 2013), we suggest that for OpenNESS, competitiveness is defined as: *the set of institutions, policies, and factors across social, economic, and environmental spheres that make a business, sector or territory productive over the long term while ensuring social and environmental sustainability*. More specifically, territorial competitiveness is seen as: *the set of institutions, policies and factors across social, economic and environmental spheres, which in combination confer long-term productivity on a specific urban or rural area, province, state or region, and constituent businesses and sectors, while ensuring social and environmental sustainability*.

There is, for example, a growing literature on the importance of ecosystem services and natural capital for businesses (e.g., Houdet, 2008; Houdet *et al.* 2009, 2016; TEEB for Business and Enterprise<sup>9</sup>). 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 twenty-two opportunities for businesses 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;
- 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 connect consumers with 'nature' and highlighting its value in the marketplace

<sup>9</sup> <http://www.teebweb.org/publications/teeb-study-reports/business-and-enterprise/>



- 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 discussions. 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 through 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 to 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 nature 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 research 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 sustainably and 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 of 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 The place of competitiveness in the cascade

Although competitiveness as an issue related to ecosystem services have been relatively little researched, as a result of the CLAIM project, Van Zanten et al. (2014) has considered the issue specifically in relation to the cascade model and how it can be applied in a specific place-based context (Figure 5.2); the work both explored the conceptual framework and applied it in a case study dealing with the agricultural landscapes of Winterswijk, in The Netherlands.

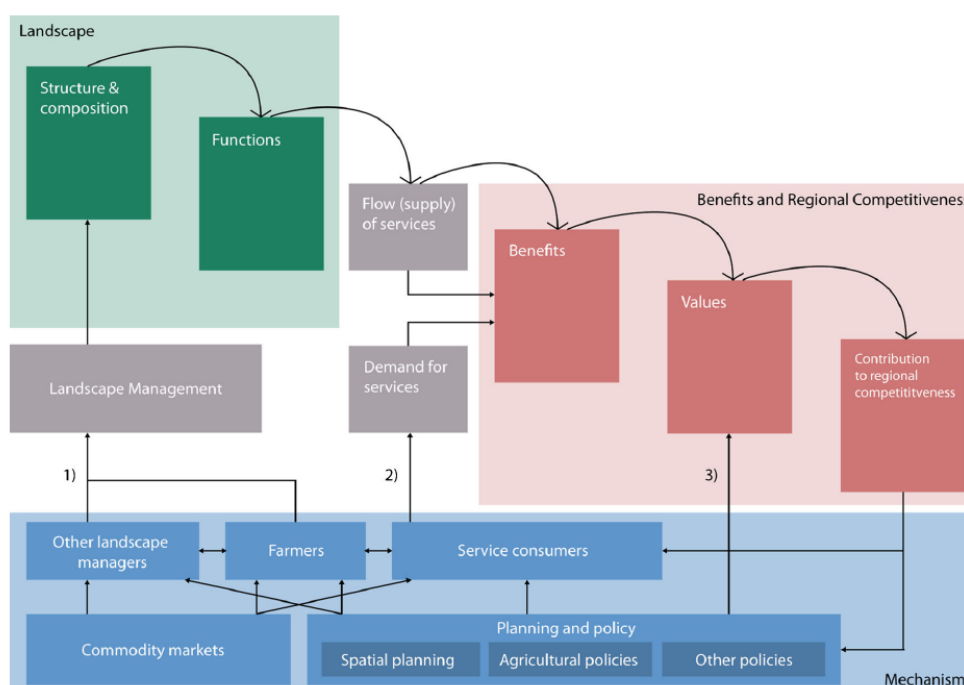


Figure 5.2: Analytical framework addressing the relationship between agricultural landscape structure and composition, the supply and demand of ecosystem services, and the contribution of these services to regional competitiveness (after Van Zanten et al., 2014).

In the study by Van Zanten et al. (2014), the cascade was used as an analytical framework, to look at the relations between landscape structure and composition and its contributions to regional competitiveness. In the cascade, the values realised from the benefits arising from ecosystem services are seen as contributing to overall regional competitiveness. However, the relationships are not simply linear ones. Instead, these authors argued that they arise from a complex set of connections between the actors and policies that impact on agricultural landscapes. Thus, Figure 5.2 shows that farmers and other land managers can affect landscape structure and composition through landscape management; consumers of different ecosystem



services can also generate a demand for services and, therefore, create benefits; and, ecosystem service benefits themselves can be influenced by policy and planning through, such mechanisms as payments for ecosystem services schemes. Van Zanten et al. (2014) argue that the policy and planning measures have an impact by ‘valorising’ ecosystem services. It is suggested that they can shape the actions of land managers through ‘regulatory’, ‘economic’, and ‘information’ instruments. In the context of Winterswijk, for example, agri-environmental measures that are part of the EU Common Agricultural Policy are a type of a voluntary economic instrument, which has been taken up by dairy farmers through compensation schemes for the maintenance of landscape elements that are considered valuable. Such measures contribute to maintaining the landscape character of the area, which attracts many walkers and cyclists; tourism benefits the regional economy in various ways, not least by stimulating ‘recreation-orientated diversification’ by farmers and investment in agricultural areas by ‘hobby farmers’ from neighbouring urban areas. These authors find that the combined contribution of tourism, recreation, and retail to the local economy far exceed that of agriculture in terms of value added.

The example of Winterswijk illustrates a number of issues in relation to the competitiveness challenge. First, in terms of developing a conceptual framework that identifies the links between natural capital, ecosystem services and competitiveness, the wider connections to human well-being, sustainable management, and governance clearly need to be emphasised. And like these other challenges, there is no single place where competitiveness issues can be located. Second, the comparative aspect of competitiveness also needs to be examined. 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. In the case of Winterswijk, for example, since farmers enter into the agri-environmental schemes on a voluntary basis, patterns of uptake will reflect the different attitudes of different types of farmers in different places, which will themselves be shaped by the different local circumstances. Although evidence-based metrics on performance are likely to be useful, analysis of competitiveness is also therefore likely to involve eliciting the views of different peoples, groups, and organisations about the contribution made by natural capital in particular places.

### A preliminary analytical framework for competitiveness

A contribution of the work being undertaken in OpenNESS WP4 has been to to better understand the different dimensions of value. The work explored 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 can clearly contribute to the design of the ‘hybrid evaluation frameworks’ proposed by WP4. Given the comparative nature of the work best opportunity for taking this forward was by exploring the ideas through the OpenNESS case studies. An essential first step was to ensure that any conceptual framework could capture the way competitiveness and innovation issues play out in the case studies, and, in particular, how they link to governance, regulatory frameworks, and incentive mechanisms at other scales and in other places.

As with the other challenges, to better understand how these theoretical considerations play out in the context of ‘real-world’ applications, a set of preliminary questions were developed as a way of exploring the conceptual thinking in the case studies:

- How do people conceptualise the notion of competitiveness, and can the ecosystem services and natural capital concepts transform our understanding of it?
- How do notions of competitiveness relate to aspects of human well-being and quality of life at different scales?

- Who is competing with whom over what and why? And what is the relationship between concepts of competitiveness and those of cooperation, collaboration, and resilience?
- How do we measure change in competitiveness? What indicators could be used to compare different areas?
- Where can the EU, as a collection of states, invest in ecosystem services to reduce costs and risks, and promote market stability?
- What kind of governance structures would be needed to sustain ecological and cultural diversity and hence build competitiveness and resilience?

Initial discussions within the OpenNESS consortium suggested that many found notions of competitiveness more problematic than the other three challenges, thus the first two questions posed were designed to capture the ways (if at all) that the case studies thought about the issue, and especially whether they made the connection to human well-being. The next two questions attempted to explore the details of what is being competed for and how to measure the process. The final questions linked to governance issues and how the case studies might see the link between competitiveness and sustainable forms of development. From the outset it was acknowledged that the place-based focus in OpenNESS would limit the analysis of competitiveness because much of the work would focus on single areas at local scales. Thus, information on the standing of these places relative to others was unlikely to be collected in a systematic way. However, it was considered worthwhile to pose these last questions to investigate whether any of the stakeholder groups that were party to the case studies thought about or were concerned with how policy or management actions could be seen at as investments in ecosystem services and natural capital that might yield social as well as economic and environmental benefits.

## 6. Operationalising the OpenNESS conceptual framework

Given the strong operational focus of OpenNESS, effort was directed towards identifying if and how the cascade could be used to help people develop their understanding of the problems that they were dealing with, and ultimately how they might be resolved. This was achieved by working with the case studies that were included in OpenNESS. Although each case study had their own distinctive concerns and ambitions, it was considered useful to test the ability of the cascade to provide a general framework for discussion of what seem initially to be a diverse range of interests. In the light of this diversity, it was also considered useful to examine the extent to which their work resonated with the issues covered by the four challenges. The ambition here was to determine whether the challenges themselves offered a way of understanding commonalities across the range of place-based studies included in the OpenNESS consortium.

Thus, representatives of the OpenNESS case studies were brought together in two workshops in 2013 (Loch Leven) and 2014 (Budapest), and asked how their broader thinking could be represented in terms of the cascade model, and in particular to consider how their concerns related to the four OpenNESS challenges. In both workshops, they were encouraged to interpret cascade and challenges from their own perspective and, if appropriate, to adapt the ideas to better reflect their needs. Later, towards the end of the Project in 2016, a subset of case studies were asked to revisit their initial ideas and describe if and how they had changed, what had shaped the process and, especially, whether their ‘stakeholders’ had been involved. The work programme was designed to be both iterative and deliberative in character, intended to help all parties unpack, understand, and critically reflect on conceptual frameworks, and to explore how thinking could be linked to the methodological and valuation work that was also being undertaken in OpenNESS.

### 6.1 Using the cascade to represent case study perspectives

The people attending the 2013 workshop were given a briefing on the role of conceptual frameworks, and, in particular, what the cascade model represented within the Project. In the subsequent discussion sessions, six groups with around 8-10 participants were formed, organised by ‘broad ecosystem type’; these were forest, urban and peri-urban, fresh water, and two groups on mixed rural landscapes. Each group selected one OpenNESS case study from those included in the group, and this was used as the basis of exploring the usefulness and applicability of the cascade model to their issues. After the workshop, having been familiarised with the issues surrounding the use and application of the cascade, all case studies were asked if they could represent their work in terms of the cascade. This follow-up was done bilaterally, and it was on the basis of these discussions that a final sub-set of case studies were selected for follow-up at the end of the project, the aim here being to find out how ideas evolved.

In the general discussion that followed the group sessions people reported that the cascade model can be helpful for clarifying the problems and the specific relations between the biophysical components leading to ecosystem services, and the benefits and values deriving from them. Moreover, this was thought to be especially so in participatory work. However, some cautioned that if researchers are uncertain of the elements of the model (as they partly were), how could stakeholders be expected to use the framework? Some participants argued that ‘no single model that is applicable for all situations’, rather than conceptual representations were ‘context dependent’. Nevertheless, there was general support for the thinking about

conceptual frameworks because the *process* of constructing them was seen as having an important ‘awareness-raising’ role. These points can be evidenced by reference to individual case study material, all of which is provided in Appendix 1.

A review of the different ways in which case studies represented their work suggested that there were very different understandings of what the different elements (boxes in the cascade) represented, or what their relevance was in specific situations. For example, the number of elements used in case study representations was sometimes reduced, for example, by dropping the notion of ‘function’ (CS#9) or by merging ‘benefits’ and ‘values’ (Fig 6.1). Some of the rationale for these changes can be illustrated by a case study that sought to apply the ecosystem services concept in a planning context; it was reported in the subsequent follow-up interview for this case study in 2016 that “planners found it somewhat difficult to use as it has so many steps and it is not clear where the boundaries are between them. For instance, it would seem simpler to pool structure and function because they are interlinked. Also the distinction between service and benefit is not always clear. So, for the purpose of planning three steps may be sufficient (1) structure and function, (2) service and benefit, and (3) value.” (CS#1). Elsewhere, however, people felt that additional elements, such as governance and/or institutions, were needed in order to make the cascade capture what was being considered in their work.

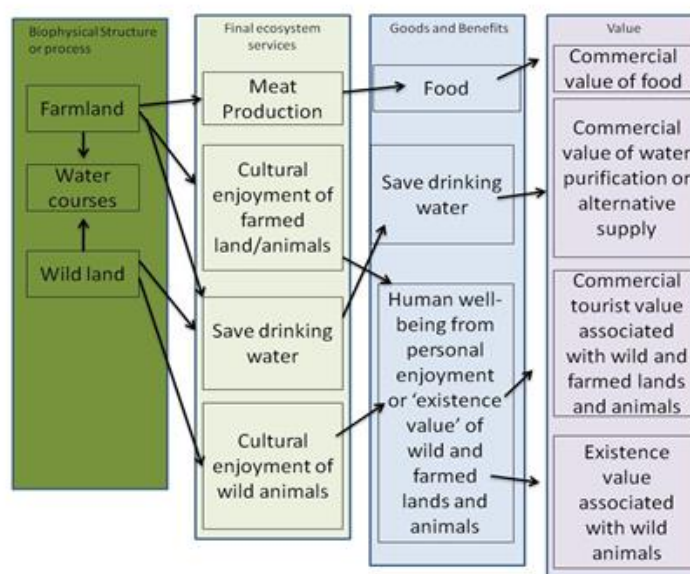


Figure 6.1: The cascade redrawn by the case study from the Cairngorms National Park (CS#9)

In the context of ecosystem services in East Godavari district, Andhra Pradesh India (CS#23), researchers found it helpful to identify ‘policy structures and mechanisms’, together with community based ‘institutions’ and forms of ‘social regulation’ as important ‘entry points’ for reading the cascade in this rural situation (Figure 6.2); the general point about whether the cascade should be read from left to right or right to left was made by several people at the 2013 workshop.

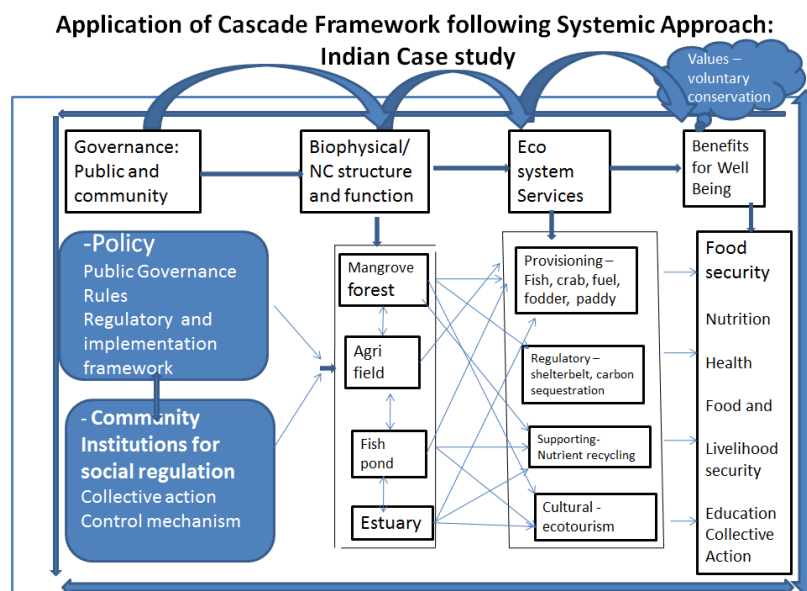


Figure 6.2: The cascade redrawn by the case study from the East Godavari district, Andhra Pradesh, India (CS#23)

Similarly, by the latter stages of the project in 2016, in another case study concerned with establishing the relevance of urban ecosystem service assessments to policy making (CS#27), researchers felt it necessary to identify the role of ‘goals’ and ‘planning’ explicitly in the framework (Figure 6.3).

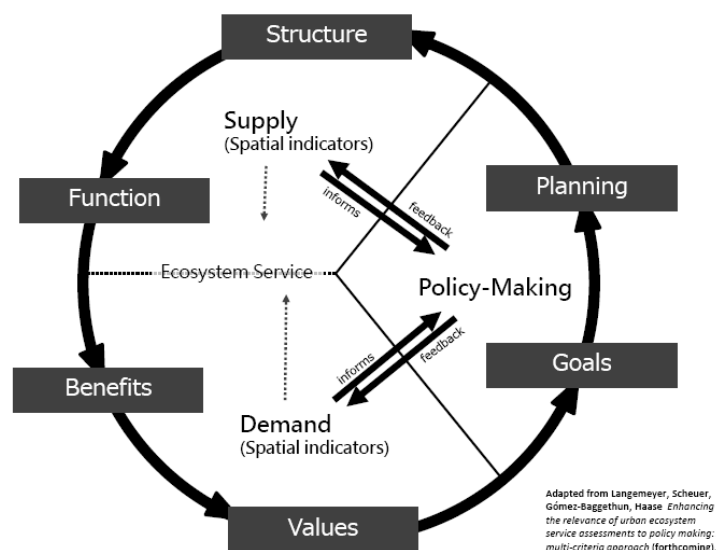


Figure 6.3: The version of the cascade provided by the case study ‘Barcelona’ (CS#27)

Better elaboration of the role of policy and governance was also identified as being necessary in a case study dealing with spatial planning in Doñana in Southwest Spain: “Probably the main concern that we have encountered is that the lower part of the cascade... From behavioural ecology to drivers, institutions or governance, several aspects could fit in that part of the graphic. Given the aim in our case study to implement the ecosystem service approach into decision-making, a more detailed description of this part of the graphic would be desirable” (CS#19).

Alongside a better understanding of how governance and decision-making issues relate to the cascade, several other important issues emerged from the work with case studies. A notable one was how ‘human well-being’ should be represented. This was, for example, also a concern of the Doñana case study. In the cascade based on the work in Kiskunság, Central Hungary (CS#12), the suggestion was to merge ‘benefits’ and ‘well-being’ into a single element (Figure 6.4). The Indian case study (CS#23) replaced the separate ‘benefits’ and ‘values’ elements in the original cascade with a single component ‘benefits for well-being’ (See Figure 6.2, above), while another case study suggested that beneficiaries also needed to be identified (CS#10). A feature of the different ways in which the case studies framed notions of benefits and values suggested that better guidance was probably needed in terms of the differences between the concepts, and how they related to overarching notions of human well-being. A further question identified by the case study dealing with impacts of bioenergy production on native vegetation in interior São Paulo, Brazil (CS#26), was how ‘harms’ or ‘dis-benefits’ should be handled.

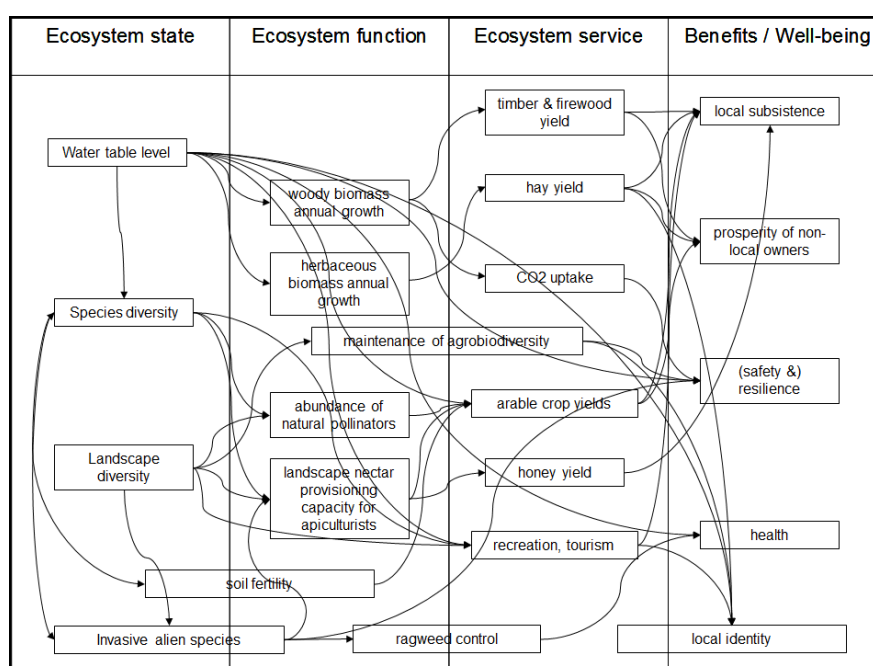


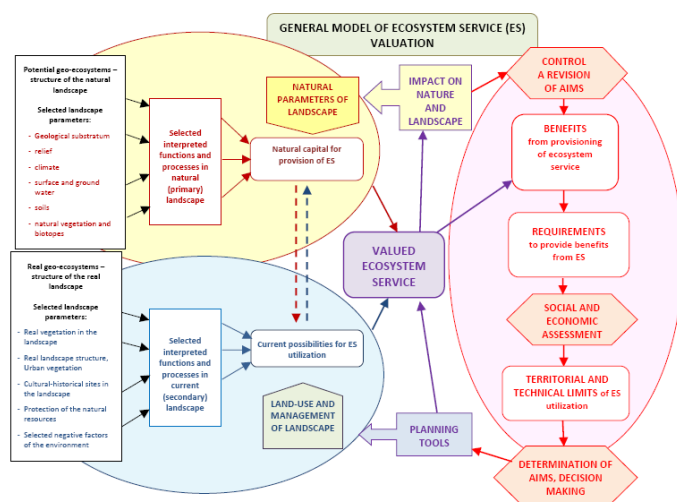
Figure 6.4: The cascade provided by the case study of Kiskunság, Central Hungary (CS#12)

A final key point to emerge from the review case study experience was that the conceptual framework could rapidly become complex as more and more case study specific issues were included. This situation often arose because case studies were dealing with more than one service. The strategy adopted by the Oslo urban case study (CS3) was to develop separate cascades for each of the services considered. Others attempted to include a number of different services in the same graphical representation, as is illustrated by Figures 6.1, 6.2, and 6.4. The advantage of this alternative strategy was that the cross-link between the services could be indicated, and the potential for trade-offs and synergies identified.

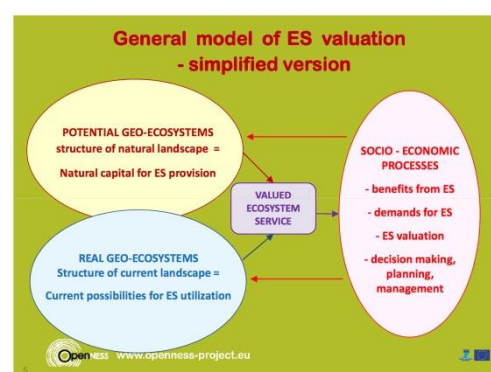
The experience of the case study dealing with landscape-ecological planning in urban and peri-urban areas in Trnava, Slovakia (CS#2) illustrates the conceptual richness that can be generated by thinking through how the cascade framework might apply in a particular place. In the follow-up interview in 2016 the case study leaders reported that the cascade has been used “within a complex general model of ecosystem service



valuation” that was developed with the stakeholders involved in the work. As Figure 6.5 a shows, the conceptual framework includes a number of additional elements, but the basic proposition linking ecological structures through functions, services, and benefits is largely retained, with ‘supply side’ issues being covered on the left hand side of the diagram, and demand-related issues to the right. Interestingly, the case study also provided in 2016 a “simplified version of the framework” (Figure 6.5b), which identified its four major components, referred to as "Real" and "Potential" geo-ecosystem landscape structures, "socio-economic processes", and “valued ecosystem services”.



(a)



(b)

Figure 6.5a & b: Conceptual frameworks based on the cascade developed by the case study from Trnava, Slovakia (CS#2)

Several features stand out from the material generated by the experiences of the case studies using the cascade. First, that it had the potential to provide a common framework upon which a diverse range of studies could be represented. As such, it provides a tool for comparison and a means of discussing the similarities and differences in the way issues are approached in a variety of place-based studies. Second, that given the complexity of many of the issues that are addressed in connection with the concept of ecosystem services and natural capital, diagrammatic elaborations can rapidly become complex. While the different schemas are rich and relevant in the context of specific applications, the general features of ecosystem-service thinking can be hidden by the detail.

As a ‘short-hand’ representation of complex, connected issues, the nuanced nature of the relationships that are depicted in a graphical model are often hidden to others. While the **process** of building the conceptual framework may have enabled those concerned to achieve a common understanding of their problem situation, the **outcomes** in terms of the lessons learned during this collaborative process are often more difficult to convey to others using a graphical representation. While we have focussed here on the cascade model, as the case study experience shows, conceptual frameworks are obviously more than diagrams. As a potential way of using the framework to develop a richer picture of different problem situations we therefore now turn to look at how it can be read in the context of the ‘four challenges’ that also provided a unifying set of ideas for the OpenNESS Project.

## 6.2 Links between case studies and the four societal challenges

In parallel with the work on the cascade, case studies were asked to reflect on their work from the perspective of the four challenges: human well-being, sustainable ecosystem management, governance, and competitiveness. The work began at the 2013 workshop; participants were given a briefing on the background to the challenges, and asked to record how (if at all) the issues they were dealing with related to these challenges. To do this they were presented with a preliminary set of ‘generic’ research questions relating to different aspects of the challenges that were discussed in Sections 2-5 of this Deliverable. Participants could, if they thought the issue relevant to their work, then record their ‘own version’ of the question; they could also simply restate the generic question if they thought it captured their concerns. Finally, if participants thought that there were issues not included in any of generic questions they could add those to the list. The set of generic questions used for the session are shown in Table 6.1.

Table 6.1: Generic questions used to explore the four OpenNESS challenges

Human well-being	Q1.1	What are the relations between specific ecosystem services (types) and specific components/types of human well-being (positive or negative)?
	Q1.2	What are the trade-offs in terms of well-being-effects of different ecosystem services between the stakeholders (i.e. is there a gain of some aspect of well-being for some stakeholders at the expense of other stakeholders and/or other components of well-being brought by ES); what are the appropriate scales (local, EU, global)?
	Q1.x	New overarching question
Sustainable ecosystem Management	Q2.1	How does biodiversity and NC attributes contribute to ES provision, and vice versa?
	Q2.2	What are the trade-offs and synergies between biodiversity conservation and ES provision?
	Q2.3	How can ecosystems be managed sustainably to support biodiversity and ES provision?
	Q2.4	How do value assumptions influence biodiversity and ES evaluations (trade-offs)?
	Q2.5	Can ecosystem management for biodiversity conservation support the adaptive potential (resilience) of ES provision to long-term environmental change?
	Q2.x	New overarching question
Governance	Q3.1	What do people mean by effectiveness? Coherence of policies?
	Q3.2	What are the determinants for policy effectiveness?
	Q3.3	How does the ES concept affect the determinants of effectiveness?
	Q3.4	How does socio-economic valuation have an impact on policy and action? And modelling impact on policy and action?
	Q3.5	What is the appropriate method for socio-economic valuation of ES?
	Q3.x	New overarching question
Competitiveness	Q4.1	How do people conceptualise the notion of competitiveness, and can ES/NC concepts transform our understanding of it?
	Q4.2	How does notions of competitiveness relate to aspects of human well-being and quality of life at different scales?
	Q4.3	Who is competing with whom over what and why? And what is the relationship between concepts of competitiveness and those of cooperation, collaboration and resilience?
	Q4.4	How do we measure change in competitiveness? What indicators could be used to compare different areas?
	Q4.5	Where can the EU, as a collection of states, invest in ES to reduce costs and risks, and promote market stability?
	Q4.6	What kind of governance structure would be needed to sustain ecological and cultural diversity and hence build competitiveness and resilience?
	Q4.x	New overarching question

Table 6.2: Priority assigned to generic research questions by case studies

Question	Question Text	Priority						Total
		H	MH	M	LM	L	UN	
Q1.1	What are the relations between specific ecosystem services (types) and specific components/types of human well-being (positive or negative)?	12	1	4		2	1	20
Q1.2	What are the trade-offs in terms of well-being-effects of different ecosystem services between the stakeholders (i.e. is there a gain of some aspect of well-being for some stakeholders at the expense of other stakeholders and/or other components of well-being brought by ES); what are the appropriate scales (local, EU, global)?	12		4		1	1	18
Q2.2	What are the trade-offs and synergies between biodiversity conservation and ES provision?	10		4	1	1	1	17
Q2.3	How can ecosystems be managed sustainably to support biodiversity and ES provision?	9		6			1	16
Q2.1	How does biodiversity contribute to ES provision, and vice versa?	8	1	3		1		13
Q3.x	New overarching question	7		1	1		2	11
Q4.x	New overarching question	5				1	2	8
Q4.3	Who is competing with whom over what and why? And what is the relationship between concepts of competitiveness and those of cooperation, collaboration and resilience?	4		4			1	9
Q2.5	Can ecosystem management for biodiversity conservation support the adaptive potential (resilience) of ES provision to long-term environmental change?	3		2		1	2	8
Q2.x	New overarching question	3		3		1		7
Q1.x	New overarching question	2		3				5
Q3.1	What do people mean by effectiveness? Coherence of policies?	2		2		1	1	6
Q3.2	What are the determinants for policy effectiveness?	2		3		1	1	7
Q3.3	How does the ES concept affect the determinants of effectiveness?	2		2		1		5
Q3.4	How does socio-economic valuation have an impact on policy and action? And modelling impact on policy and action?	2		3		1	1	7
Q3.5	What is the appropriate method for socio-economic valuation of ES?	2		4		1	2	9
Q2.4	How do value assumptions influence biodiversity and ES evaluations (trade-offs)?	1		3		1		5
Q4.4	How do we measure change in competitiveness? What indicators could be used to compare different areas?	1		1		1	1	4
Q4.6	What kind of governance structure would be needed to sustain ecological and cultural diversity and hence build competitiveness and resilience?	1		2		2		5
Q4.1	How do people conceptualise the notion of competitiveness, and can ES/NC concepts transform our understanding of it?			1		3	1	5
Q4.2	How does notions of competitiveness relate to aspects of human well-being and quality of life at different scales?			2		1	3	6
Q4.5	Where can the EU, as a collection of states, invest in ES to reduce costs and risks, and promote market stability?			2		1		3

As with the work on the cascade, the exploration of the challenges was undertaken iteratively. Following the 2013 workshop, case study representatives were asked to refine and confirm their initial set of research questions recorded at the meeting. Using a questionnaire, they were also asked in 2014 to indicate the priority they attached to the questions, the kinds of evidence they felt was relevant in answering it and what methods might be employed in the work. Finally, they were asked to suggest what kind of project outcome

they were expecting in relation to the question. During the consultation process, which extended over 12 months, case study representatives were encouraged to refine, add or delete questions as their thinking developed. The results presented here relate to the final versions ‘frozen’ at the end of 2014.

Our first concern was to understand how the case studies judged the relevance of the challenges, and the issues they implied, to their work. This was assessed by the number of consultees who provided a case study specific version of the generic questions shown in Table 6.1, and the priority they assigned to them. The results are shown in Table 6.2.

Questions relating to human well-being (Q1.1 and Q1.2), together with those dealing with issues associated with sustainable ecosystem management (Q2.2, Q2.3 and Q2.1) were found to have greatest resonance with the concerns of the case studies. These five questions formed the template to the largest number of case study specific versions of these issues, which were themselves ranked as having the highest priority for the different groups. By contrast, those relating to competitiveness and governance were less frequently identified as important, although for those case studies that did highlight them, the case specific questions were also given higher priorities. A point to note, however, was when considering governance and competitiveness issues, respondents were stimulated to formulate their own questions rather than to develop versions of the ones offered. For governance, these concerned the role of informal institutions, planning mechanisms, and specific policy measure at EU level (such as the CAP and RED). For competitiveness, new issues included those relating to how conservation measures might impact on a regions standing, and how competitiveness might be improved by investment in green infrastructure. While none of the generic questions failed to attract interest from the case studies, it is clear from the rankings in Table 6.2 that ‘competitiveness’, however it was framed, attracted less attention than the other challenges.

Altogether, the case studies provided 202 questions using the template shown in Table 6.1. In order to gain an overview of the main concerns, the answers were coded according to which elements of the cascade were referred to, or whether the question implied the analysis of trade-offs, synergies, policy or management issues, stakeholder involvement or some kind of methodological investigation. The results are shown in Figure 6.6. Only 15 case-specific questions could not be coded; this was largely due to respondents adding a comment rather than formulating a question, or actually attempting to answer the generic question itself.

Given that ecosystem services are the focus for OpenNESS, it not surprising that ‘services’ were the most frequently used concept across all the case-specific questions. Despite this, interrogation of the concept ‘ecosystem function’ was amongst the least frequently recorded coding category. Issues relating to structure, benefits, and values were more common concerns. This contrast perhaps reflects the difficulty that the concept of ‘function’ often poses for researchers. Figure 6.6 also shows that a large number of the case-specific questions made reference to policy or management issues, possibly echoing the ‘operational’ emphasis of the OpenNESS Project. The conceptual themes used in Figure 6.6 to code the case-specific questions were rarely referred to in isolation. Rather, the complexity of the questions provided meant that more than one code would be appropriate.

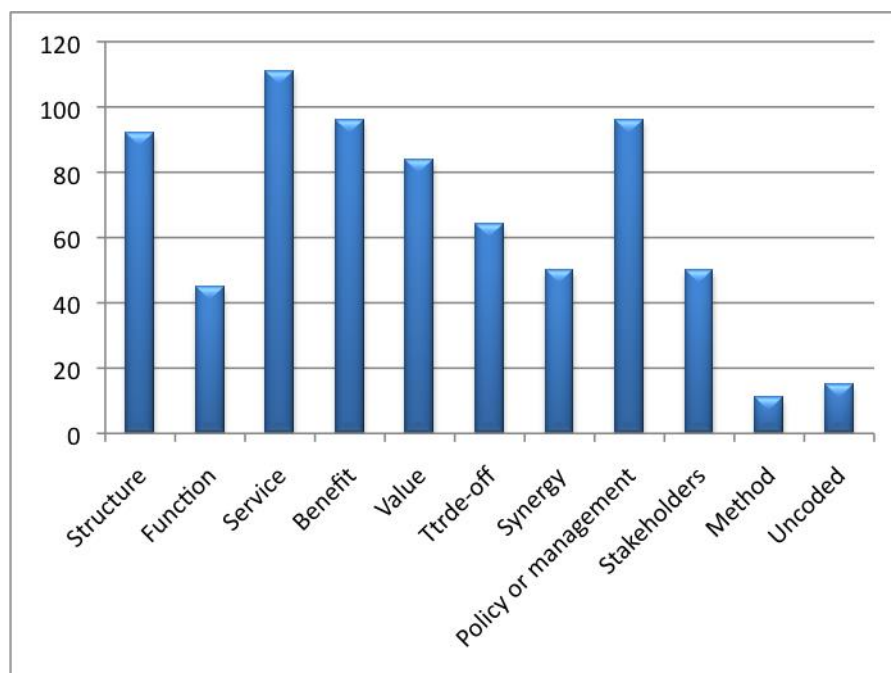


Figure 6.6: Frequency of themes included in the case-specific research questions

Figure 6.7 provides an insight into the differences in complexity across all the questions, which are ordered on the horizontal axis from the most frequently asked through to the least. Most questions involved more than one of the five elements of the cascade; the more complex questions that were frequently asked concerned the relationships between services and human well-being (Q1.1) and the relationship between biodiversity and ecosystem services (Q2.1). Although the significance is difficult to assess, there is also the suggestion in the results shown in Figure 6.7 that the least frequently asked questions tended to involve more elements of the cascade than the more often cited themes.

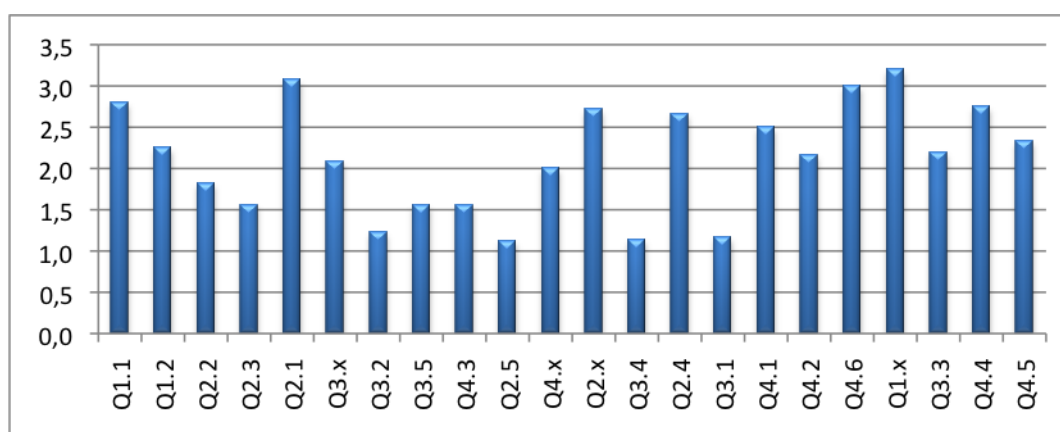


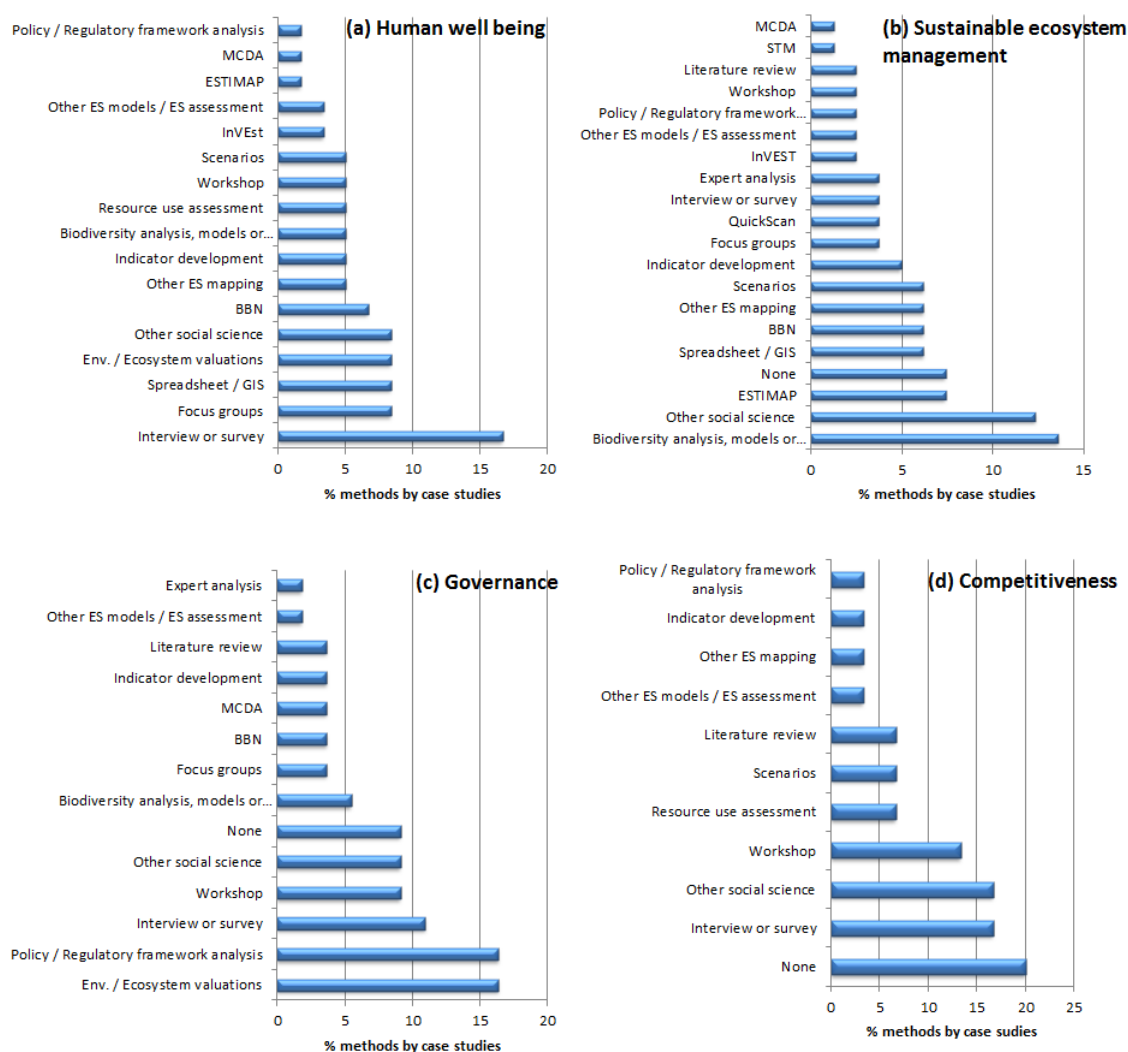
Figure 6.7: Average number of times one of the 'five' elements of the cascade were included in the case-specific research questions.

Table 6.3: Example responses from case studies indicating methods, evidence, and conclusions in relation to research questions.

<b>Example 1</b>	
General RQ 2.1	How does biodiversity contribute to ES provision, and vice versa?
Specific RQ	How does biodiversity contribute to the provision of the ES considered as relevant by local stakeholders? (and vice versa?)
Methods	Developing/adapting indicators, ES mapping (Estimap, QuickScan, Biome-BGC, statistical models)
Evidence	Indicators
Conclusion	Estimated degree of biodiversity dependence for each studied ES
<b>Example 2</b>	
General RQ 1.1	What are the relations between specific ecosystem services (types) and specific components/types of human well-being (positive or negative)?
Specific RQ	Which ES do local stakeholders consider most relevant for their well-being and why?
Methods	Preference assessment (photo elicitation)
Evidence	Field data
Conclusion	Local preference list
<b>Example 3</b>	
General RQ 3.3	How does the ES concept affect the determinants of effectiveness?
Specific RQ	How can the ES concepts be used to identify policy incoherence between the RED and CAP?
Methods	Policy analysis via Document analysis
Evidence	No specified
Conclusion	Conclusions on the usefulness of the ES concept to analyse policy coherence.
<b>Example 4</b>	
General RQ 4.3	Who is competing with whom over what and why? And what is the relationship between concepts of competitiveness and those of cooperation, collaboration and resilience?
Specific RQ	What are the main conflicts among stakeholders in the case study area, and how do they cooperate? How these relationships affect ES management?
Methods	Stakeholder analysis. Workshops. Preferences assessment. ES mapping
Evidence	ES demand, land use maps. Official documents and stakeholders preferences.
Conclusion	What are the main conflicting activities and their impact on ES management. How the existing cooperation among stakeholders is benefiting ES?



In addition to the case study specific questions, respondents were asked about the methods they anticipated using to answer them, the types of evidence generated, and the kind of outcome they sought. Three examples of complete responses are shown in Table 6.3. All the responses from the case studies were coded and summarised according to the methods suggested (Figure 6.8 a-d), and the nature of the outcome anticipated, namely whether it be a recognised product, such as a map or a report, or mainly had to do with the processes of problem solving or decision-making (Table 6.4). Responses were also coded according to the stage in the policy cycle implied by the response, namely problem formulation, response design, implementation, monitoring outcomes, evaluation or reporting (Table 6.5).



Key to abbreviations/names: BBN= Bayesian Belief networks; ESTIMAP= Mapping and visualisation software; MCDA= Multi-criteria decision making; QuickScan= A spatial modelling environment; STM= State and transition models.

Figure 6.8: Frequency of methods cited by case studies for questions under each of the four challenges

Table 6.4: Percentage of outcomes indicated by case studies coded as either a product or a process

Challenge	Product (%)	Process (%)
Well-being	61	39
SEM	71	31
Governance	28	75
Competitiveness	50	50

Table 6.5: Percentage of outcomes indicated by case studies coded by stage in the 'policy cycle'

Challenge	Formulation	Design	Implement- ation	Monitoring	Evaluation	Reporting
Well-being	84	16	0	16	19	0
SEM	63	12	25	15	17	0
Governance	42	28	33	42	25	6
Competitiveness	64	14	23	36	14	9

As a result of their involvement in their own and other work within the OpenNESS Project (WP3 & 4) the case studies were well versed in a range of potentially useful analytical methods. As Figure 6.8 therefore shows, a wide range of techniques were suggested by the case studies. In relation to human well-being (Figure 6.8a) the most frequently cited were qualitative methods such as interview and focus groups, whereas for questions relating to sustainable ecosystem management, modelling and mapping tools were the most frequently mentioned (Figure 6.8b). Qualitative methods, including analysis of policy and regulatory frameworks, also dominated in relation to the governance challenge (Figure 6.8c), along with valuation. The responses to the competitiveness challenge differed significantly from the others in that a large number of the case studies were not able to identify a suitable method for generating the evidence they might need to answer the question they formulated.

In terms of the types of outcome anticipated there appeared to be a split between those expected for questions on human well-being and sustainable ecosystem management as compared to governance and competitiveness. The former two tended to be associated with the production of a tangible output, such as a map or a report, whereas the others (especially governance) focussed more on the process of problem solving or decision-making. These differences are illustrated by the examples in Table 6.3. The framings of the case study specific questions in the first two examples imply the goal of achieving concrete outcomes such as a conclusion ("Estimated degree of biodiversity dependence for each studied ES") or document ("local preference list"), whereas examples three and four illustrate that in other areas case studies were seeking to improve the dynamics of decision-making or stakeholder interaction by understanding, say, "how the existing cooperation among stakeholders is benefiting ES".

In reviewing the data presented in Table 6.4 it is important to note that the coding is based on our reading of the material provided and that not all responses could be coded because respondents either did not provide sufficient information on 'evidence' and 'conclusions' etc., or the answers were ambiguous. Moreover, as example four in Table 6.4 illustrates, goals can encompass both concrete outcome and improvements in stakeholder engagement; thus the product vs process dichotomy is not mutually exclusive.

The results of the analysis of where in the decision-making or policy cycle case studies were located that are shown in Table 6.5 should also be regarded as indicative, because they too depend on our reading of the

material provided. Nevertheless, it does appear that given the way the specific research questions were put and the outcomes that were anticipated, case studies tended to be working more at the ‘problem formulation’ stages of the cycle than in monitoring outcomes or reporting the success of implementation measures. The exploratory focus is especially clear in the case of the human well-being, sustainable ecosystem management, and competitiveness themes, whereas for governance the concerns are more evenly spread. However, it is important to note that given the partial nature of the underpinning data, not all case studies could be assigned to the various stages.

From the analysis of the way in which the OpenNESS case studies were able to frame their concerns around the four challenges a number of key points emerge. First, while issues relating to human well-being and sustainable ecosystem management were common across the set, concerns about governance and competitiveness were far less often considered as relevant. This is perhaps less surprising for competitiveness than for governance because it is rarely explicitly addressed in the ecosystem services literature. However, given that governance issues are more widely debated the relative lack of interest amongst the OpenNESS case studies may suggest that a better understanding of the issues could have been helpful. It is interesting to note that while the frequency of case specific questions under governance was low (Table 6.2), the number of research questions that contained reference to management or policy issues (Figure 6.6) was high. Given that fewer case studies were able to indicate the methods they would use to collect evidence relevant to issues related to governance and competitiveness (Figure 6.8), it might also be that these issues are less well understood than the others.

A second key point to emerge from the analysis of the case study questions was that their focus is as much conceptual as it is methodological. Many of the case-specific questions are complex, linking more than one element of the cascade, and cannot be addressed by a single analytical approach. While the case studies had methodological concerns in terms of how they might generate the evidence needed to solve a problem, few of their specific questions related to how to develop a method or to decide what the best method for analysis was (Figure 6.6). The exploratory character of the questions posed by the case studies suggests that any guidelines developed as a result of this work need to help people to understand the key concepts and navigate the relationships between them, and use this knowledge to assess the relevance of different kinds of evidence generated by different methods in a reflective and critical way.

A final lesson that we draw from this part of the analysis is that while the cascade itself can be a useful way of making comparisons between different place-based studies, the tool can probably be strengthened by complementing it with a set of stimulus questions that encourage people to develop a richer interpretation of the network of ideas that it contains. By linking such questions to supplementary material on issues and methods, these questions could be a useful vehicle for generating a better understanding of what the key concepts entail and what is involved in making them operational. Given this finding it is concluded that while helpful at the initial stage of the project, the question framework linked to the four challenges needs to be refined to develop an effective, and more generic set of guidelines: their focus needs to move away from a generalised or high-level statement of questions relating to challenges to a more interrogatory set. The aim should be to help people explore basic concepts and their relationships so that they can build a richer narrative around the challenges themselves or a new issue that has elements of them included in their remit.

## 7. Conclusions: Towards operational guidelines

### 7.1 Linking the cascade and the four societal challenges

The aim of this Deliverable has been to examine whether the four ‘OpenNESS Challenges’ of human well-being, sustainable ecosystem management, governance, and competitiveness can be viewed through a single conceptual framework, and whether the cascade model provides a basis for an integrated approach.

Although the conceptual work in OpenNESS was designed to explore the four challenges separately it was recognised from the outset 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, by securing ‘prosperity’; similarly the sustainable management of environmental resources will have implications for human well-being in terms of, say, ‘security’ and ‘social justice’. In the context of these examples, both might only be achieved if appropriate modes of governance and institutions are established and operate appropriately.

Preliminary work on the links between the four challenges was reported by Potschin et al. (2013). During the four years of the OpenNESS Project conceptual thinking has been further developed through a series of Synthesis Papers prepared by members of the consortium; these are listed in Appendix 2 where their key findings are highlighted. The Synthesis Papers were updated in 2016 and are available on-line as a ‘reference book’<sup>10</sup>. The definitions of key terms and ideas that they provided are collected together in the OpenNESS Glossary of Terms, which is also available via the internet<sup>11</sup>. Apart from the relevance of the Synthesis Papers as an underpinning resource for the OpenNESS conceptual framework, the work is especially pertinent in the current context because the authors were asked to identify how the different topics related to the four challenges, and indeed how the four challenges relate to each other. The findings in relation to the links between the challenges are summarised in Table 7.1. They confirm that there are indeed strong conceptual links between the themes covered in the four challenges, and therefore suggest that whatever conceptual frameworks are developed to help deal with them, an integrated approach is probably desirable. In this context, it is especially important to examine where the cascade model provides the basis for understanding the relationships between them. This was been done during the first part of the OpenNESS Project where case studies were asked to represent what they were attempting to do in terms of the cascade.

The results presented in Section 6.1 of this document suggest that the cascade was able to capture many of the basic ideas that case studies were using to represent their research problem. Thus, the model could potentially offer a common framework upon which a diverse range of place-based studies could be represented and compared. Several approaches to modifying the model were noted. On the one hand, especially amongst case studies having to communicate with ‘non-expert’ stakeholders, there was a need to simplify by collapsing the elements to make messages clearer. On the other, given the intricacy of the issues that the case studies were dealing with, there was a danger that in the hands of researchers diagrammatic elaborations could rapidly become complex. While theses more complex representations of the cascade were found to be rich and relevant in the context of specific applications, the general features of ecosystem service thinking can be hidden by the detail of. What was clear in both cases, however, was that the process of building the models was potentially as valuable as the outcomes.

<sup>10</sup> <http://www.openness-project.eu/library/reference-book>

<sup>11</sup> <http://www.openness-project.eu/glossary>

Table 7.1: A summary of the links between the challenges taken from the synthesis papers dealing with the topics updated in 2016

	Human Well-Being	Sustainable Ecosystem Management	Governance	Competitiveness
Human Well-being		Sustainable ecosystem management must be in accordance with the aim of fostering HWB.	Good governance must reflect the aim of enhancing HWB and harmonise different interests and ideas of HWB involved.	Competitiveness affects HWB in different ways. The role of competitiveness for HWB needs to be explored.
Sustainable Ecosystem Management	Sustainable ecosystem management is necessary to preserve the long term ability of ecosystems to deliver the services that underpin human well-being. This may involve trade-offs between short term wellbeing and long term resilience. It will also involve trade-offs between different ES, which in turn depends (partly) on the benefits of each ES for human well-being, including the cultural value of managing an area for particular species. We should be aware of the need to use a range of approaches for ES valuation, and avoiding over-reliance on monetary values, and we need to explore ways of maximising synergies and minimising trade-offs.		Effective governance is critical for the negotiation and management process, and this will require a high degree of co-ordination between stakeholders and administrative agencies. Key governance needs include: inclusion of all stakeholders in the negotiation process; regular monitoring and review of goals to enable adaptive management; enforcement of protected areas; regulation to protect ecosystems from pollution, development and over-exploitation; managing offsets (if appropriate); incentives for sustainable use (e.g., PES, organic farming, eco-tourism).	Choice of ecosystem management techniques (e.g. restoration, enforcement of protected areas): how much will they cost? What is the value of ES benefits and the wider social and economic impacts, e.g. for long term sustainability of agricultural production (soil erosion and fertility, water availability, genetic resources, pollination, pest regulation), employment, social cohesion, health and well-being (reduced health care costs, impacts on productivity of work force), education, innovation?
Governance	How is human well-being 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 that mean in practise?	How are normative considerations linked to the design and analysis of governance processes?	Represent a specific policy goal which must be balanced with other goals and must be addressed by appropriate processes.
Competitiveness	Social competitiveness links with equity, justice, health, livelihoods Environmental competitiveness links with access to / sharing benefits from ES / NC, for example through biodiversity conservation. Economic competitiveness links with livelihood security, potentially also linked with quality of life, where business acts to secure wider societal benefits.	Management can enhance flow of or access to important ES for various beneficiaries: the challenge is to ensure that management promotes equity, reduces trade-offs, enhances resilience. Competitiveness connects also to ecological footprinting, particularly in terms of reliance on external resources.	Governance structures to address links between ES/NS and the other dimensions of competitiveness as a way to develop in the SD strategy	

In an effort to understand the issues that concerned the case studies better, and particularly how they related to the OpenNESS challenges, an analysis was undertaken of how the case studies saw their work in relation to some of the key conceptual issues that are embedded in the four thematic areas. The results of this work were reported in Section 6.2.

A key finding to emerge was that issues relating to human well-being and sustainable ecosystem management were common across many of the case studies. For example, twenty of the twenty-seven case studies were able to represent what they were doing in terms of a general question about the relationships between ecosystem services and human well-being; the majority was also interested in trade-offs and their consequences. Similarly, more than half of the case studies were interested in questions related to the links between ecosystem services and biodiversity and how they could be managed sustainably. The richness of the questions posed was indicated by the fact that they made reference to more than one element of the cascade. While we found that concerns about the themes of governance and competitiveness were far less often considered as relevant by the case studies, there was evidence suggesting that issues related to these two themes were often being considered implicitly rather than explicitly. This was especially so in the case of governance, given the finding that policy and management issues were some most frequently mentioned issues embedded in the questions posed by the case studies; while the case studies did not necessarily register them under the governance heading, policy and management were often embedded in questions related to human well-being and sustainable ecosystem management.

The work undertaken with the case studies suggested whether or not the issues related to the four challenges were at the forefront of their thinking, consideration of them could be a useful part of the process of formulating the place-specific questions that they were addressing and what kinds of evidence might be relevant in answering them. While there is clearly no necessity to consider the themes embedded in the challenges in a uniform, step-by-step way, it was concluded that in developing some set of conceptual guidelines, they might be designed primarily to helping people to look at the basic framework of the cascade in different ways, so that a richer picture of their problem situation could be developed.

The creation of such conceptual guidelines is a major requirement of the OpenNESS work programme for WP1, and is the specific focus of Deliverable 1.4. In the final part of this document, we summarise the key lessons that we take from the work presented here that shape this next step.

## 7.2 Reading the cascade

To accommodate the OpenNESS challenges within the cascade model explicitly, it might be useful considering them as ‘outputs’ or ‘performance characteristics’ of the socio-ecological system represented by the cascade. The cascade model can therefore be used as a tool 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, or indeed any other general topic that is relevant in the context of dealing with ecosystem services and natural capital. From this perspective, the four challenges could be seen simply as some initial archetypal issues that could provide entry-points for work on ecosystem services and natural capital. A possible graphical representation of this idea is shown in Figure 7.1.



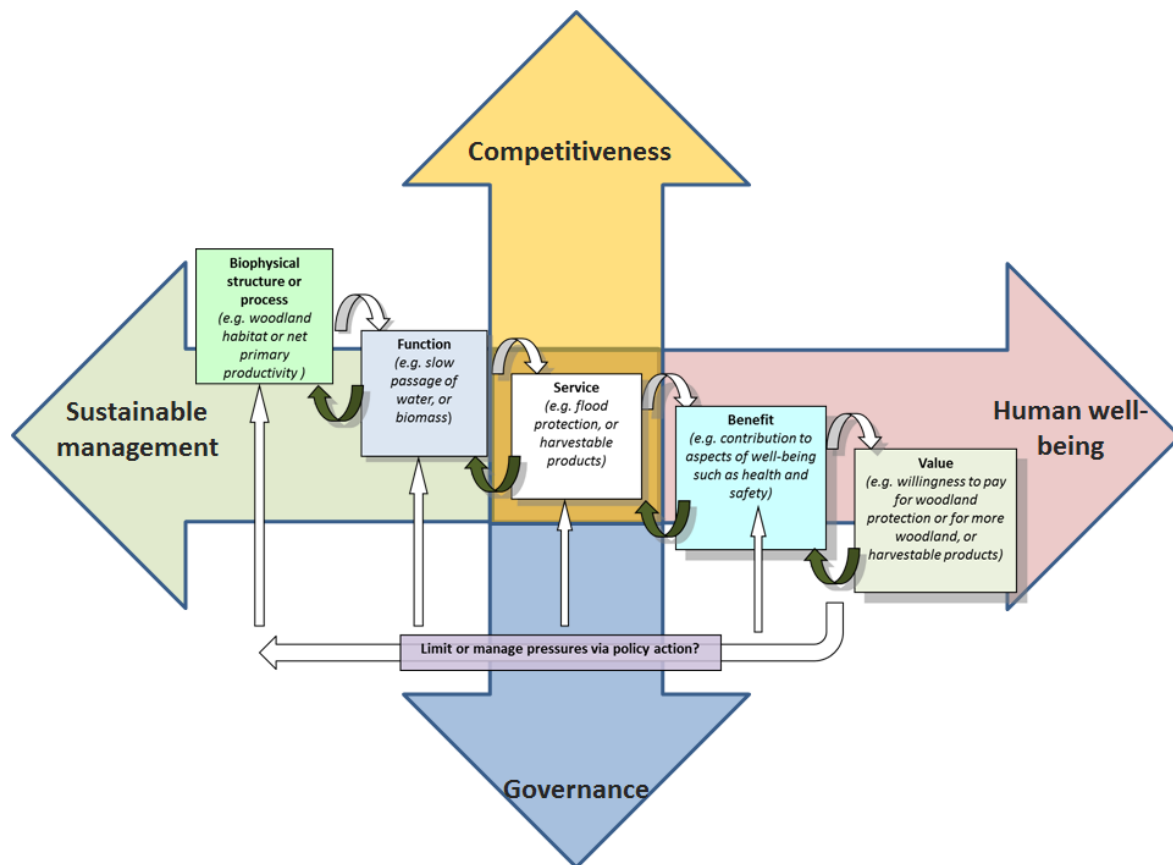


Figure 7.1: The four challenges and the cascade

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, 2016a), and building on this idea, we suggest that they are useful for initiating 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 ecosystem service (as suggested already by Jax 2010, p. 70f.). 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.

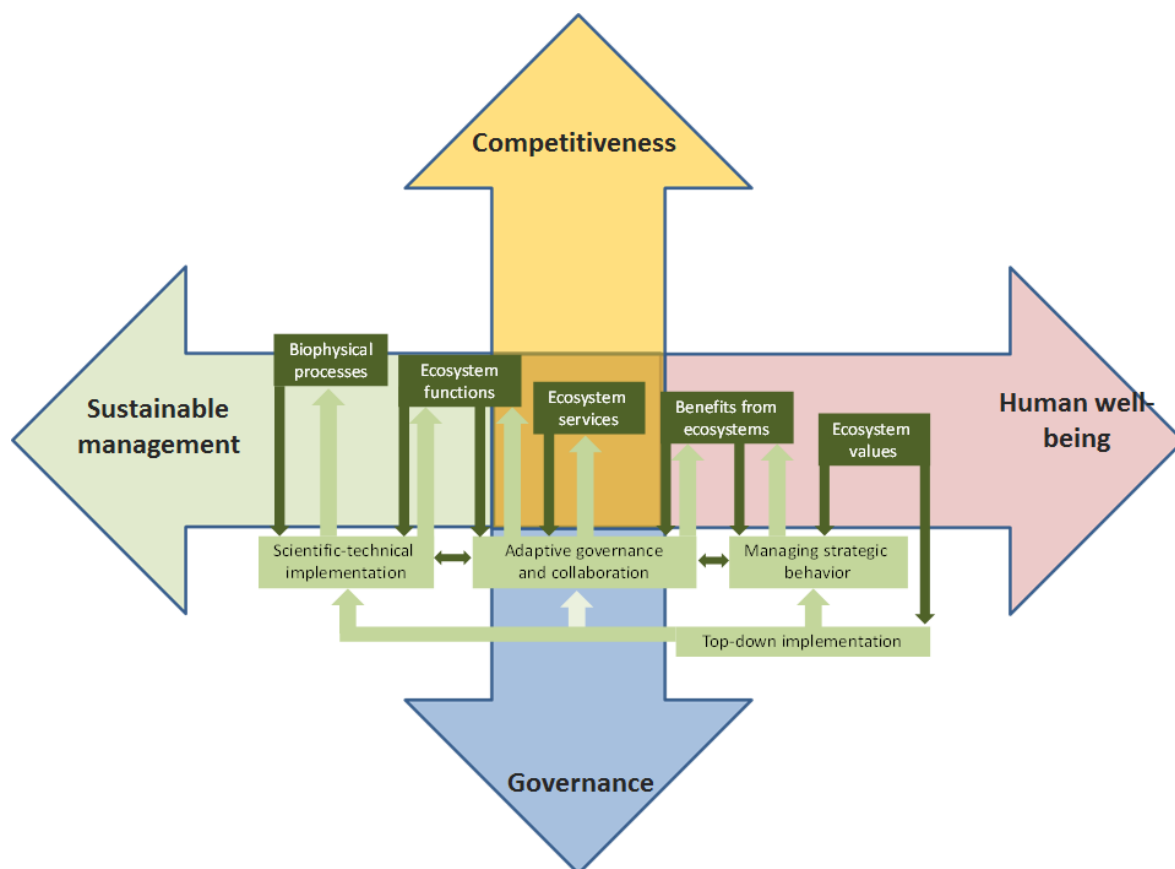


Figure 7.2: Governance issues incorporated into the modified conceptual framework (modified according to Primmer et al., 2015)

For example, the utility of the cascade model was explored recently by Primmer et al. (2015) 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.

What is worthy to note about the representation of the work of Primmer et al. (2015) is the bi-directional nature of the links used to describe the structure of the governance processes. Clearly, for a specific application, in a case study say, the details of the governance mode 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.).

A further interesting feature of the representation of governance issues by Primmer et al. (2015) 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.

Although the development of graphical models may help people to represent their conceptual thinking, the final key lesson that we take from this work is that these diagrammatic representations such as the cascade are not ends in themselves. In thinking about how to take the work on conceptual frameworks forward, and using it to help people operationalise their thinking about natural capital and ecosystem services, the work presented here suggests that it is necessary to move beyond the cascade as a simple static representation and to design a multi-faceted approach. The approach must be customisable, so that it can be used in different problem situations.

Fundamentally, we conclude that any set of conceptual guidelines should allow the cascade *to be read in different ways* according to the context of each local study. In the work described here, we found that the questions and frameworks initially developed around the four challenges was useful in stimulating discussion. However, to be effective in promoting a common understanding of issues, these questions probably need to be refined and expanded to develop an effective set of guidelines. Their structure needs to move away from a generalised, high-level statement of questions relating to challenges themselves, to a more interrogatory set that encourages people to explore basic concepts and their relationships. With this modified approach, people are more likely to be able to construct a richer narrative around the challenges themselves or a new issue that has elements of them included within its remit. Use of these guidelines could be supported by a range of multi-media resources, such as the OpenNESS Glossary and the OpenNESS Reference Book, FAQs (see, for example, Appendix 3) or any other background documents.

Thinking about the four challenges of human well-being, sustainable ecosystem management, governance, and competitiveness from the perspective of developing a common conceptual formwork has been instructive insofar as it shows that we are dealing with a network of related ideas, theories, and abstractions. If these concepts are to be useful, i.e. used *operationally*, then we need to find ways to help people navigate this ‘nexus’ in an efficient and creative manner. Traditionally such skills have been achieved through formal education. In the kinds of rapidly changing transdisciplinary work that arises in relation to ecosystem services and natural capital, we need to discover other means to stimulate both individual and social learning. This task is taken up in the other major output from Work Package 1, which describes the development and testing of the OpenNESS Conceptual Nexus (ONEX) (EU FP7 OpenNESS Project Deliverable 1.3 (2016) and upcoming Del 1.4).

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## Appendices

**A1: The cascade models provided by the OpenNESS case studies**

**A2: Matrix of concepts and the four OpenNESS Challenges**

**A3: Frequently asked questions about the cascade**



**From concepts to real-world applications**

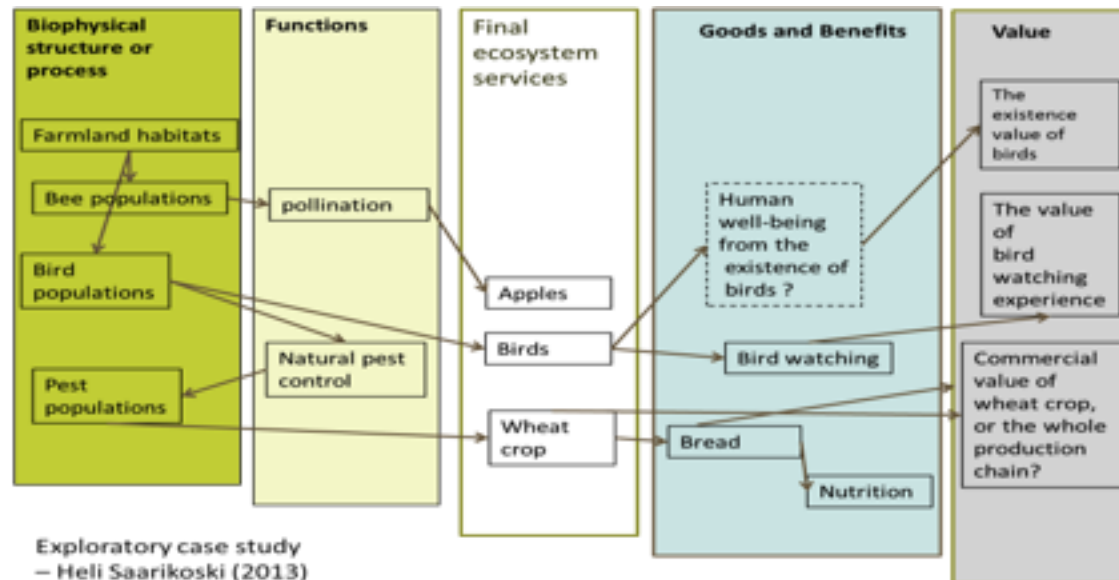
[www.openness-project.eu](http://www.openness-project.eu)

## A1: The cascade models provided by the OpenNESS case studies

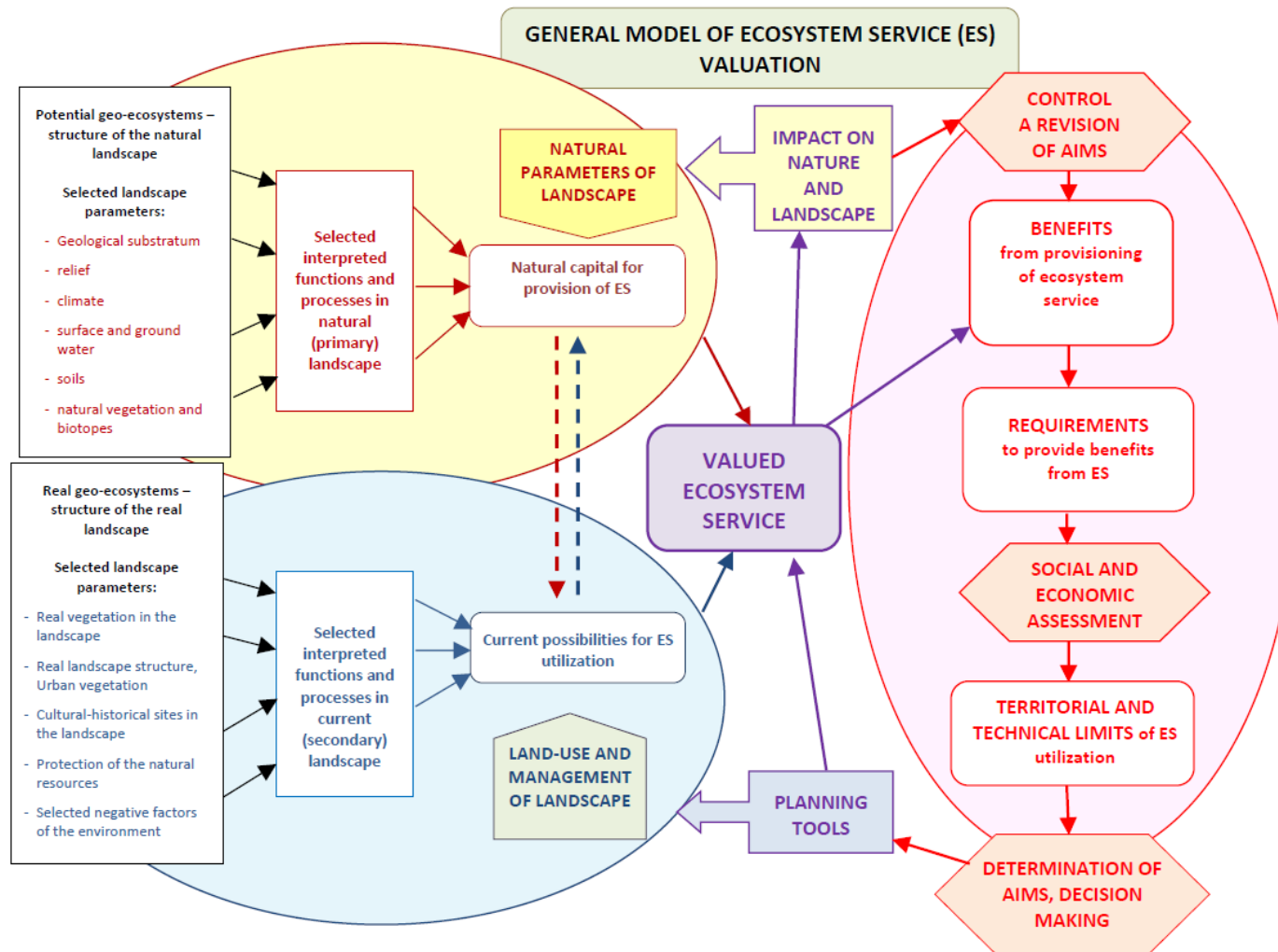
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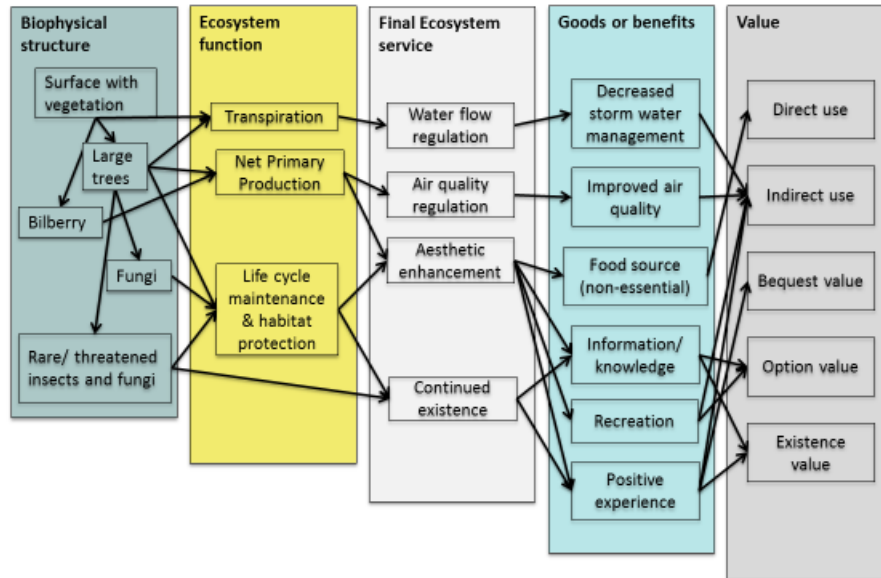
Jari Niemelä, Vesa Yli-Pelkonen and Leena Kopperoinen; Peter Bezak, Zita Izakovičová and Peter Mederly; David N. Barton/ Henrik Lindhjem / Rasmus Reinvang; Gemma Garcia-Blanco and Efren Feliu; Sandra Luque; Heli Saarikoski; Ovidiu Badea; Jennifer Hauck and Joerg Priess; Jan Dick; Berta Martín-López; Miklós Kertész and Orsolya Lazányi; Rob Bugter; Fabio Masi and Camino Lique; Laurence Carvalho; Francis Turkelboom and Wim Verheyden; Erik Gómez-Baggethun and Ignacio Palomo; Charlotte Deerenberg and Chris Klok; Rui Santos and Paula Antunes; Guy Duke and Pam Berry; Roy Murherjee and Raktima Mukhopadhyay; David Odee; Guillermo Martines Pastur; David M. Lapola and Patricia Pinho; Francesc Baró



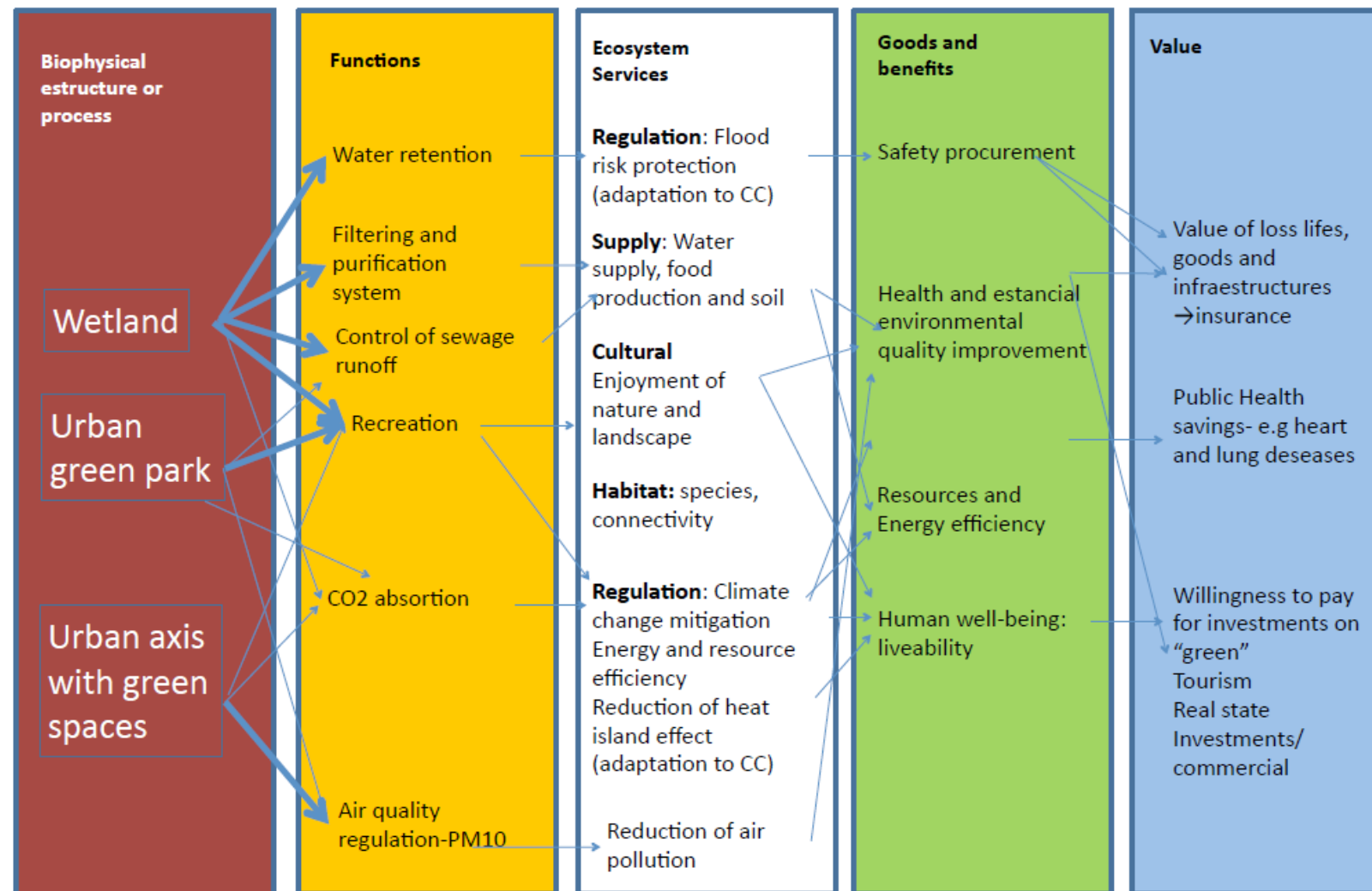
CS #1:



CASCADE DIAGRAM EXAMPLE WITH MORE DETAIL



CS # 3: Osla

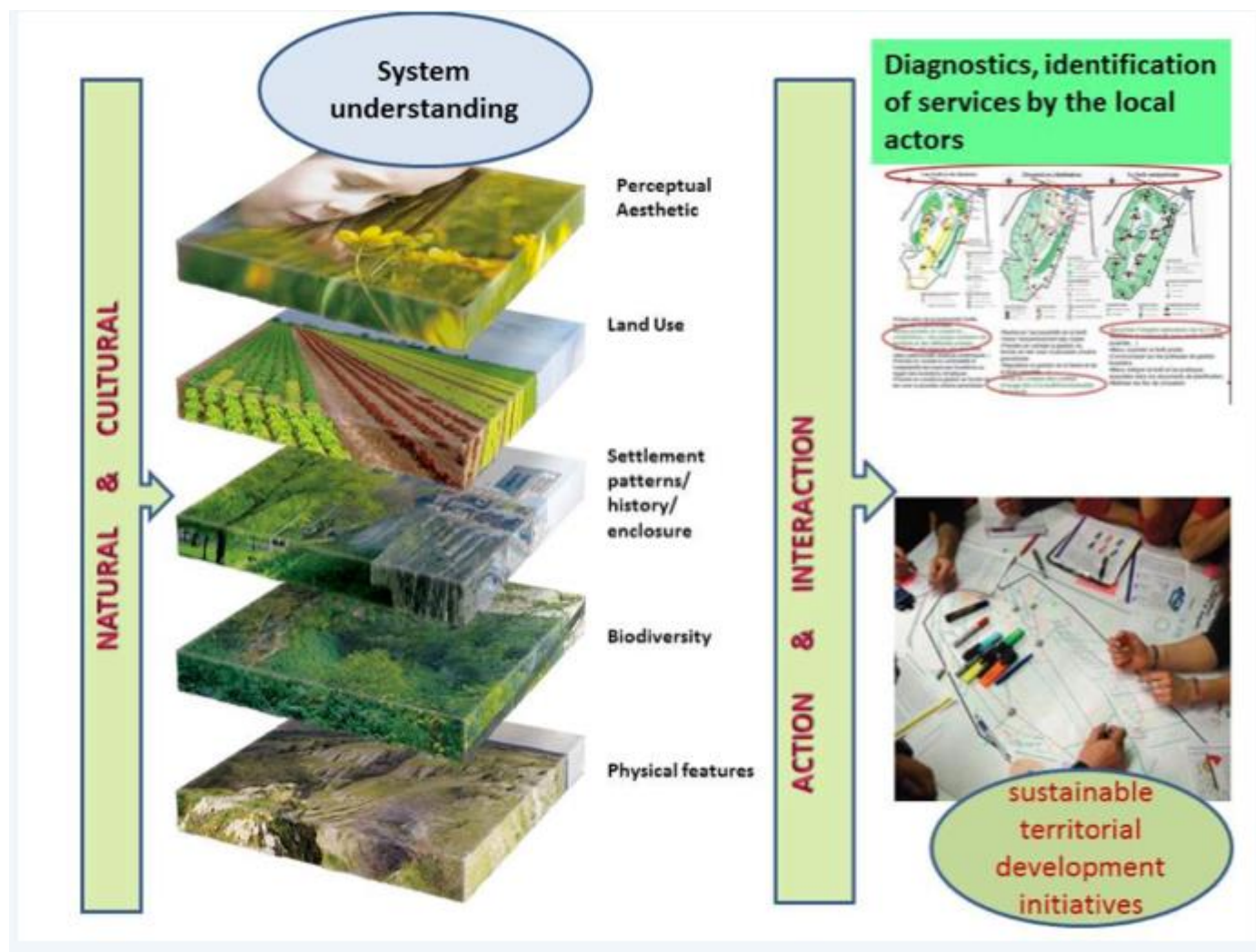


Vitoria Gasteiz Case no 4. Draft ES conceptual model.Gemma Garcia-Blanco (2014)

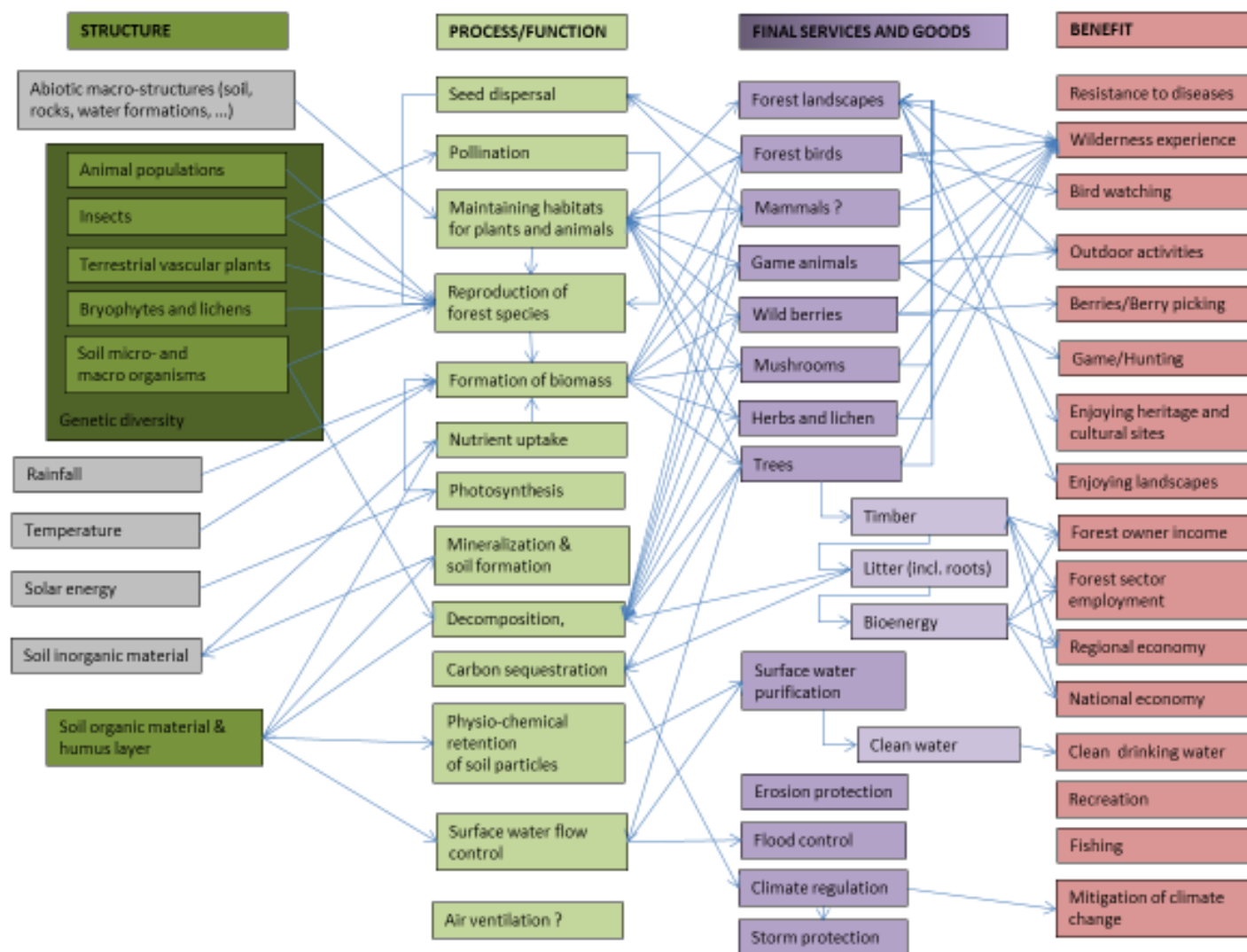
Wetland in Peri-urban park called Salburua

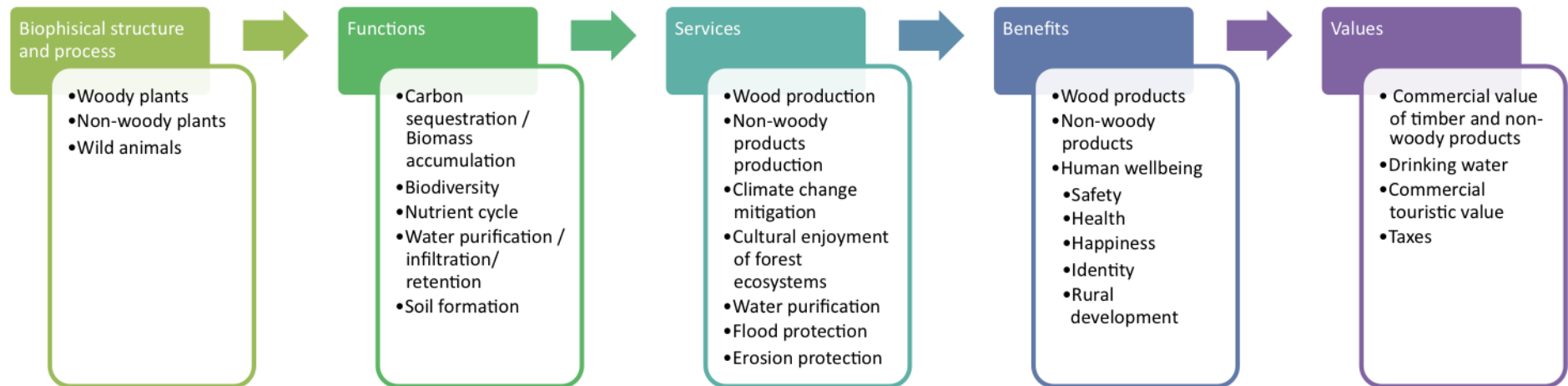
Urban Green Park: "Antonio Machado Park"/ alternatively "Salinillas de Buradón park"

Urban axis with green spaces: North- South connector. Old railway Basque Navarro

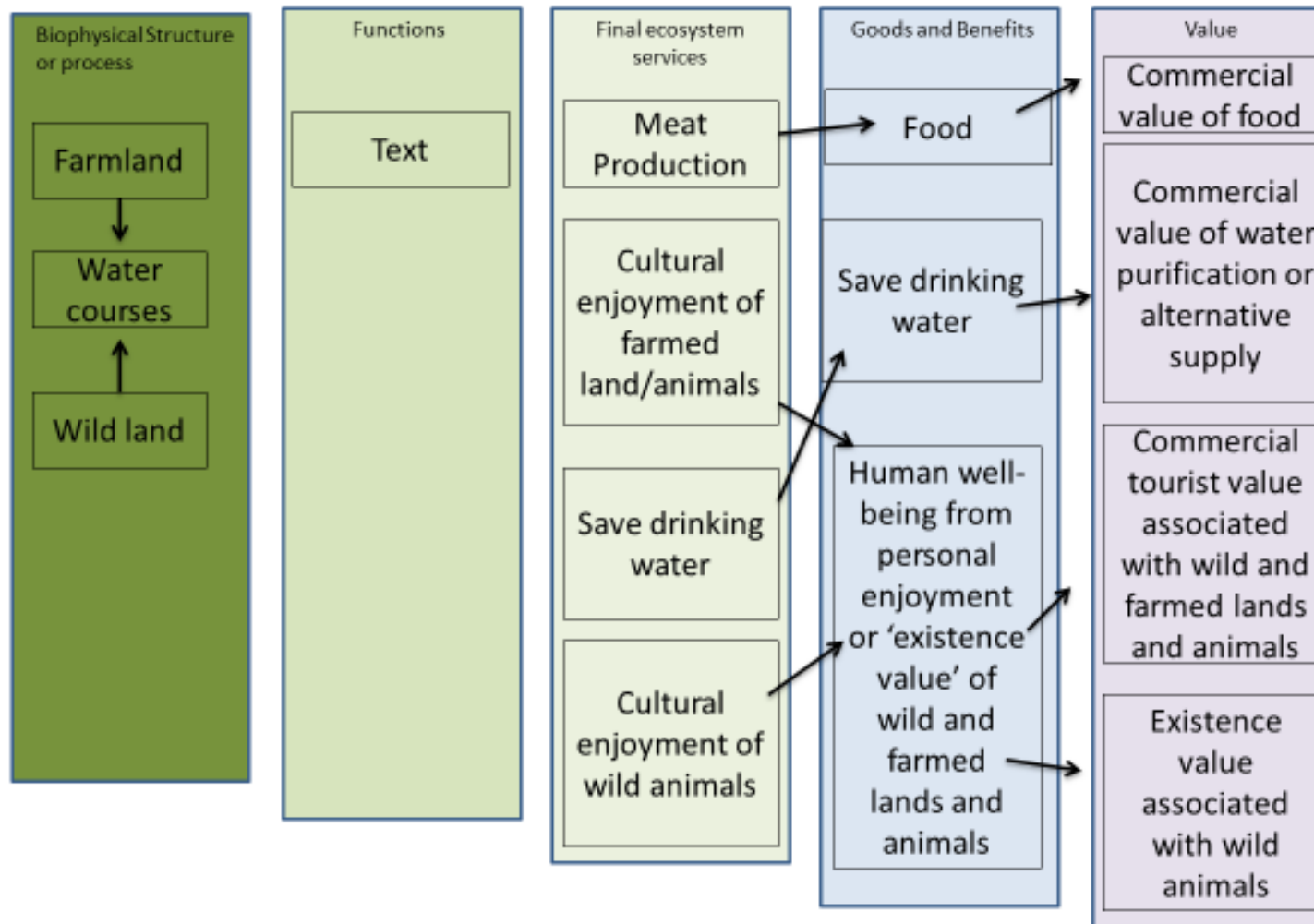




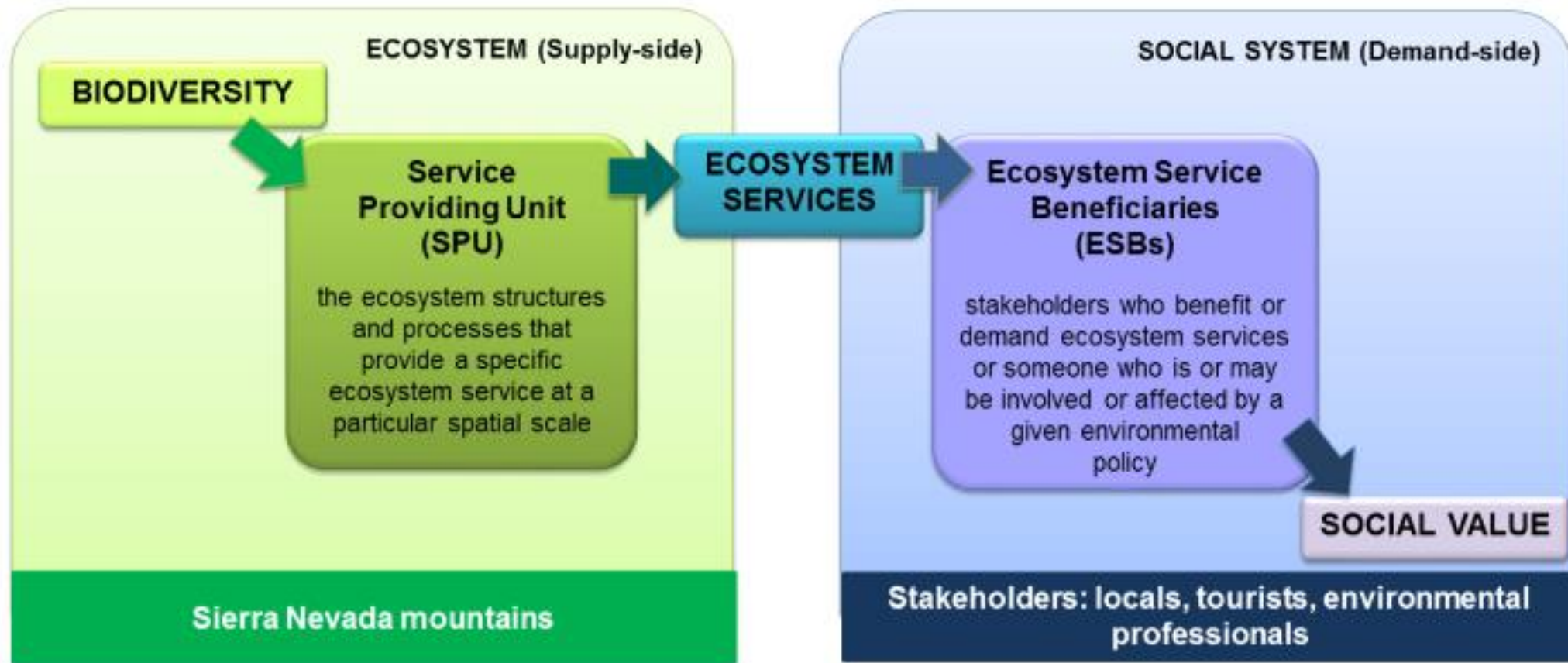




CS # 7



CS # 9



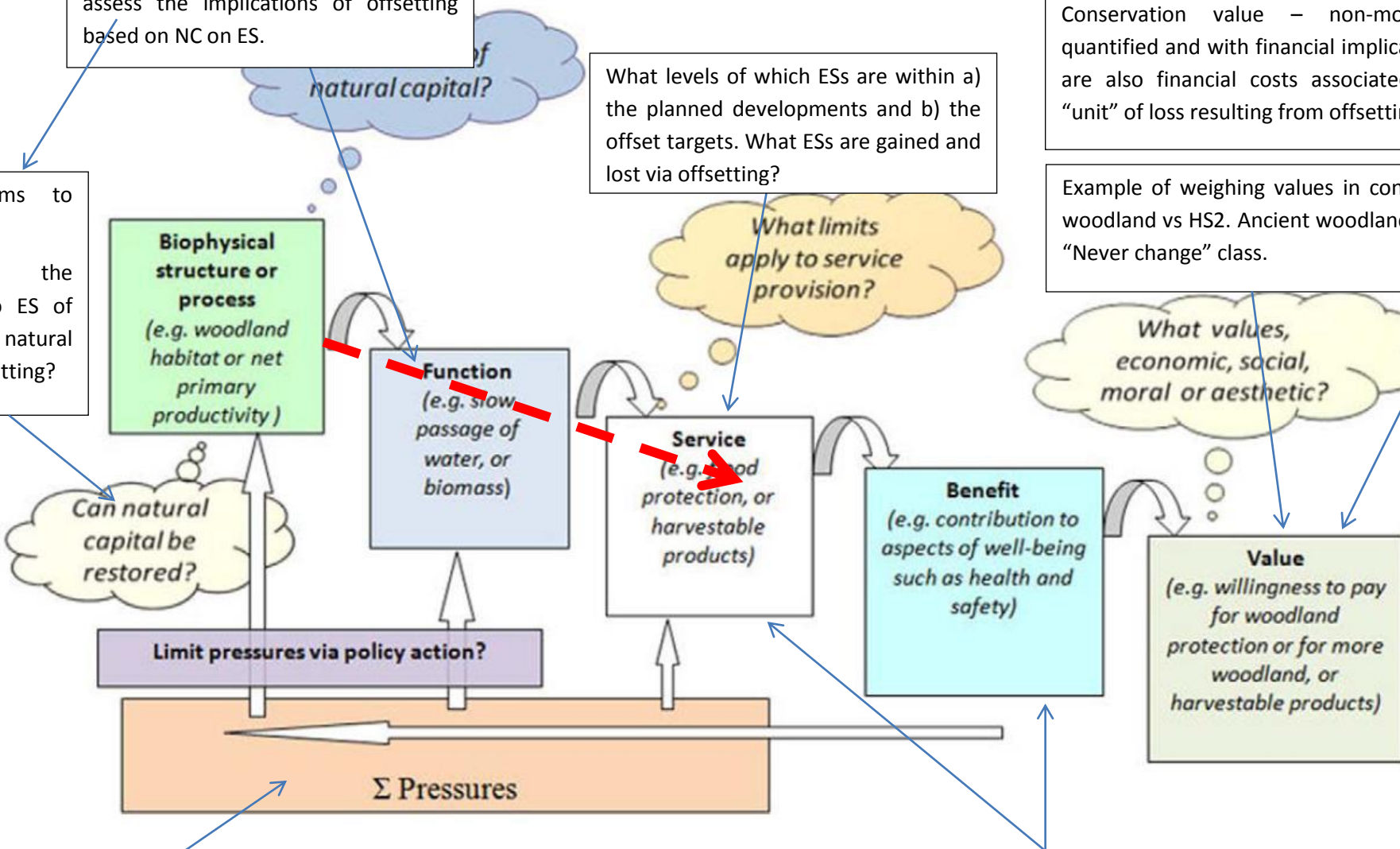
García-Nieto et al. (2013) *Ecosystem Services*

CS # 10

Need some understanding of the relationship between NC-EF-ES to assess the implications of offsetting based on NC on ES.

Offsetting, aims to address this!

What are the implications to ES of restoring natural capital via offsetting?



Development is a pressure on ES ... then so is conservation depending on the ES in question!

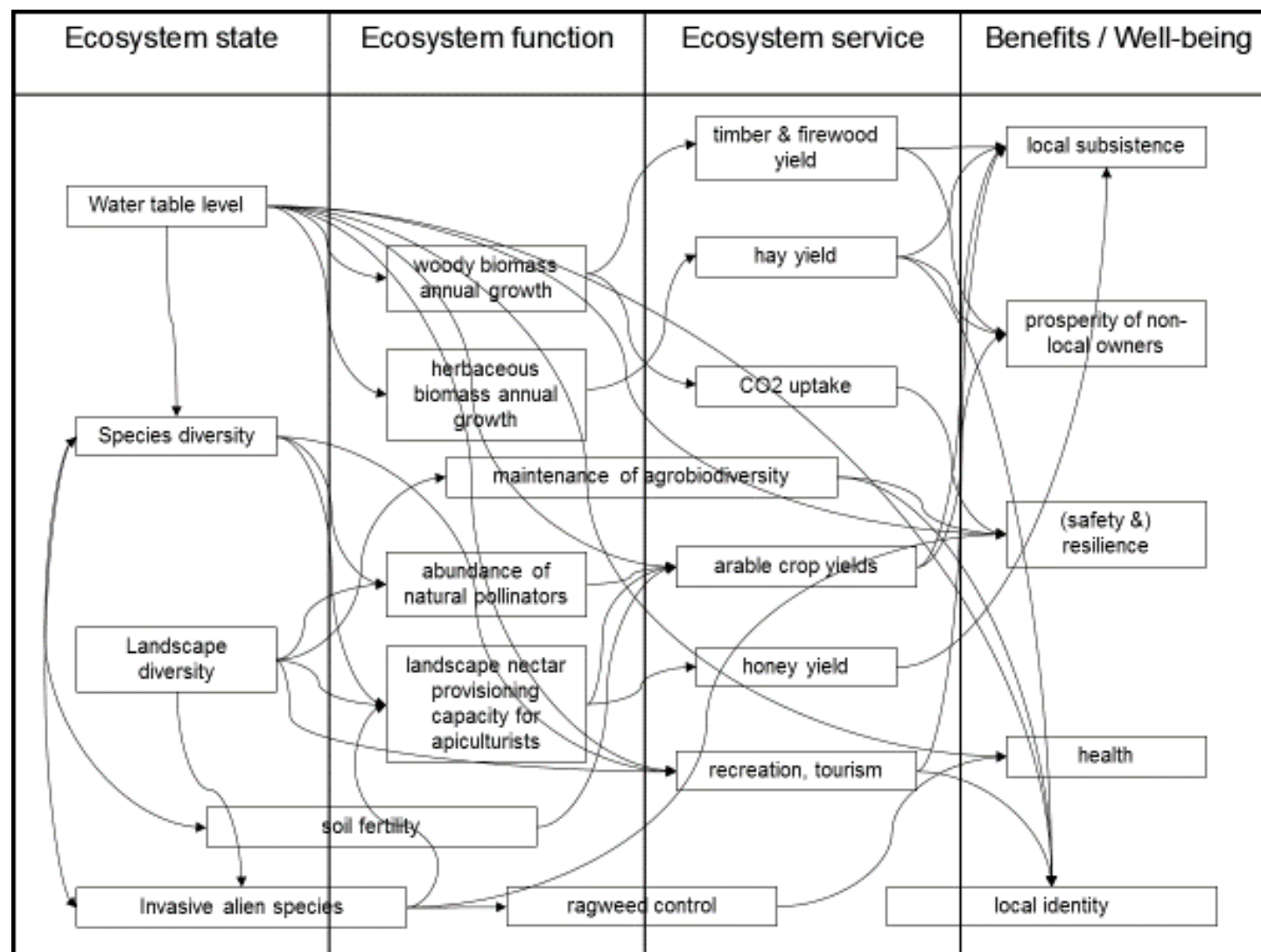
We are looking at climate change as well.

There are metrics used within the offset calculator that assign "values" to different land use / habitat types based on their condition and distinctiveness.

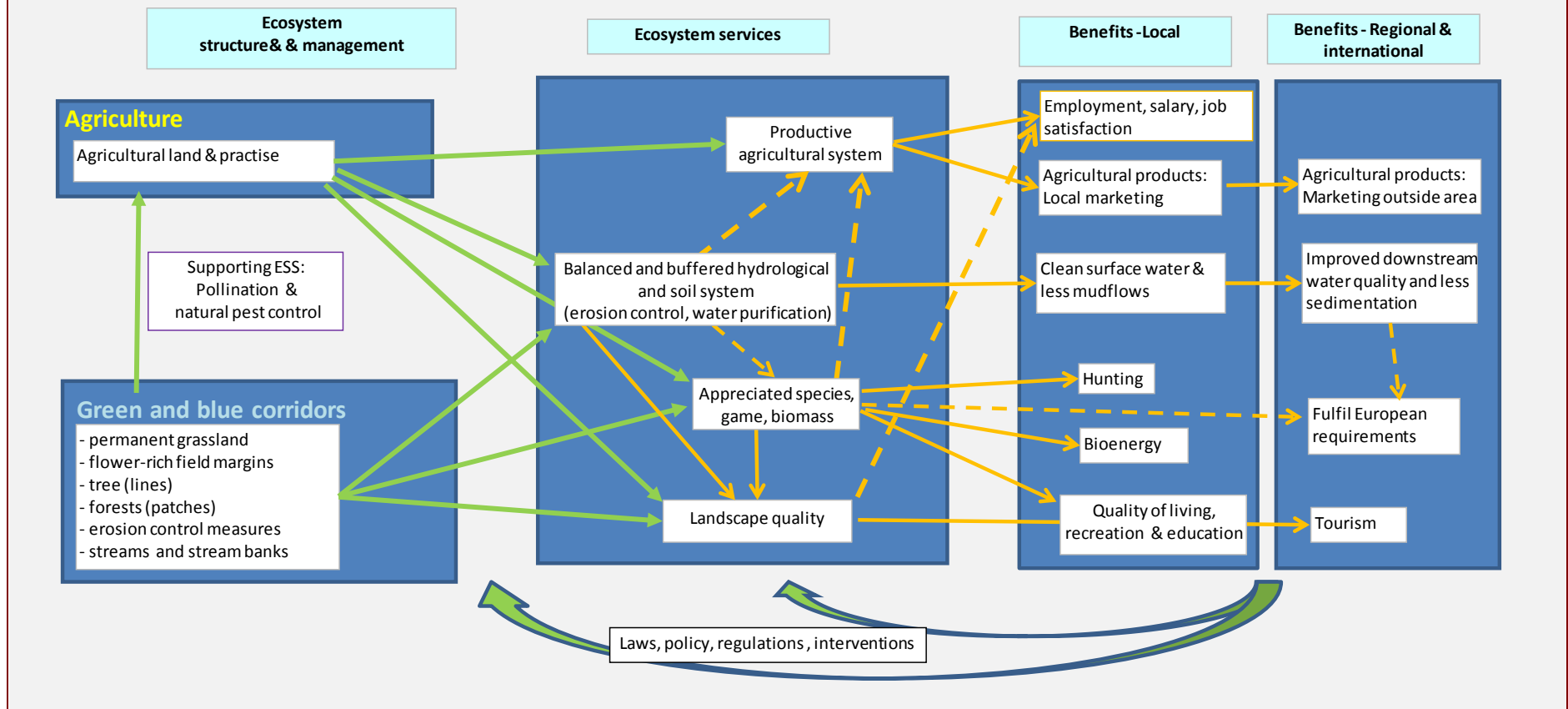
Conservation value – non-monetary but quantified and with financial implications (There are also financial costs associated with each "unit" of loss resulting from offsetting).

There will be ES trade-offs between service provision resulting from offsetting for conservation reasons. Agricultural ESP related services will be most hit as agricultural land will be developed on and the target for any conservation improvement.

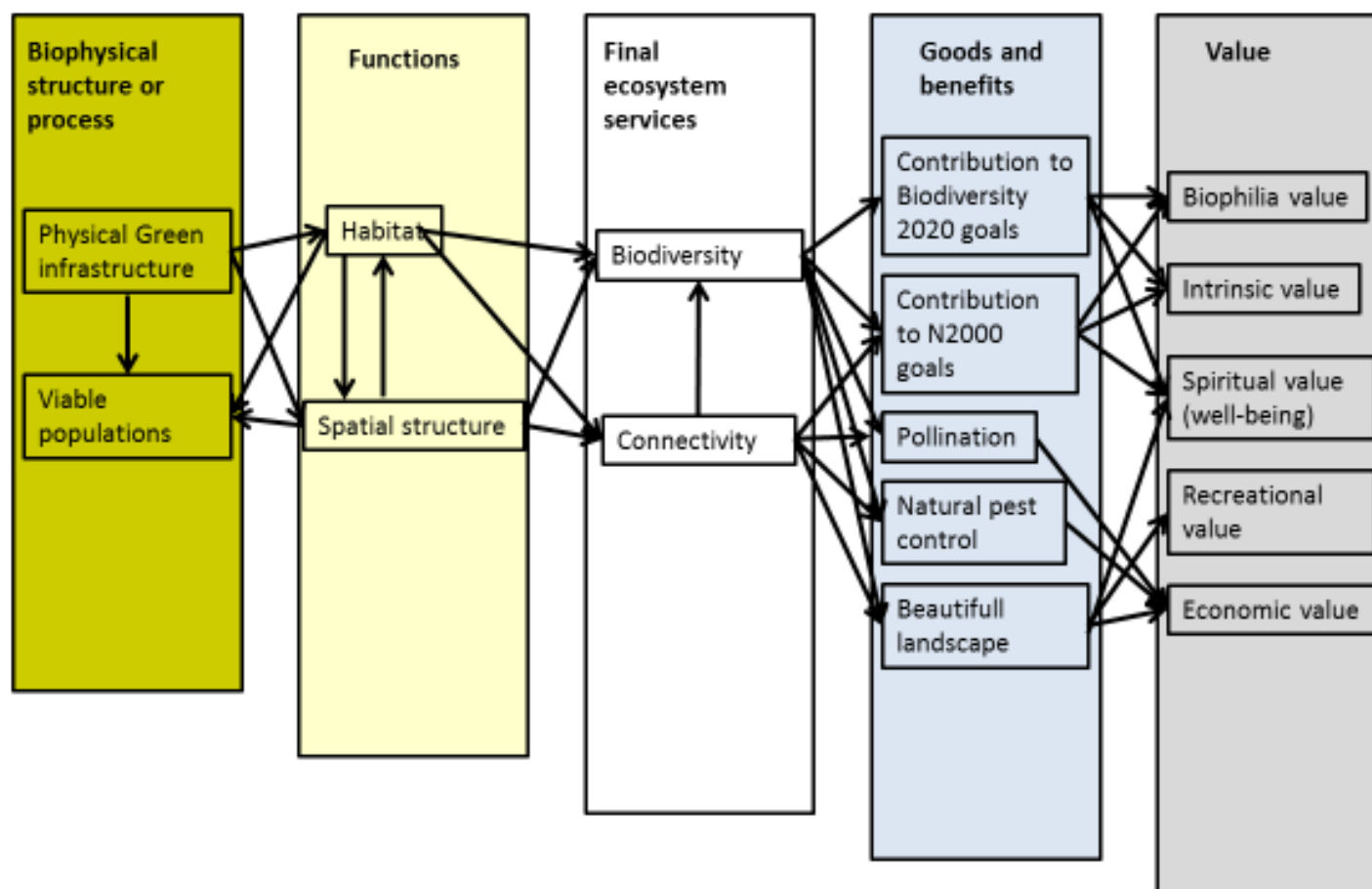




## ANALYSIS of ECOSYSTEM SERVICES (ESS) & BENEFITS of the PROJECT AREA 'DE CIRKEL' (No 13)

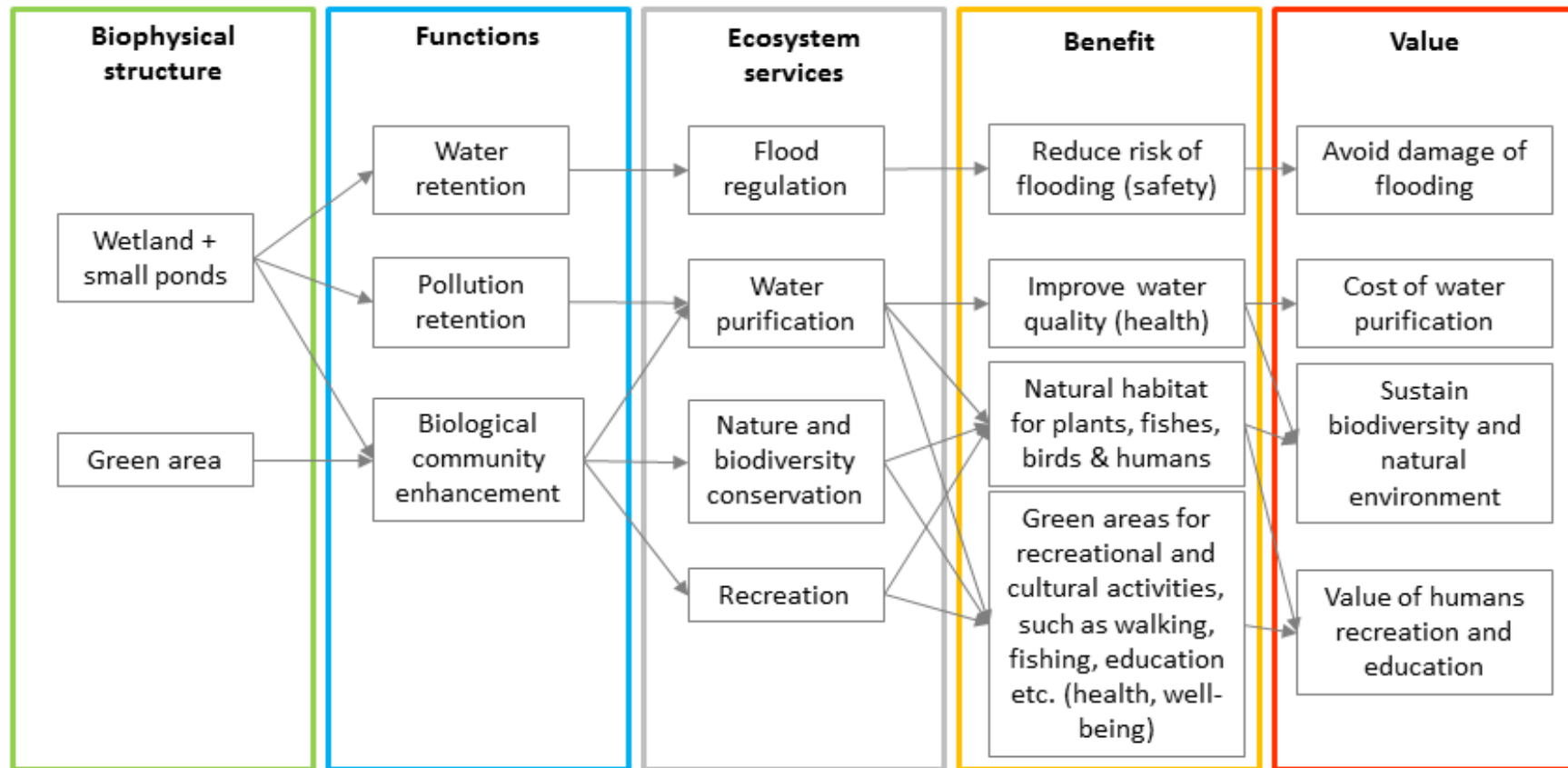


CS # 13



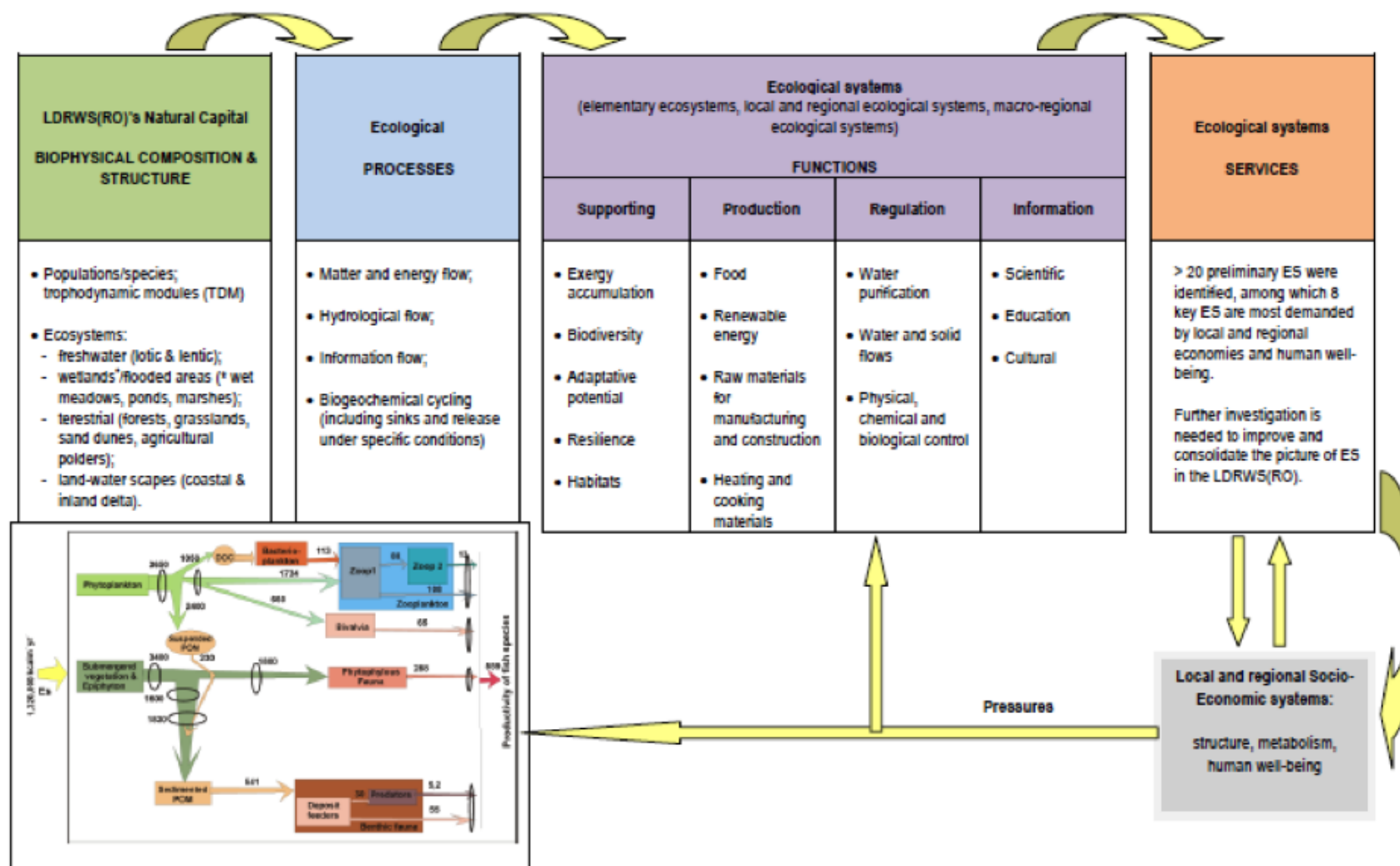
Case 14: Services connected with biodiversity and connectivity enhancement by GI improvement

CS # 14

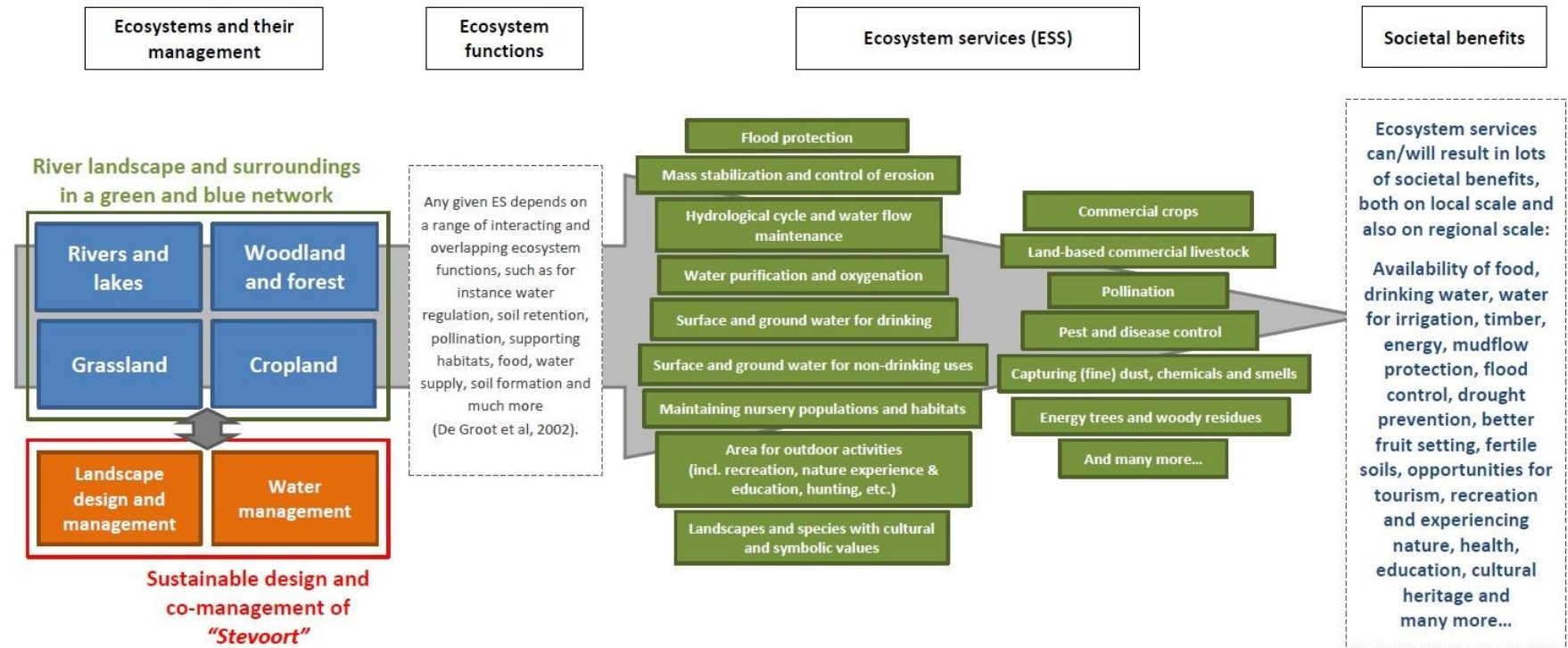


Ecosystem Service Cascade Model, Case study Gorla - Grizzetti B., Conte F., Masi F. (version 30/10/2013)

CS # 15

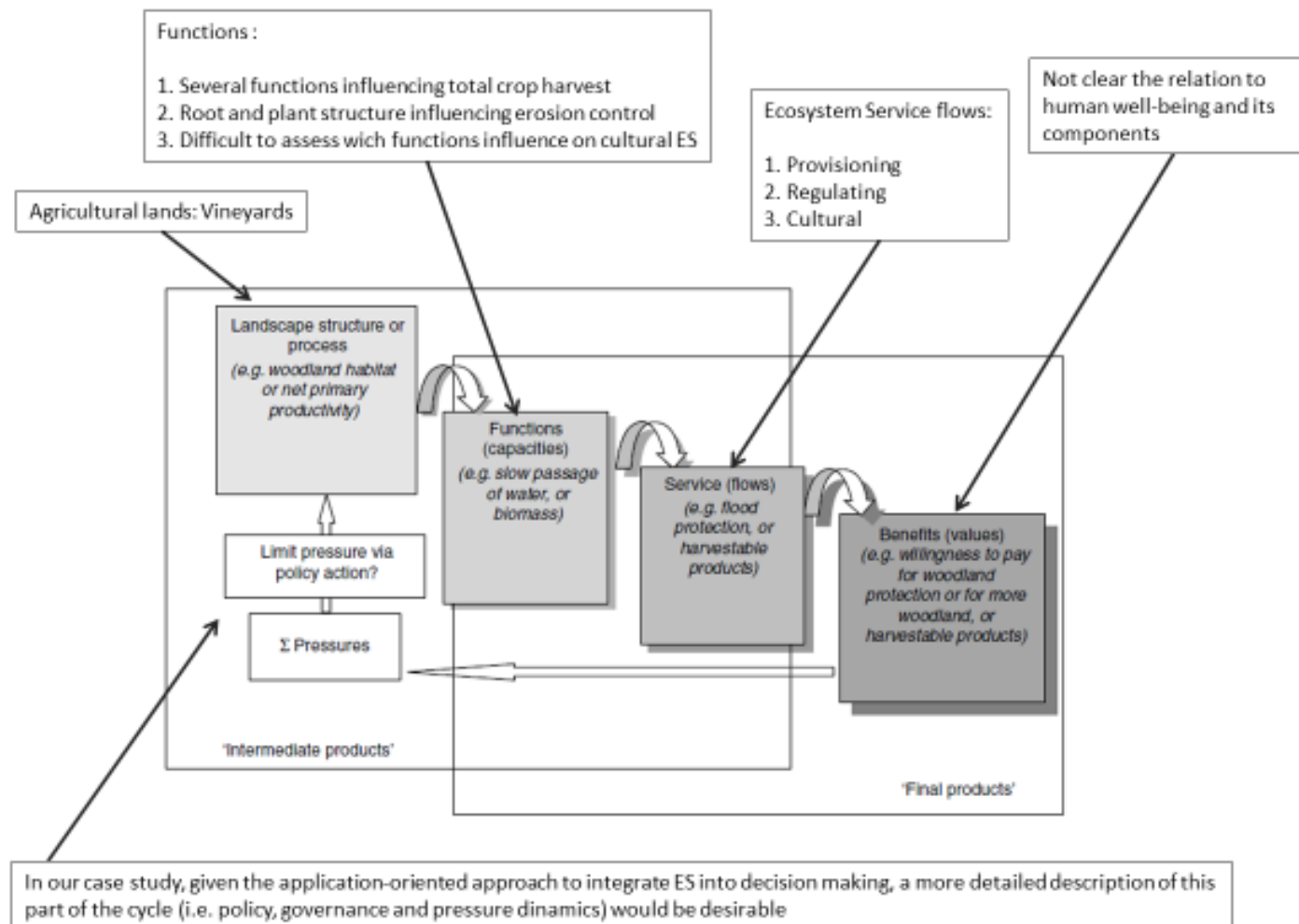


CS # 17

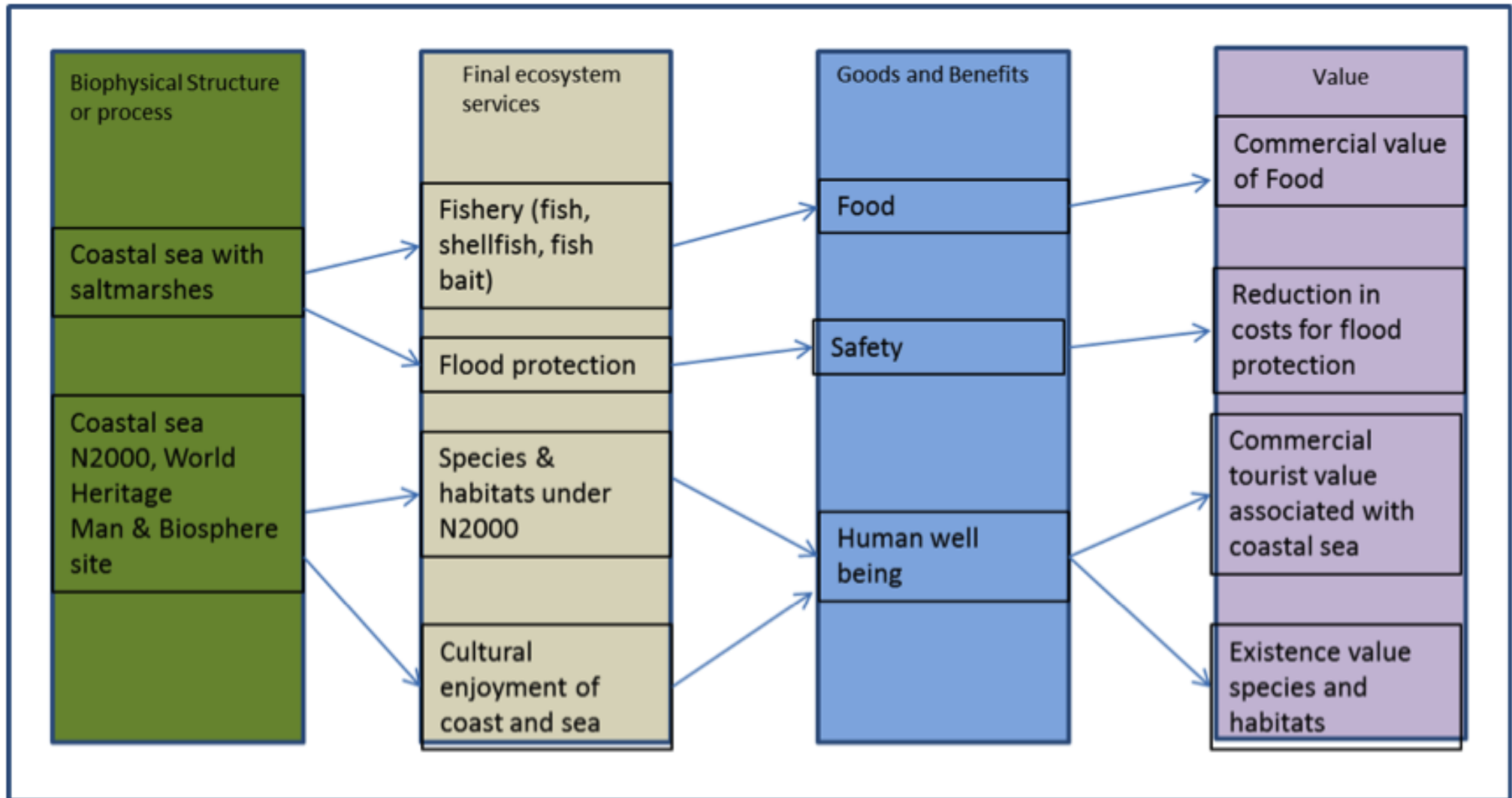


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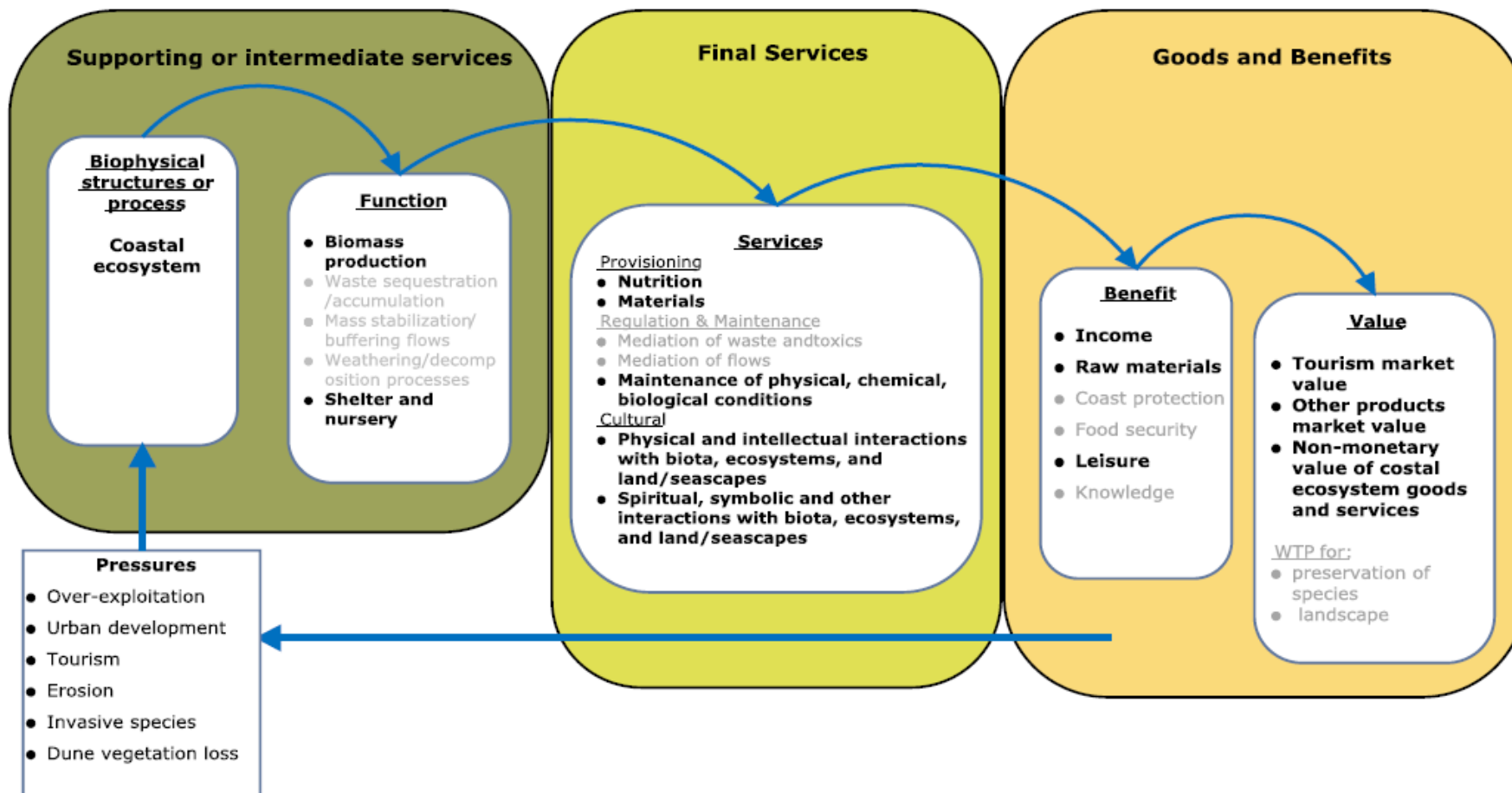
CS # 19



CS # 20

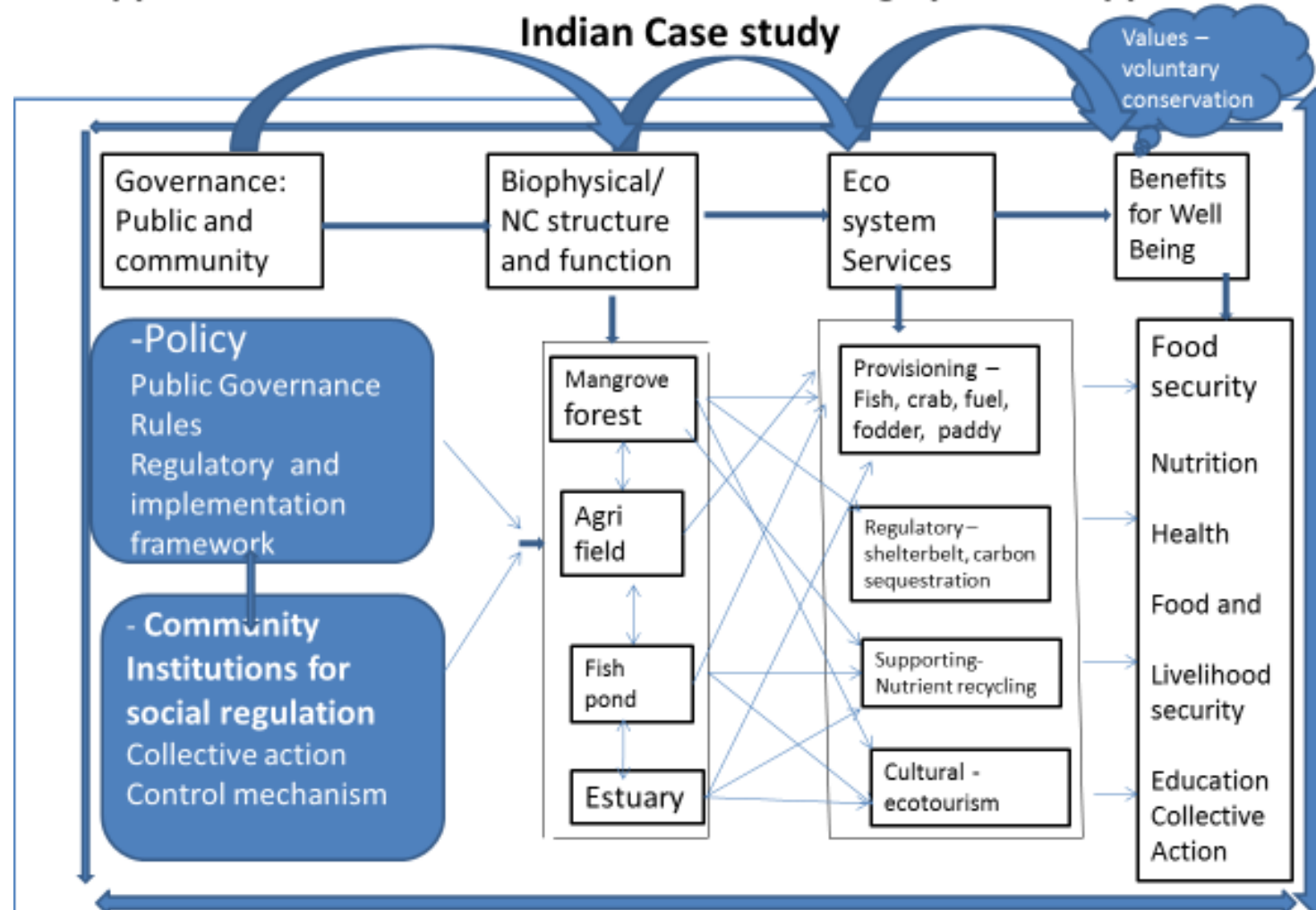
## CASE STUDY 21 - Natural capital and ES for sustainable livelihoods in Costa Vicentina, Portugal

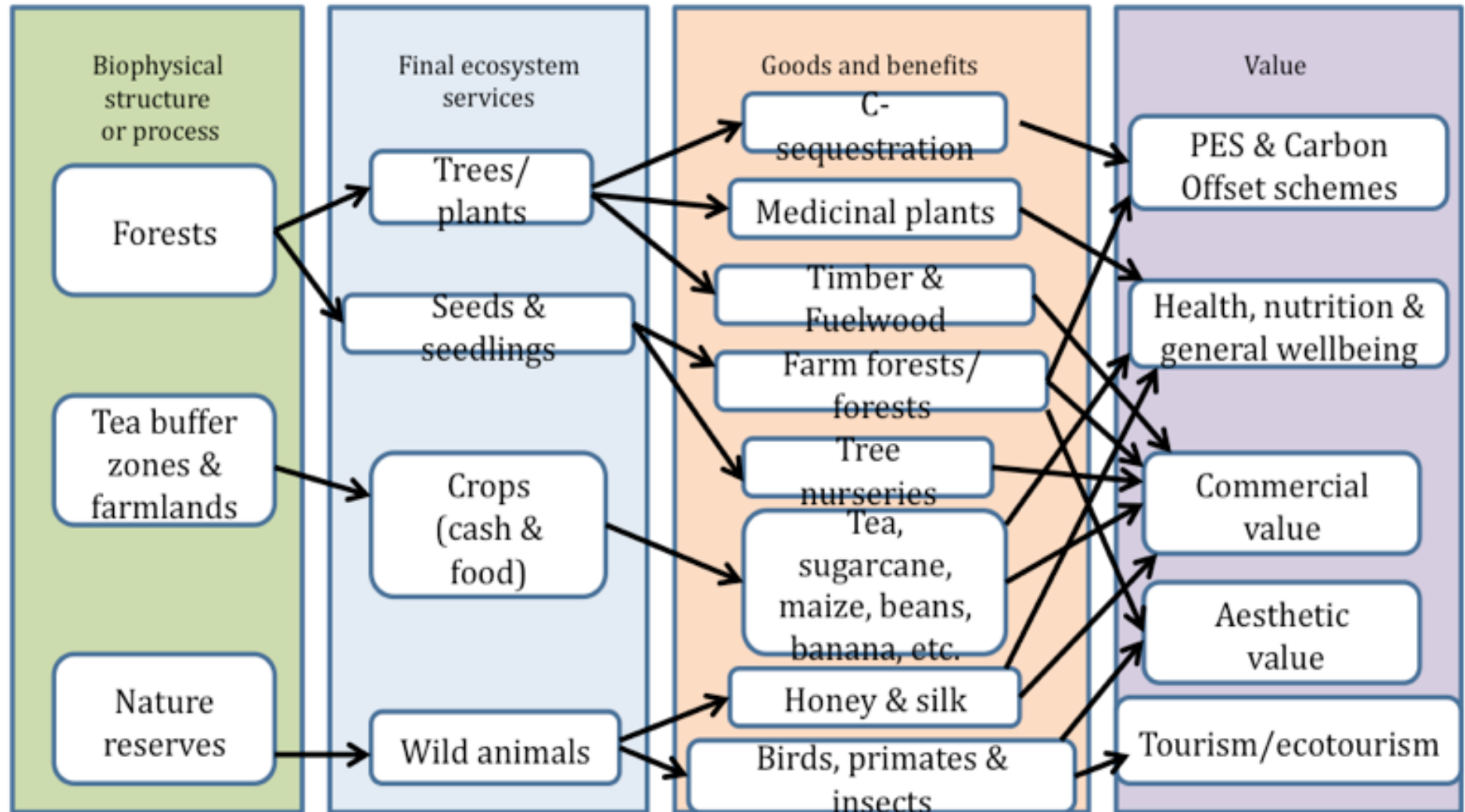
### CASCADE MODEL



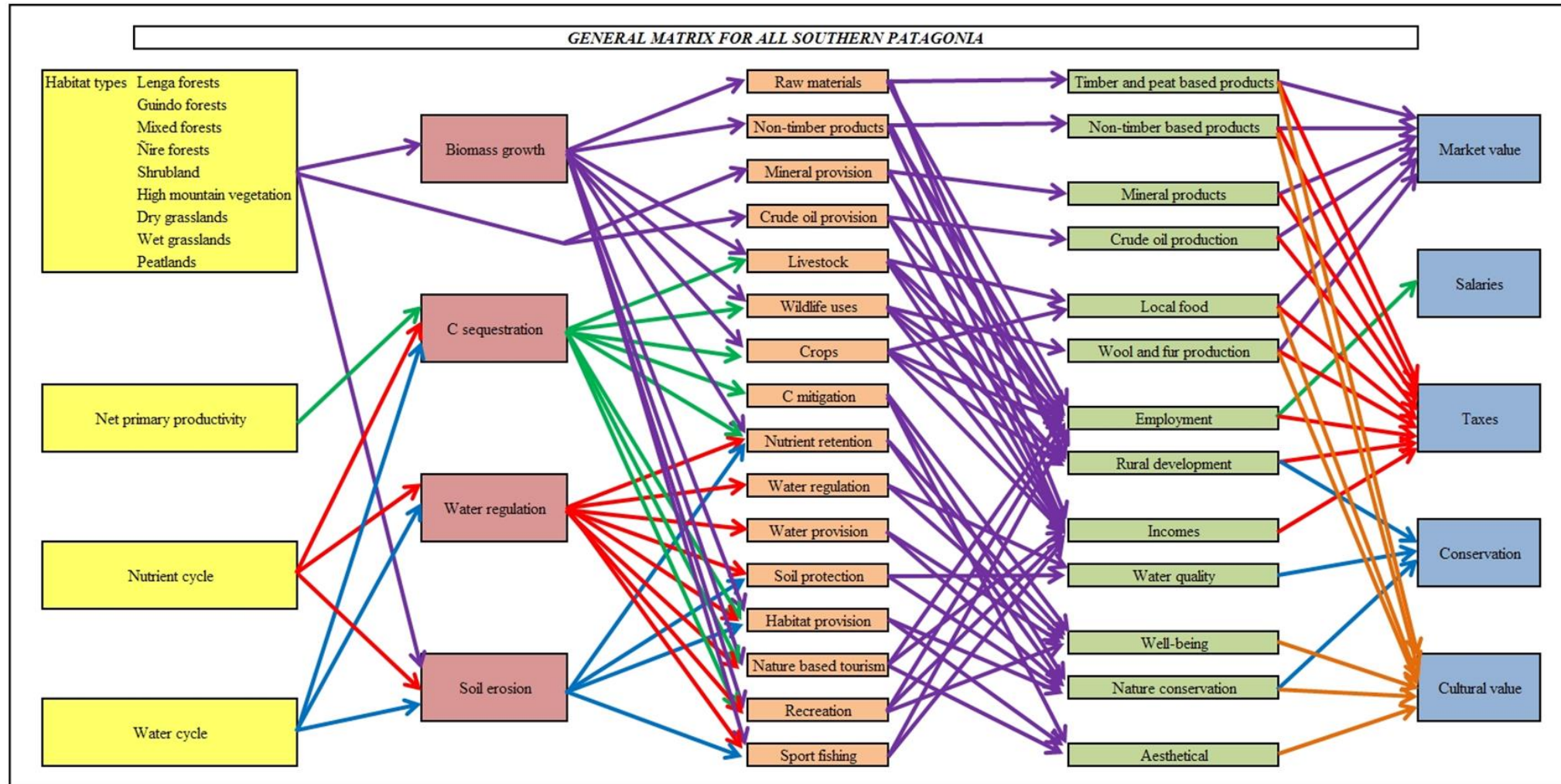
## Application of Cascade Framework following Systemic Approach:

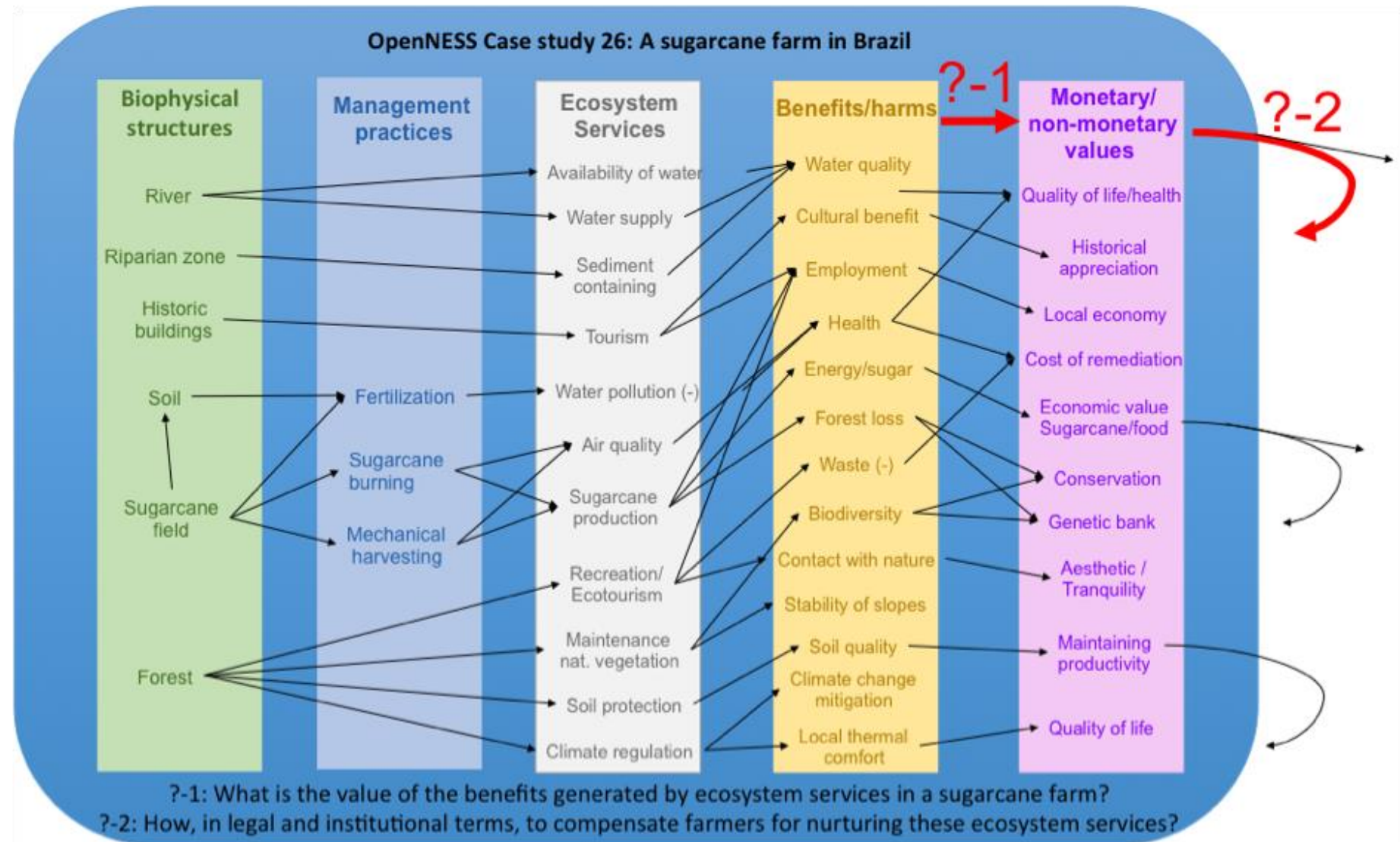
### Indian Case study

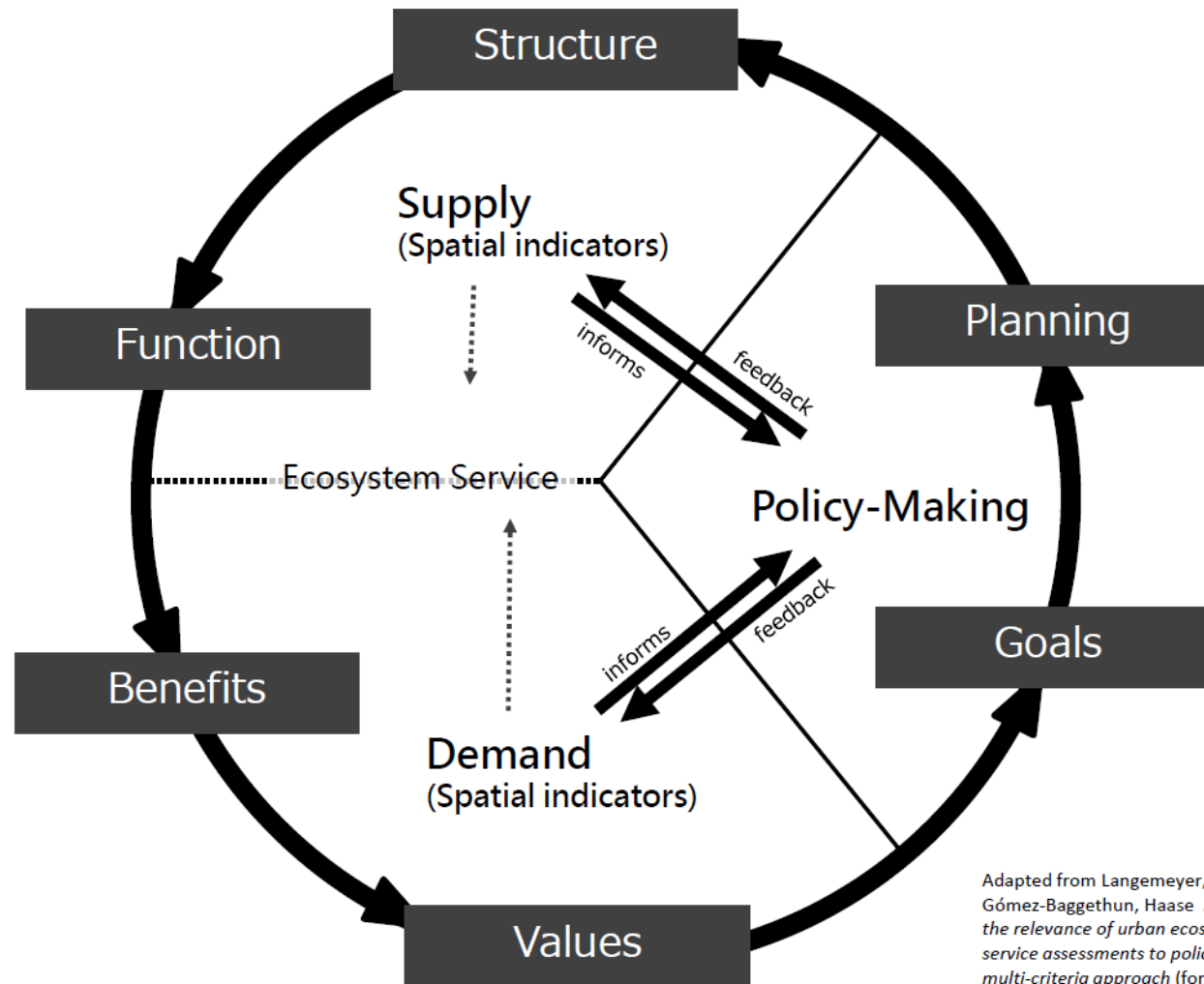












## A2: Matrix of concepts and the four OpenNESS Challenges

Concept	Human Well-Being	Sustainable Ecosystem Management	Governance	Competitiveness	SP Source
<b>Competitiveness</b>	<p>Social competitiveness –links with equity, justice, health, livelihoods</p> <p>Environmental competitiveness – linked with access to / sharing benefits from ES / NC, e.g. through biodiversity conservation.</p> <p>Economic competitiveness – linked with livelihood security, potentially also linked with quality of life, where business acts to secure wider societal benefits.</p>	<p>Management can enhance flow of / access to important ES for various beneficiaries: challenge is to ensure that management promotes equity, reduces trade-offs, enhances resilience. Competitiveness connects also to ecological footprinting, particularly in terms of reliance on external resources.</p>	<p>Governance structures to address links between ES/NS and the other dimensions of competitiveness as a way to develop in the SD strategy</p>	<b>Self-evident</b>	Haines-Young et al. (2016)
<b>Conceptual Frameworks and the Cascade Model</b>	<p>How can trade-offs, synergies, and conflicting interests be valued, and assessment of changes in well-being made in different decision making contexts?</p>	<p>How is service output functionally related to the underlying biophysical structures and processes, and how can supply be managed sustainably?</p>	<p>What governance structure and regulatory frameworks are effective in maintaining and restoring ecosystem functionality and sustaining ecosystem services at levels required by society?</p>	<p>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?</p>	Potschin and Haines-Young (2016)

Concept	Human Well-Being	SEM	Governance	Competitiveness	SP Source
<b>Effectiveness</b>	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. (2016):
<b>Ecosystem Service Bundles</b>	Little is known about how changes in ecosystem services bundle delivery will affect human well-being (Reyers et al., 2013), but it is a component of the CBD Target 14.	Synergies in ecosystem services 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 ecosystem services bundles+ stimulate desirable synergies, and mitigate undesirable trade-offs.	Great? use of the synergies in ecosystem services desirable bundles may enhance competitiveness.	Berry et al, (2016)
<b>Gender Perspective</b>	The contribution of ES to human well-being may not only depend on the status and trends of ecological processes, but also on how social and institutional contexts influence the equal access to ES of certain groups. Having different roles and	We can assume that a more differentiated focus (e.g. gender) improves the sustainability of ecosystems, although additional research and experimenting is needed to investigate how and to what extent gendered roles and	Governance mechanisms should take into account that women and men may have different preferences for ES, different needs, and different knowledge and should provide institutional arrangements that do not crowd out any of these	There is little knowledge on how gendered preferences to ESs relates to competitiveness	Kelemen et al. (2016)



	identities along the continuum of women-men deeply influence the person's relationship to nature, access to the ES it provides, as well as the well-being effect realized. Part of human well-being is health, gender aspects are relevant here.	identities of landscape managers influence the service providing capacity of ecosystems. Local ecological knowledge is gender sensitive (see Reyes-García et al., 2010) and therefore should be explored respectively and not one fits all approach.	gendered differences.		
<b>Good Governance</b>	How is human well-being 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. (2016)
<b>Green Infrastructure</b>	Little is known about how changes in ES bundle delivery will affect human well-being, but it is a component of the CBD Target 14.	ES bundles may represent opportunities for more sustainable management, by maintaining stocks and enhancing sustainable flows of a range of ES from ecosystems while preserving their ecological value and biological diversity	Cross-sectoral policies and governance will be needed to ensure the sustainable delivery of ES bundles	Stable ES provision via bundles may enhance stability and resilience of private sector initiatives depending on natural resources and ecosystems (e.g. agriculture, nature-based tourism), and hence strengthen competitiveness.	Baró at al. (2016)
<b>Human Health</b>	Health is a major factor in measures / reports of subjective and objective well-being. Health is closely linked with economic well-being – i.e. the ability of an individual to manage or care for their health, or that of their family or wider	If ecosystems are viewed as settings for health, then SEM has many potential positive and negative impacts on health. e.g. habitat creation, conservation and restoration can improve health outcomes & resilience against future health risks,	ES and health links provide multiple opportunities for cross-sector, cross-government partnerships in policy development – e.g. all areas related to use, development or management of land and natural resources, including	Public health is an important element in social competitiveness (i.e. relating to social cohesion, justice and well-being of a population), particularly in the context of health equity. Also relates to economic competitiveness - in	Kretsch and Keune (2016)



	community, is strongly linked with economic security.	however potential negative impacts of nature conservation policies on health may arise as distributive impacts. Diseases from nature affecting humans, crops and livestock represent a further challenge for SEM.	those regulating or influencing public access. Also scope for integration where policy-driven changes in BD or ES can affect health outcomes.	terms of direct benefits to private sector health companies. Links with environmental competitiveness (i.e. relating to how natural capital is recognised, utilised and secured) in context of maintaining the flow and sustainability of ES related to health.	
<b>Human Well-Being</b>	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 (2016)
<b>Indicators for ecosystem services</b>	Indicators at the fourth level of the cascade can explore the dimensions of HWB. More conceptual work is needed on the dimensions other than monetary wealth. Applying a consistent system of indicators helps to develop a detailed and quantitative insight into the way natural capital (which can also be conceptualized using indicators along the cascade) and service flows exert influence on well-being.	Quantifying NC and ES in different geographical, environmental and management contexts may help to measure structures and processes, as well as improve management planning, providing decision support for a sustainable flow of services. Measuring the same indicator over time can provide an overview of the sustainability of the system/ES.	Ensuring credibility, salience and legitimacy for all major stakeholder groups is necessary for policy influence. This can be achieved by thorough stakeholder involvement in the development and use of indicators. New participatory and transdisciplinary models for developing biophysical indicators should be actively sought.	Inconsistencies between local capacities and actual use, as well as spatial lags between sources and beneficiaries can be explored using indicators. These factors can add relevant insights into regional competitiveness studies.	Czucz and Arany (2016)

Concept	Human Well-Being	SEM	Governance	Competitiveness	SP Source
<b>Institutional Analysis</b>	<p>Formally and informally defined rights of different actors to benefit from ecosystem services are institutions. Without recognising these institutions, we cannot influence them.</p> <p>Formal and informal institutions condition allocating and redistributing benefits to different groups in the society.</p>	<p>Formal regulations and informal practices condition 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.</p>	<p>Institutional design and the rights of different actors are the starting point of governance.</p> <p>In addition to formally defined governance mechanisms, also existing informal practices shape governance. Identifying both formal and informal governance mechanisms provides an essential basis for further developing governance.</p>	<p>Institutional design and the rights of different actors are the starting point of governance.</p> <p>In addition to formally defined governance mechanisms, also existing informal practices shape governance. Identifying both formal and informal governance mechanisms provides an essential basis for further developing governance.</p>	<p>Primmer et al. (2016)</p>
<b>Link between Biodiversity and Ecosystem Services</b>	<p>The relation between biodiversity and ecosystem services improves our understanding of how biodiversity contributes to human well-being.</p>	<p>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.</p>	<p>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.</p>	<p>Collection of new, empirical data and data-storage on the relation between biodiversity and ecosystem services, can help to improve the use of ecosystem services 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</p>	<p>De Groot, Jax and Harrison (2016)</p>

				companies as well as regions.	
Concept	Human Well-Being	SEM	Governance	Competitiveness	SP Source
<b>Natural Capital Accounting</b>	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 capital 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 (2014)
<b>Nature-Based Solutions</b>	NBS to economic, social and environmental risks/challenges can help to strengthen, enhance, and secure human well-being, through ecosystem-based strategies for risk reduction, climate change adaptation and mitigation, sustainable (green) urbanisation, mitigation of pollution, and ‘one health’ approaches to disease outbreaks.	Current concepts of NBS often include discussion of stakeholder engagement, and the restoration/use and management of ecosystems to ensure essential ecosystem services are preserved and enhanced.	IUCN identifies governance as a key area for promoting NBS—along with education, investment and capacity building. Engagement with stakeholders and users of ecosystem services are important considerations for managing and implementing NBS.	NBS are relevant to issues of industrial / business competitiveness and innovation (e.g. biomimicry), as well as to wider social and environmental competitiveness (e.g. resilience & adaptation to economic, environmental and social challenges).	Potschin et al. (2016)
<b>Non-monetary valuation of ecosystem services</b>	<ul style="list-style-type: none"> <li>NMV grasps how ESs contribute to different well-being dimensions (e.g. material, health, social, spiritual)</li> </ul>	<ul style="list-style-type: none"> <li>Results of NMV can be integrated with supply and demand side indicators in integrated methodologies (i.e.</li> </ul>	<ul style="list-style-type: none"> <li>NMV provides information on multiple and incommensurable values and trade-offs induced by management</li> </ul>	<ul style="list-style-type: none"> <li>NMV promises a deeper insight into human-nature relationship, which allows doing business</li> </ul>	Kelemen et al. (2016)

	<ul style="list-style-type: none"> <li>Some NMV methods are capable of inferring subjective well-being by describing how stakeholders define well-being components and what the locally relevant aspects are in relation to ESs</li> </ul>	<p>mapping, MCDA or BBN) that provide key information for ES management.</p> <ul style="list-style-type: none"> <li>NMV explores the beliefs, motivations and socio-demographic factors that influence individual and social choices in ES management, which helps identify potential intervention points to present unsustainable practices</li> </ul>	<p>decisions</p> <ul style="list-style-type: none"> <li>NMV could increase social support and engagement to certain environmental policies which is a key to effective and successful policies</li> <li>NMV encourages to be transparent about the methodological choice</li> </ul>	<p>more sustainably than nowadays</p> <ul style="list-style-type: none"> <li>A key strength of NMV is to value cultural ESs. Hence a major business oriented target group could be the SMEs dealing with ecotourism, recreation, cultural heritage and contact with nature under different interventions</li> </ul>	
<b>Public Goods</b>	<p>Environmental public goods provide a range of social, cultural, and economic benefits that support well-being. Conversely, loss of access to public goods can negatively impact well-being (e.g., pollution of air or water supplies damaging a public good and impacting directly on health). Linkages between global and local concepts of public good-type ES and well-being should be considered.</p>	<p>There has been much research into the provision of environmental public goods through ecosystem management, particularly relating to agriculture. Provision of public good-type ES can be an important co-benefit of landscape management and nature conservation strategies, ensuring social and / or economic returns on investment in natural capital.</p>	<p>Governance mechanisms to secure or enhance delivery of public good-type ES must recognise the complexity inherent in ecosystems as well as in the social contexts within which they are provided and utilised. Market-based mechanisms alone are unlikely to be sufficient to secure provisioning of ES; where markets are considered, the interests and motivations of all stakeholders should be addressed. Local participatory ES assessment processes can help to enhance local awareness of public good-type ES and thus promote a better govern-</p>	<p>Security of stocks of environmental public goods may contribute to social, economic, and environmental dimensions of competitiveness, though valorisation depends upon the awareness and capacity of stakeholders. This may be complicated by privatisation of public good-type ES or related elements of biodiversity and NC. Difference in local vs. global demands for and values of public good-type ES should also be considered.</p>	Kretsch et al. (2016)

			ance at the local/regional level.		
Concept	Human Well-Being	SEM	Governance	Competitiveness	SP Source
<b>Resilience</b>	Resilience (taken as the ability of individual, communities, or institutions to adapt to a challenge) can be considered an important determinant of well-being; e.g., it has been argued that resilience is a key aspect of human health, and it is increasingly important in policies for protecting vulnerable populations from impacts of climate change	Resilience is a key aspect of ecosystem health. Long term ecosystem sustainability requires resilience in the face of social, economic, environmental and demographic changes, and should be a key aim of management planning and practices.	Resilience may be considered an important cross-cutting issue for mainstreaming BD / ES / NC across government sectors and for ensuring coherence between various policies.	Resilience is a core component of economic competitiveness for enterprise and for cities, regions, countries etc. It is also an important element of social competitiveness, related to long-term cohesion, stability and well-being within communities. It also links to environmental competitiveness – the sustainability of natural capital and heritage assets which support societies and economies.	Kretsch and Stange (2016)
<b>Scenario Building</b>	The storylines facilitate a (participatory) prioritisation and evaluation of policies and regulatory frameworks ensuring the relevance and usefulness of the scenarios for the intended users. Furthermore, the common framework of scenario assumptions facilitates testing the robustness of policies (Hauck et al. in preparation) e.g. via comparative analyses across OpenNESS case studies.	In the scenarios very different types of land and ecosystem managements are assumed to assess a broad range of their potential positive and negative impacts. (See simulation results (Veerkamp et al. forthcoming; Priess et al. forthcoming))	The OpenNESS case studies and modelling approaches 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. Subsequently, participatory scenario workshops could explore the human wellbeing of different stakeholders across	The OpenNESS scenarios make explicit assumptions about changes in different sectors of the economy, lifestyles, demography, urban and rural areas etc., several of them with potentially strong impacts on competitiveness. It is envisaged that case studies and modellers will analyse the multiple impacts on NC, ES, human well-being etc. in the different scenarios, and their impacts on	Priess and Hauck (2016)

			scenarios.	competitiveness.	
Concept	Human Well-Being	SEM	Governance	Competitiveness	SP Source
<b>Social Justice</b>	Social justice relates to the ability of all groups to integrate into society, enjoy freedom of choice and action, gain fair and equitable access to goods, services, right and protections, and the degree to which various groups are impacted by environmental change and management decisions. Social justice can therefore be considered as an essential component for long term sustainable social well-being. Equity can be a common denominator: equity is both a component / dimension of well-being, and a criterion for social justice	Where the management of ecosystems can affect the distribution of, or access to, ES for particular groups social justice issues may arise. This should be factored into management processes, including monitoring of effectiveness and impacts.	Social justice is often framed as an issue of governance, with responsibility for ensuring equity and access resting with policy makers. Considering the potential for distributive impacts from biodiversity policies, it is important to factor these issues into relevant policy development and implementation processes. Procedural aspects of social justice also relate directly to governance structures and processes.	The concept of social competitiveness is largely rooted in social justice – a society is socially competitive when the benefits and privileges of residing in an area are equitably distributed and accessible to all. Economic competitiveness can also have a social justice component, in terms of how economic policy impacts on livelihood security and poverty.	Kretsch and Kelemen (2016)
<b>Stakeholder involvement in ecosystem service decision-making and research</b>	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	The necessity to include perspectives from various stakeholders is important for understanding potential strategies for sustainable ecosystem management. It is common that stakeholders with different stakes 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	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	Hauck et al. (2016b)



	of human well-being.		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?	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.	
<b>Sustainable Ecosystem Management</b>	Sustainable ecosystem management is necessary to preserve the long term ability of ecosystems to deliver the services that underpin human well-being. This may involve trade-offs between short term wellbeing and long term resilience. It will also involve trade-offs between different ES, which in turn depends (partly) on the benefits of each ES for human well-being, including the cultural value of managing an area for particular species. We should be aware of the need to use a range of approaches for ES valuation, and avoiding over-reliance on monetary values, and we need to explore ways of maximising synergies and	Self-evident	Effective governance is critical for the negotiation and management process, and this will require a high degree of co-ordination between stakeholders and administrative agencies. Key governance needs include: inclusion of all stakeholders in the negotiation process; regular monitoring and review of goals to enable adaptive management; enforcement of protected areas; regulation to protect ecosystems from pollution, development and over-exploitation; managing offsets (if appropriate); incentives for sustainable use (e.g. PES, organic farming, eco-tourism).	Choice of ecosystem management techniques (e.g. restoration, enforcement of protected areas): how much will they cost? What is the value of ES benefits and the wider social and economic impacts, e.g. for long term sustainability of agricultural production (soil erosion and fertility, water availability, genetic resources, pollination, pest regulation), employment, social cohesion, health and well-being (reduced health care costs, impacts on productivity of work force), education, innovation?	Smith et al. (2016)

	minimising trade-offs.				
<b>Concept</b>	<b>Human Well-Being</b>	<b>SEM</b>	<b>Governance</b>	<b>Competitiveness</b>	<b>SP Source</b>
<b>Trade-offs and synergies</b>	When ES that are important for human well-being are affected by trade-offs or synergies, then well-being will be affected	It is often not possible for SEM to achieve all management objectives and fulfil all public expectations. Therefore it is essential to make trade-offs explicit and find appropriate ways to deal with them.	To be effective, cross-sectoral policies and governance need to consider (potential) ES trade-offs and their distributional impacts.	The private sector need to consider trade-offs in their daily management decisions. ES can be traded-off against other business priorities. However, if this is impacting supporting ES on which a business depends, their long-term profitability can be affected. In case these decisions impact ES important for society, reputation damage will be the result.	Turkelboom et al. (2016)
<b>Transdisciplinarity</b>	Transdisciplinary relates to all four challenges in terms of processes of how to deal with the challenges with different actors (research, policy, media, stakeholders), hence it is difficult to see how the approach would differ in the individual challenges.				Hauck et al. (2016a)
<b>Thresholds, tipping points and limits</b>	Conceptions of human well-being must take into account e.g. lower limits of human needs and vice versa define regulatory limits for minimal ES provision.	Must take into account ecological thresholds that influence ES provision and define limits of sustainable use	Governance mechanisms must take into account the consequences of possible occurrence of thresholds and assess the effects of policy setting regulatory limits.	Uncertainties about ecological thresholds can impede political decisions and planning processes, and thus competitiveness.	Jax (2016)
<b>Typology/Classification of Ecosystem Services</b>	If ways of measuring changes 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	If ecosystem functioning is to 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	The design and evaluation of 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	Advocates of the importance 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	Haines-Young and Potschin (2016a)

	aspects of the cascade are probably needed.	allow changes to be monitored over time.	accepted typology of services which is defensible in the public arena.	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 defensible.	
<b>Valuation of Ecosystem Services</b>	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)

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

**All** - In: Potschin, M. and K. Jax (eds): OpenNESS Ecosystem Services Reference Book. EC FP7 Grant Agreement no. 308428. Available via: <http://www.openness-project.eu/library/reference-book>

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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 framework is 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 ecosystem services 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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