MAES pilot study on natural capital accounting

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Executive Summary: Natural capital accounting and its development to 2020

[To be completed]

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Version 1.0 – for comment

1 INTRODUCTION: AIM, OBJECTIVES AND SCOPE OF THE PILOT STUDY

A range of international and national commitments and initiatives are contributing to an increased momentum for developing natural capital accounting.

At the global level, these include the UN SEEA process, TEEB and WAVES, the Convention on Biological Diversity and the Strategic Plan for Biodiversity 2011-2020, and the 2012 Rio+20 conference.

At EU level, key initiatives supporting accounting include the EU Regulation 691/2011, the EU Biodiversity Strategy to 2020, the recently adopted 7th EU Environmental Action programme and the MAES process.

The MAES pilot study on natural capital aims to explore the potential for natural capital accounting, both in biophysical and monetary terms, in order to support the EU 2020 Biodiversity Strategy. It also aims to support countries developing accounts by creating a resource that clarifies key concepts and terms, presents insight on accounting experiences at the national level and highlights the policy utility of accounting approaches.

1.1 Policy context: Global processes and EU policy objectives

The concept and goals of environmental accounting have been discussed for over two decades at the international level, and earlier than that in academic circles. The first global environmental-economic accounting standards (SEEA) were published by the United Nations Statistics Commission (UNSC) already in 1993. A revision of those guidelines and complementary work on ecosystem accounting were finalised in 2012/13[1].

The international environmental conference Rio+20 in Brazil resulted in a conference communiqué on natural capital accounting that encourages further development and implementation of the concept at global and national level[2]. This ambition is taken up in the World Bank WAVES project[3] and finds its reflection in the 2012 Aichi targets[4] under the global Convention on Biological Diversity (CBD).

The international work on environmental accounting has long been supported by the EU and European countries. EU legislation and policy strategies also promote the development of environmental accounting. The first formal EU rules on environmental accounting were

[1] http://unstats.un.org/unsd/envaccounting/seea.asp
SEEA Central Framework: https://unstats.un.org/unsd/envaccounting/White_cover.pdf
SEEA 2012 Experimental Ecosystem Accounting: https://unstats.un.org/unsd/envaccounting/eea_white_cover.pdf
SEEA Water: https://unstats.un.org/unsd/envaccounting/seeaw/seeawaterwebversion.pdf
[2] Natural Capital Declaration, 2012: www.naturalcapitaldeclaration.org/the-declaration/#
3 www.wavespartnership.org/waves/sites/waves/files/images/Moving_Beyond_GDP.pdf
[4] http://www.cbd.int/sp/targets/

established with Regulation 691/2011[5]. This introduced a first set of three modules: air emission accounts, accounts on environmental taxes and material flow accounts. The Regulation establishes that more modules can be added in the future[6] to respond to key policy needs.

Ecosystem accounting is referred to in two other key EU policy documents – the EU Biodiversity Strategy to 2020[7] and the 7th EU Environmental Action Programme[8]. The EU Biodiversity Strategy to 2020 has set the following goals under Target 2, Action 5:

"Member States, with the assistance of the Commission, will map and assess the state of ecosystems and their services in their national territory by 2014, assess the economic value of such services, and promote the integration of these values into accounting and reporting systems at EU and national level by 2020".

The Biodiversity Strategy therefore contains a clear commitment to develop accounting approaches with regard to the state of ecosystems and their services, including an assessment of their economic value. This is reinforced by the following text in the 7th EU Environmental Action Programme:

"The integration of the economic value of ecosystem services into accounting and reporting systems at EU and national level by 2020 will result in better management of the EU's natural capital.[…] Work to develop a system of environmental accounts, including physical and monetary accounts for natural capital and ecosystem services, will need to be stepped up".

Consequently, the 7th EAP lists the following action to be carried out: *"Developing and applying alternative indicators that complement and go beyond GDP to monitor how sustainable our progress is and continuing work to integrate economic indicators with environmental and social indicators, including natural capital accounting".*

At EU level, the European Commission has established a joint process with Member States to support the mapping and assessment of ecosystems and their services (the so-called MAES process). This responds to the above policy targets, in particular those established under the EU Biodiversity Strategy to 2020. The conceptual framework for the MAES process is described in a methodological guidance document (European Commission, 2013).

1.2 Aims of pilot study and structure of the report

This pilot study aims at exploring methodological questions in relation to natural capital accounting and valuation in the context of the EU 2020 Biodiversity Strategy, using latest developments on ecosystem accounts at international and EU level and concrete examples in European countries. It also discusses the potential policy uses of accounts and provides a reference document to countries interested in developing or improving natural capital accounting approaches at national level.

[5] http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2011:192:0001:0016:EN:PDF

[6] This is possible every three years. The next window of opportunity is December 2013, thereafter December 2016.

[7] http://ec.europa.eu/environment/nature/biodiversity/comm2006/pdf/2020/1_EN_ACT_part1_v7%5b1%5d.pdf and http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2011:0244:FIN:EN:PDF

[8] http://ec.europa.eu/environment/newprg/7eap.htm

This report initially explores the definition of 'natural capital accounting' and its interaction with the ecosystem services concept. That links to the question of which natural capital assets and ecosystem service and natural resource flows to include in such accounts. These questions are explored in the context of international environmental accounting guidelines in Chapters 2 and 3.

Chapter 4 discusses the utility of accounting approaches for policy processes. The potential for natural capital accounting needs to be assessed in relation to likely policy demand. This section addresses some general questions and reviews potential applications in selected policy areas.

Chapter 5 reviews the outcome of a survey on natural capital accounting at national level. This includes information on existing practice in EU Member States and other European countries and provides an overview of remaining challenges and needs for guidance.

Chapter 6 discusses opportunities and challenges in developing natural capital accounting. This covers the analytical strengths and limits of accounting approaches, key factors in building a suitable data platform for accounting approaches, and the possibilities for moving from physical accounts to monetary valuation. Additional information on these issues is also provided in four annexes.

2 NATURAL CAPITAL: THE CONCEPT

This chapter introduces the different elements of the natural capital concept. Natural capital includes both abiotic and biotic assets. Abiotic components include sub-soil assets (e.g. fossil fuels, minerals) and geophysical cycles that provide abiotic flows like solar and wind energy. The biotic components of natural capital represent the ecosystem capital: different types of ecosystems, which provide a flow of ecosystem services.

The EU initiative on the Mapping and Assessment of Ecosystems and their Services (MAES), which aims to support the implementation of the EU Biodiversity Strategy to 2020, focuses particularly on ecosystem capital.

Accounting tools need to be able to address the different types of natural capital, the different types of flows from the capital and issues related to changes in capital stocks (whether these imply loss, degradation or simply change).

2.1 What is natural capital? A clarification of concepts

"Natural capital" is a term proposed by David Pearce (Pearce *et al.*, 1989), as a way to underline the role of nature in supporting the economy and human welfare. The concept builds on the idea of manufactured capital as one of the factors of production (together with land and labour), which was introduced by Adam Smith and David Ricardo in the Eighteenth century.

There are arguably four types of capital, which support the economy and human welfare (Pearce *et al.*, 1989; Ekins, 1992; ten Brink *et al.* 2012):

- **Manufactured** or **"man-made" Capital**: Man-made assets are those used to produce goods and services, like for example, machines, tools, buildings and infrastructure. Financial capital includes money and other financial assets, and it is sometimes seen as a distinct category (Aronson *et al.* 2007).
- **Human capital:** Knowledge, education, motivation and work skills, mental and physical health.
- **Social capital:** Social trust, norms and networks that facilitate social and intellectual interactions and solutions to common problems (e.g. neighbourhood associations, civic organizations and cooperatives); the political and legal structures of a society.
- **Natural capital:** Natural assets that provide humans with a flow of ecosystem services, non-renewable resource stocks such as fossil fuels, minerals and metals, as well as renewable natural resource flows such as solar and wind energy.

All four types of capital are needed to support human welfare. However, natural capital is arguably the most important one, as it is embedded in all other forms of capital, and underpins them. For example, minerals, metals and energy are needed to build the components of manufactured capital. Human and social capitals are heavily dependent on the physical health of individuals, who in turn are dependent upon ecosystem services to maintain good health, including food, freshwater, timber and fibre and a wide range of regulating ecosystem services (e.g. water purification, nutrient cycling, protection from

floods and other extreme events). Also, landscapes and related cultural ecosystem services are key to ensure well-being, identity and belonging.

The concept of natural capital is anthropocentric in nature, as it focuses on those aspects of nature that benefit humans, and does not directly reflect the intrinsic value of nature and the benefits to other species.

However, the concept of natural capital may have an important ethical, political and social role, as it helps to shed light on the benefits that nature provides to human society; and consequently on the need for nature protection not only for moral reasons but also as a way to enhance human wellbeing. As such, it can contribute to influence policy-making towards an improved environmental protection, besides acting as an environmental education tool for awareness building.

Natural capital accounting needs to be seen as one of the tools in the policy makers' toolkit, and should be complemented by other measures and wider biodiversity indicators. This is particularly important in the context of the MAES process and the overall ambition of using accounts to, *inter alia*, contribute to the conservation of biodiversity. Box 1 discusses the question of intrinsic value and the limits of accounting approaches.

Box 1: Intrinsic values of nature and limits of accounting and valuation approaches

Nature, through the provision of ecosystem services provides benefits to people, society and the economy – hence the use of the natural capital concept. Nature also has an intrinsic value beyond its utility to mankind. Both types of values are important to recognise and reflect in decision making. The wider values of nature were recognised in the recent Rio+20 outcome document which reaffirms *"the intrinsic value of biological diversity, as well as the ecological, genetic, social, economic, scientific, educational, cultural, recreational and aesthetic values of biological diversity and its critical role in maintaining ecosystems that provide essential services, which are critical foundations for sustainable development and human well-being"* (para 197 UNCSD 2012).

Only some of the values of nature are included in the System of Environmental-Economic Accounts (SEEA), i.e. the ones that benefit society. The intrinsic value of nature remains beyond the reach of accounting tools and requires the need for complementary biodiversity indicators to evaluate status and assess changes.

This raises the question as to whether there is a risk in integrating nature into accounts (in quantitative and/or monetary terms), as any valuation or accounts would only reflect a partial understanding of nature (see Martinez-Alier *et al*., 1997). The resulting insights would hardly capture the complexity of either nature's contribution to human well-being and economic development or the importance of nature per se.

However, ecosystem capital accounting, even though it only captures part of the value(s) of nature, can help argue for environmental protection by showing the benefits society obtains from nature and the impacts of nature degradation on human wellbeing. It has therefore an important policy role to play. However, the limits of accounting for nature and what bias it might lead to in decision making (in the absence of complementary measures), do need to be systematically assessed. This can help underline the need for complementary measures to avoid inevitable distortions that may arise because accounts only integrate a subset of the evidence base on nature's importance for human well-being. Accounting may represent a step forward, but the approach needs to be complemented with other indicators and indices, as well as information beyond those types amenable to quantitative representation.

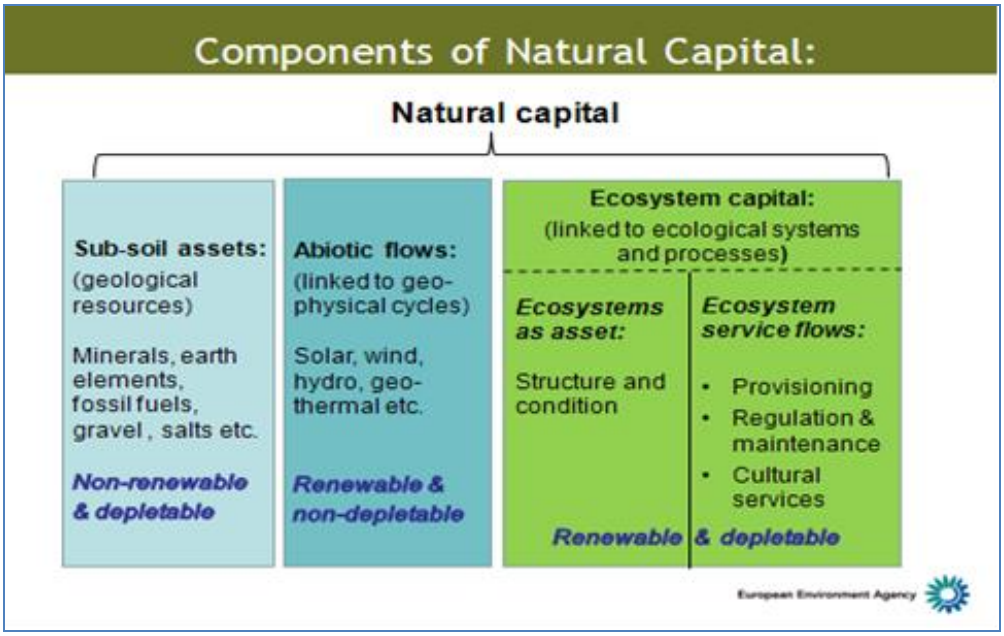
2.2 The components of natural capital and links to ecosystem services

The EU guidance report on the 'Mapping and Assessment of Ecosystems and their services' (European Commission, 2013) distinguishes between the following components of natural capital (see also Figure 2.1).

- Abiotic natural capital, provided by geophysical resources and processes (geosphere):
    - Sub-soil assets, which are non-renewable and depletable (e.g. fossil fuels, minerals, metals)
    - Geo-physical cycles that provide abiotic flows, which are renewable and non-depletable (e.g. renewable energy that is driven by solar radiation or wind energy)
- Ecosystem capital (biotic component of natural capital), which is renewable and can be depleted and degraded. It consists of:
    - Ecosystems[9] as assets
    - Ecosystem service flows, that are provided by the stock of ecosystems (extraction can be considered sustainable if it does not degrade the stock).

Natural capital is generally seen as the stock of the overall asset. Flows are generally seen as not being part of the capital itself, though the value of the asset (i.e. the capital value) can in principle be related to the capitalisation (i.e. monetary valuation of the flows).

Figure 2.1 Conceptual representation of the components of natural capital



Source: MAES analytical framework, European Commission, 2013

[9] Ecosystems are defined by the Convention on Biological Diversity (2003), as follows: "Ecosystems are a dynamic complex of plant, animal and micro-organism communities and their non-living environment interacting as a functional unit" (Art.2).

The various types of asset and associated flows have different characteristics of importance to accounting approaches.

Abiotic flows arise from geophysical processes (e.g. solar energy), and the use of these flows generally does not deplete them and hence there is no need to consider depletion or degradation. Most abiotic stocks on the other hand can be depleted (e.g. fossil fuels, minerals, metals).

Biotic stocks are often degraded, which can have a negative impact on the flow of ecosystem services they provide. Furthermore, if degraded beyond a critical threshold the loss may be irreversible, and for this reason it is important to measure degradation rates.

It is also worthwhile to note that the distinction between biotic and abiotic elements is not always clear-cut, as ecosystems are defined as "a dynamic complex of plant, animal and micro-organism communities and their non-living environment interacting as a functional unit" (Convention on Biological Diversity, Art.2). For example, water is an abiotic element in itself, but ecosystems play a modulating role in its cycle, and water plays a key role in all ecosystems (Russi *et al*., 2013; Haines-Young and Potschin, 2013).

As noted in Chapter 1, various international initiatives and processes have adopted the concept of natural capital and call for its integration into national accounting. As 'natural capital' is a term that is open to interpretation, it is useful to clarify which aspects of natural capital different international processes focus on. This can help facilitate communication, comparability and support complementarity (see Box for TEEB and Box 3 for the WAVES initiative).

Box 2: TEEB - The Economics of Ecosystems and Biodiversity

TEEB adopts the concept of natural capital, based on the earlier Millennium Ecosystem Assessment (MA, 2005), as an '*economic metaphor for the limited stocks of physical and biological resources found on earth'* (ten Brink (ed.), 2011). Nature, in providing a series of ecosystem services that benefit society and the economy, can be understood as being an asset, effectively providing a natural capital. More precisely, TEEB sees natural capital to include natural resources such as timber, water, and energy and mineral reserves, as well as natural assets that are not easy to value monetarily (e.g. species diversity, endangered species, ecosystems that perform ecological services like air and water filtration).

While TEEB recognises the abiotic elements of natural capital, its focus is particularly on the biotic components. Where it does focus on the abiotic elements this is generally on its role as part of wider ecosystems, as the interactions between abiotic and biotic elements in ecosystems are what drive ecosystem functions. Finally, TEEB focuses on the impact of decision making at different levels of governance on ecosystems and ecosystem services. A good summary of the TEEB approach is provided in recent guidance to countries:

http://www.teebtest.org/wp-content/uploads/2013/06/TEEB_GuidanceManual_2013_1.0.pdf

Box 3: WAVES

The WAVES (2012) partnership initiative[10], promoted by the World Bank and including UNDP, UNEP, UNCEEA, countries, NGOs and academics, aims to support the measurement of natural capital, including sub-soil assets, ecosystem stocks and ecosystem services. The focus of WAVES (2012) is to promote the development of environmental accounting according to the SEEA's guidelines. The WAVES initiative is leading to practical applications and insights from practice will become increasingly available in the next years.

The WAVES partnership includes both developing countries - Botswana, Colombia, Costa Rica, Madagascar, and the Philippines—all working to establish natural capital accounts— and developed countries (Australia, Canada, Denmark, France, Japan, Norway, Spain, and the United Kingdom), which are already exploring natural capital accounting and have valuable lessons. Given the additional commitments for accounting made at Rio+20, it seems likely that lessons from accounting initiatives will be increasing in the coming years.

http://www.wavespartnership.org/waves/sites/waves/files/images/Moving_Beyond_GDP.pdf

The Common International Classification of Ecosystem Services (CICES) defines ecosystem services as "contributions that ecosystems make to human well-being". CICES provides a classification for ecosystem services that aims to support the work of the European Environment Agency on ecosystem capital accounts and the SEEA's experimental ecosystem accounts ('SEEA-EEA', see section 3.2)[11]. The CICES definition took as a starting point the Millennium Ecosystem Service classification, but modified it in the context of more recent research and the need to reduce the risk of double counting as much as possible. The three main ecosystem service categories under CICES are: 1) Provisioning services (e.g. biomass, water, fibre); 2) Regulating services (e.g. soil formation and composition, pest and disease control, climate regulation); and 3) Cultural services (the physical, intellectual, spiritual and symbolic interactions with ecosystems, lands and seascapes).

The biotic component of natural capital, which includes ecosystems and associated flows (i.e. ecosystem services) and constitutes the ecosystem capital, is the focus of the MAES process, as the latter aims to support the implementation of the EU 2020 Biodiversity Strategy. For this reason, this document specifically focuses on ecosystem capital, even though accounts that contribute to the measurement of the abiotic component of natural capital are also reviewed in Chapter 3.

[10] http://www.wavespartnership.org/waves/sites/waves/files/images/Moving_Beyond_GDP.pdf
[11] See the related webpage http://cices.eu/

3 ACCOUNTING FOR NATURAL CAPITAL

The UN System of Environmental-Economic Accounting (SEEA) provides a systematised framework to collect information on the state of the natural capital and its changes over time, in two main components:

a) the Central Framework (SEEA-CF) provides guidance on how to measure the stock and flows of natural resources covering abiotic resources and also some biotic ones (e.g. energy accounts, material flow accounts, water accounts, timber accounts).

b) the experimental ecosystem accounts (SEEA-EEA) aim to measure the ecosystem capital: i.e. the state of ecosystems and the flows of ecosystem services they provide to society.

Both categories of accounts can include physical and monetary data. Developing monetary accounts of ecosystems and ecosystem services is a challenge discussed in SEEA-EEA. There remains debate as regards appropriate methodological solutions, and national experimentation will contribute to the discussion on whether, for which ecosystem/ecosystem services and how to develop monetary accounts.

3.1 What is accounting and what is environmental accounting?

Introduction to the system of national accounts:

Official national income statistics are a relatively recent development. Only in 1952 was the first Standardized System of National Accounts (SNA) published. The international System of National Accounts provides an agreed-upon methodology for national economic accounts that focus on factors of production and consumption in the economy with inputs in monetary terms. Man-made capital is presented via economic assets (opening stocks, closing stocks and change in stocks over the accounting year) and flows (taxes, added value). Social and human capital, such as labour, is presented through remuneration and labour taxes; natural capital via the value of the commodities that are an input to production or consumption (e.g. timber, fish landings). For most ecosystem services there is rarely any remuneration that would then feature in accounts (see Figure 3.1)

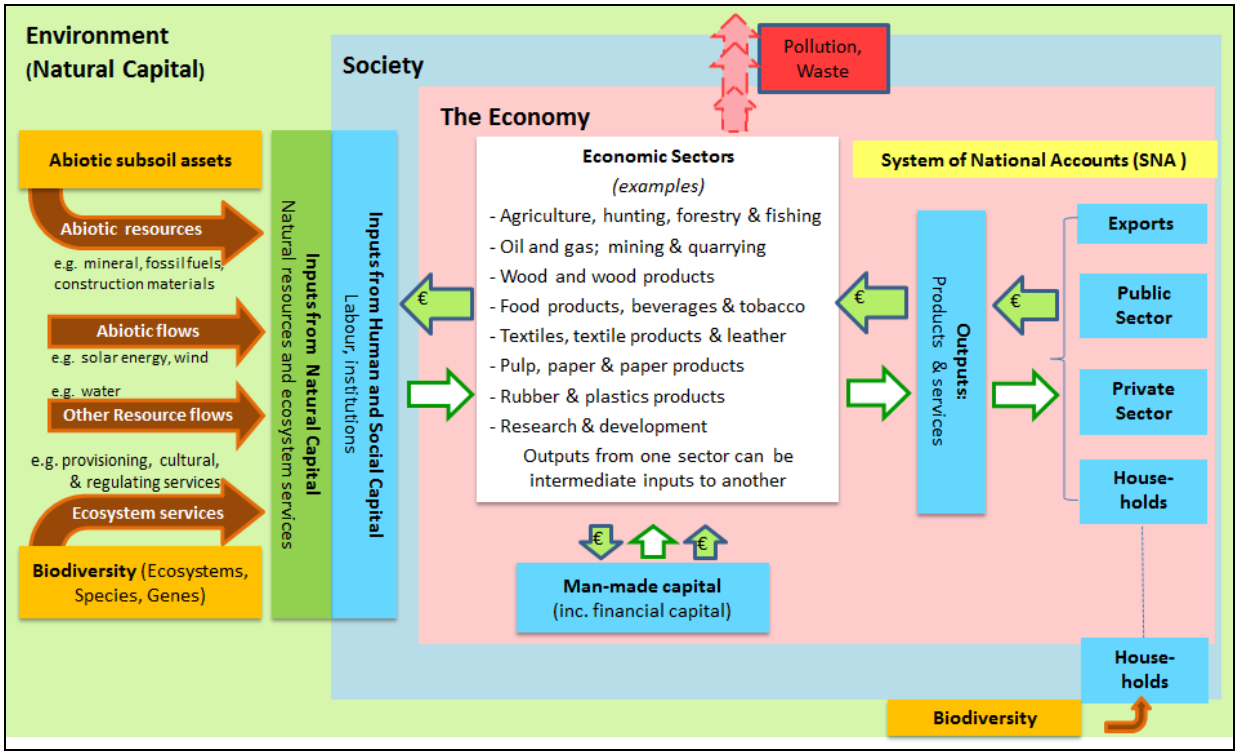
SNA accounts are the main source of information for internationally comparable economic aggregates and indicators such as Gross Domestic Production (GDP), value added, national income, consumption, economic growth rate and government deficit. SNA-derived indicators can account for the economic performance of sectors, the flows of money between the latter and households (e.g. salaries, purchases of goods and services) and public and private investments and savings.

The main advantage of the indicators derived from the SNA is that they can provide synthesized and meaningful information on the economic performance of countries.

Consequently, economic decisions based on SNA indicators focus on improving welfare by stimulating economic growth, creating employment or reducing government debt.

SNA indicators need to be complemented by additional measures to reflect human, social and natural capital, in order to be able to derive a full picture of the factors affecting human wellbeing (see Figure 3.1).

Figure 3.1 Natural, social and economic capital



Source: adapted by ten Brink, Mazza, Dekker and Russi from Figure 1.6 in ten Brink et al., 2011.

Why to do environmental accounting?

Many ecosystem services fall outside of the SNA framework, the reason being that they are more often than not unpriced. In fact, while many provisioning ecosystem services go into the economy as inputs (e.g. crops, timber, meat), other ecosystem services do not have a market price (e.g. regulating services such as clean air). As the SNA only includes the goods and services that are traded in the market, complementary accounts are therefore needed to get insight into how the economy functions within the boundaries of the natural system. Also, in general the prices of natural resources do not reflect their importance and their contribution to human economy, but only the costs related to extraction and costs. Moreover, market prices do not include externalities, i.e. the negative impact of resource extraction, processing and use on human wellbeing.

Secondly, revenue obtained from the sale of natural resources is treated by the SNA system as current income available for consumption, not as the erosion of capital. Therefore, economic growth derived from the extraction of non-renewable resources is recorded as good economic performance, and not distinguished from the economic growth produced by other factors of production (e.g. labour, capital), technological progress and efficiency

improvements (El Serafy S., 1989). Similarly, economic growth derived from over-use of renewable resources (e.g. fisheries, forestry, land, water) is also not distinguished from other more sustainable sources of economic growth.

Finally, one key issue that particularly merits assessment is that of the ecological debt, i.e. the environmental degradation that is transferred to next generations or to foreign countries. This relates to the loss of domestic natural capital and also to the environmental impacts that are transferred to other countries by importing goods or exporting waste flows (e.g. Martinez-Alier, J., 2005; Weber, J-L., 2012). Both elements pose important accounting challenges.

Summing up, one can say that nature's ability to provide valuable inputs to the economy and to act as a waste sink for air emissions, waste water and wastes is limited. Consequently, the economy's long term survival is dependent on its ability to adapt and learn to operate within the limits of nature. For this reason, it is very important that the decision-making processes at the international, national, regional, local and business level take into account not only the economic variables, but also the role of nature in the economy. This means that economic accounts need to be complemented with environment-focused accounting approaches, to ensure that they include natural capital. This in turn will have a positive impact on governance and decision making processes by providing a more complete picture and filling in 'knowledge gaps'.

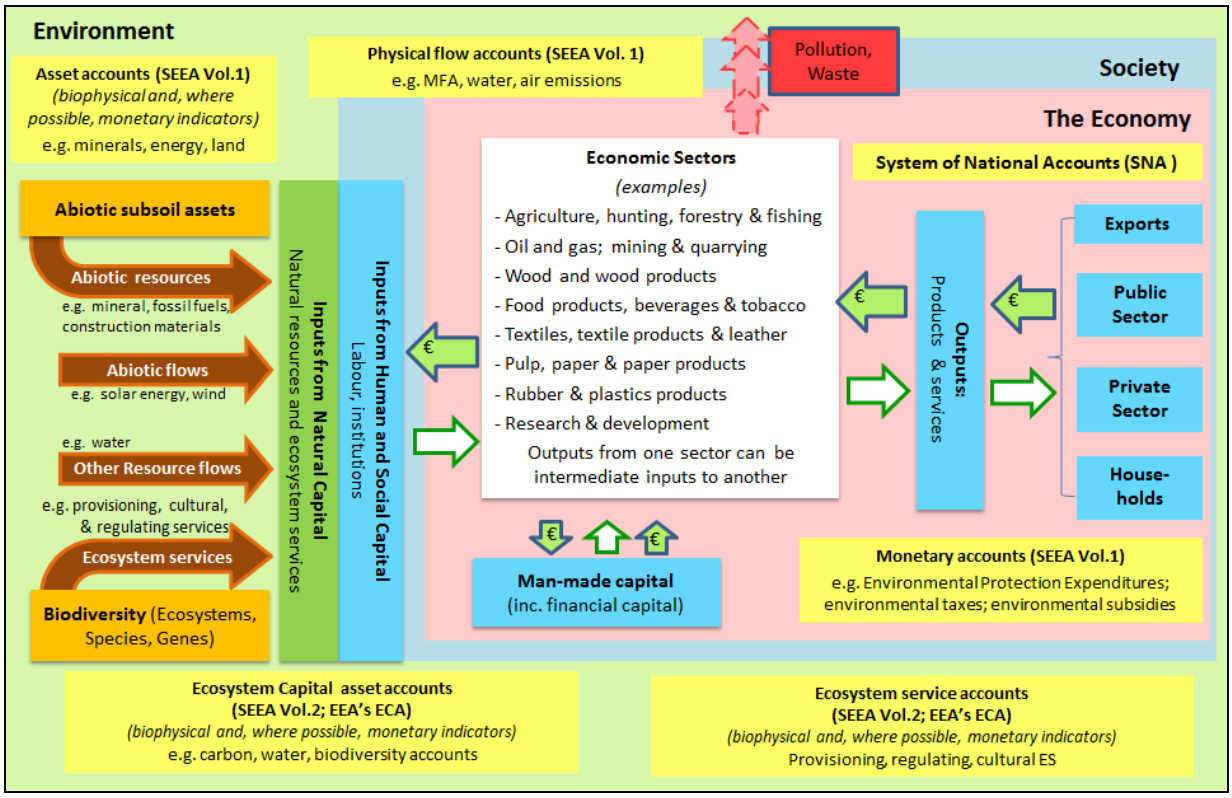
Environmental accounting has been developed to fulfil this objective, by collecting and systematising information on the amount of natural resources being extracted and the amount of wastes generated. Early work that mainly focused on abiotic assets has now been complemented with accounting approaches that aim to detect trends in the status of biological assets (ecosystem capital) and associated flows (ecosystem services). Together these accounting systems provide potential tools for a better management of the different components of natural capital (see Figure 3.2).

3.2 An overview of physical and monetary accounting options

The need for complementary measurement and accounting identified above has informed the development of The System of Environmental-Economic Accounting (SEEA). SEEA provides a systematised framework to carry out environmental accounting, and it aims to measure natural capital, i.e. the biotic and abiotic assets that compose it, the degradation/improvement of these assets and the biotic and abiotic flows between nature and society. Figure 3.2 presents an overview of where different SEEA accounting approaches help provide a fuller picture of the interactions between the economy and the environment.

SEEA provides a set of tables that are consistent and can be integrated with the SNA's structure, classifications, definitions and accounting rules, thereby enabling the analysis of the changes in the natural capital, its contribution to the economy and the impacts of economic activities on it. SEEA provides detailed methodological guidance to prepare environmental-economic accounts on a wide range of issues. Each country can select the modules it is interested in, according to their political priorities, resource availability and data accessibility.

Figure 3.2 Overview of accounting approaches and their scope



Source: adapted by ten Brink, Mazza, Dekker and Russi from Figure 1.6 in ten Brink et al., 2011.

SEEA has been prepared by the United Nations Statistical Commission (UNSC) and the London Group on Environmental Accounting[12], under the auspices of the UN Committee of Experts on Environmental-Economic Accounting (UNCEEA). It includes three volumes:

- SEEA Central Framework - Volume 1 (SEEA-CF, published in 2012): the core environmental resource accounts, which measure in physical and monetary terms the stock of natural resources and the flows that cross the boundary between the economy and the environment and circulate within the economy. Vol.1 focuses on abiotic components (e.g. minerals and energy), but it also includes some biotic components of ecosystem capital (e.g. timber accounts). It also includes material flow accounts (MFA) and waste, water and air emissions accounts (see Table 3.1);

- The experimental ecosystem accounts - Volume 2 (SEEA-EEA, published in 2013 as methodological guidance rather than a formal statistical standard): these aim to measure the ecosystem capital, i.e. the state of ecosystems and their capacity to provide ecosystem services, as well as to calculate the costs of avoiding or repairing damage. The aim is to have ecosystem capital asset accounts (e.g carbon, water and biodiversity) and also ecosystem service accounts for a growing number of ecosystem services, using initially quantitative indicators and over time monetary indicators for certain services (depending on methodological suitability);

[12] The London Group on Environmental Accounting is an informal group of experts, from national statistical agencies and international organisations, which was created in 1993 in order to contribute to the international debate on environmental accounts.

- Extensions and applications of the accounts - Volume 3 (not yet published): this volume will describe examples of analytical and policy uses of environmental accounts.

As a contribution to global discussions, the European Environment Agency is developing simplified ecosystem capital accounts (ECA). This initiative supports progress toward the first application of experimental ecosystem accounts, based on the available data at the European level. The methodological framework was published in 2011 (European Environment Agency, 2011) and the first simplified ecosystem capital accounts are currently under preparation.

Table 3.1 shows the different kinds of natural capital accounts that are included in SEEA-CF and in SEEA experimental ecosystem accounts. They will be explained in more detail in sections 3.3 and 3.4.

Table 3.1 Natural capital accounts

<table>
<tr><th colspan="5">Natural capital accounts</th></tr>
<tr><td></td><td colspan="2">SEEA Central Framework (Vol.1)</td><td colspan="2">SEEA experimental ecosystem accounts (Vol.2)</td></tr>
<tr><td></td><td>Assets</td><td>Flows</td><td>Assets</td><td>Flows</td></tr>
<tr><td>Physical Accounts</td><td rowspan="2">In principle both physical and monetary accounts for:

• Mineral and energy resources
• Land
• Soil resources
• Timber resources
• Aquatic resources
• Other biological resources
• Water resources</td><td>Physical accounts for:
• Energy
• Water
• Material flows
• Air emissions
• Waste water
• Solid waste</td><td rowspan="2">In principle both physical and monetary accounts for:

• Land accounts
• Carbon accounts;
• Water accounts;
• Soil and nutrient accounts;
• Forest accounts;
• Biodiversity accounts.</td><td rowspan="2">In principle both physical and monetary accounts for:

• Provisioning ecosystem services
• Regulation and maintenance ecosystem services
• Cultural ecosystem services</td></tr>
<tr><td>Monetary Accounts</td><td>• Environmental protection expenditure
• Environmental goods and services sector
• Environmental taxes and environmental subsidies</td></tr>
</table>

3.3 Physical accounts

The physical accounts are measured in physical units (e.g. tonnes, cubic metres, kWh) and are used both in SEEA Central Framework and in the experimental ecosystem accounts. They include both stocks and flows. The ones included in SEEA-CF collect information on:

- ***Physical flows*** between the economy and the environment both for the input side (energy accounts, water accounts, material flow accounts) and the output side (air emissions accounts, waste water accounts, solid wastes accounts);

- ***Physical assets***, i.e. the available natural resources and their changes due to extraction, new discoveries, natural growth, natural disasters and other reasons: asset accounts for mineral and energy resources, asset accounts for land, accounts for soil resources, asset accounts for timber resources, asset accounts for aquatic resources, accounts for other biological resources and asset accounts for water resources.

In the context of experimental ecosystem accounts (SEEA-EEA), assets are ecosystems and flows the ecosystem services they provide to humans. In regard to the former, SEEA-EEA defines ecosystem assets as "spatial areas containing a combination of biotic and abiotic components and other characteristics that function together" (page 23 of SEEA-EEA).

In SEEA-CF assets are considered "individual" environmental assets (e.g. energy resources, water, minerals, land, timber). On the contrary, in SEEA EEA environmental assets are seen from a broader perspective, and accounting aims to assess how different environmental assets interact as part of natural processes in a specific location to provide ecosystem services (i.e. looking at the relationship of land type, land use, carbon biomass and water provision). Another difference is that SEEA-CF includes biotic and abiotic environmental components, whereas SEEA EEA only includes biotic assets and flows (i.e. only the components of the ecosystem capital). The two systems are complementary, as accounts included in SEEA-CF provide useful information to describe the state of ecosystems (e.g. water accounts, timber accounts) and SEEA EEA accounts can provide insight on the state of natural capital recorded in SEEA-CF accounts (e.g. water and timber accounting).

In SEEA EEA, assets are measured on the basis of 1) the ecosystem condition and extent; 2) changes in ecosystem assets; 3) expected ecosystem services. They are accounted for through land accounts, carbon accounts, water accounts, soil and nutrient accounts, forest accounts, and biodiversity accounts.

The simplified ecosystem capital accounts (ECA), under development by the EEA, will consist of accounts for individual components (e.g. organic carbon accounts, land accounts and water accounts). The ECA process does not aim to generate new data, but to integrate existing ones available at EU level. In order to do so, all utilised data sets are transposed into a $1km^2$ grid across the entire area covered. More detail on the simplified ECA is available in Annex 2.

Ecosystem services are accounted for using the CICES accounting framework (see Section 2.2), which distinguishes among provisioning, regulation/maintenance and cultural ecosystem services. Table 3.2 shows the CICES classification of ecosystem services as developed for the first three levels of the hierarchy – the full system goes into much more detail, see www.cices.eu.

Table 3.2 The CICES 4.3 classification of ecosystem services (first three levels)

Section	Division	Group
Provisioning	Nutrition	Biomass
		Water
	Materials	Biomass, Fibre
		Water
	Energy	Biomass-based energy sources
		Mechanical energy
Regulation & Maintenance	Mediation of waste, toxics and other nuisances	Mediation by biota
		Mediation by ecosystems
	Mediation of flows	Mass flows
		Liquid flows
		Gaseous / air flows
	Maintenance of physical, chemical, biological conditions	Lifecycle maintenance, habitat and gene pool protection
		Pest and disease control
		Soil formation and composition
		Water conditions
		Atmospheric composition and climate regulation
Cultural	Physical and intellectual interactions with ecosystems and land-/seascapes [environmental settings]	Physical and experiential interactions
		Intellectual and representational interactions
	Spiritual, symbolic and other interactions with ecosystems and land-/seascapes [environmental settings]	Spiritual and/or emblematic
		Other cultural outputs

Source: CICES 4.3, http://cices.eu

3.4 Monetary accounts and valuation approaches

Monetary indicators are included in both SEEA CF and SEEA-EEA.

SEEA-CF includes the ***Functional Accounts for Environmental Transactions***, which are recorded in monetary terms and include the following:

- Environmental protection expenditure accounts[13] (e.g. expenditures on pollution prevention and abatement);
- Environmental goods and services sector accounts (i.e. information on providers of environmental goods and services, i.e. waste and wastewater management and treatment services, and energy and water saving activities;
- Environmental taxes;

[13] Under Eurostat, these have been called RUMEA (Resource Use Management Environmental Accounts), see http://epp.eurostat.ec.europa.eu/portal/page/portal/environmental_accounts/documents/UK%20%20471%20RUMEA.pdf

- Environmental subsidies.

These four accounts do not account for elements of natural capital, but for elements that can have a negative or positive impact on it.

Additionally, SEEA-CF indicates that the asset accounts mentioned in section 3.3[14] can be expressed also in monetary terms, and not only in physical terms. However, the scope of monetary valuation of the assets included in SEEA-CF is more limited than the one of physical asset accounts themselves. Under current practice, monetary accounting in SEEA-CF includes only assets that have a price in the market.

Monetary valuation in the context of ecosystem accounts (SEEA-EEA and ECA) is challenging, as most ecosystem assets and ecosystem services are not traded in markets and therefore do not have a market price, which could otherwise have been used to develop monetary accounts. To overcome this challenge, economists have proposed three categories of methodologies to be used for monetary valuation of ecosystem services[15] (see White *et al*., 2011, chapter 4 in ten Brink (ed.), 2011; Pascual *et al*., 2010, chapter 5 in Kumar P. (ed.), 2010; see also Brouwer *et al*., 2013, table 4 and SEEA Central Framework, Chapter 5):

1) Methodologies based on costs, which use market prices to indirectly estimate the monetary value of ecosystem services. Examples include methodologies based on the avoided costs, such as the economic damage from floods by managing floodplains in a sustainable way; methodologies based on the replacement cost, such as the cost of mechanical purification of water, which is needed to replace natural water purification provided by healthy ecosystems; and methodologies based on the restoration costs, which calculate the cost of restoring a degraded ecosystem.

2) Methodologies based on revealed preferences estimate values based on the preferences of individuals, shown by their behaviour. Examples are the Travel Cost Method and Hedonic Pricing. The former can be used to estimate the value of a protected area through the amount of time and money people spend in order to visit it. The Hedonic Pricing Method uses the changes in the market value of a good that is directly related to the ecosystem services to be valued. For example differences in property prices can be used as indicators of the cultural ecosystem services provided by the landscape.

3) Methodologies based on stated preferences such as Contingent Valuation, are based on the preferences that are directly stated by people through surveys. They investigate people's willingness to pay (WTP) for improved environmental conditions or their willingness to accept (WTA) compensation for a reduction in environmental quality.

[14] The asset accounts mentioned in the SEEA Central Framework are the following: asset accounts for mineral and energy resources, asset accounts for land, accounts for soil resources, asset accounts for timber resources, asset accounts for aquatic resources, accounts for other biological resources and asset accounts for water resources

[15] In the accounting context, the value of ecosystems (i.e. assets) can be approximated using the sustained flows of ecosystem services they provide. For example forests provide regulating services (e.g. carbon storage), provisioning ecosystem services (e.g. timber) and cultural ecosystem services (e.g. recreational activities).

Also, since monetary valuation studies are time and resource intensive, in many cases monetary values already calculated elsewhere for similar ecosystems are used. This procedure is called value (or benefit) transfer and needs to be carried out very cautiously because the provision of ecosystem services are often location-specific (see White *et al.*, 2011, in ten Brink (ed.), 2011; Pascual *et al.*, 2010, in Kumar P. (ed.), 2010; Brouwer *et al*. 2013, section 6.2.4.3, SEEA Vol.2, section 5.6.3; and Kettunen and ten Brink (ed.), 2013).

Brouwer *et al*. (2013) prepared a review of EU MS ecosystem service national assessments and found that most studies cover different kinds of provisioning, regulating, cultural and (in some cases) supporting ecosystem services, but only a small subset of them use monetary valuation methodologies to assess the ecosystem services. In general, monetary valuation of ecosystem services is still at a very early stage (see chapter 5 for country experiences). The study found that most provisioning services are or will be valued using market prices, and most regulating services using methodologies based on costs, where possible. Monetary valuation of cultural ecosystem services, which are mostly valued using stated valuation methods, is much more complicated, because of methodological challenges, lack of data, lack of resources to conduct original valuation studies and also criticisms towards the use of monetary non-market valuation in some of the countries.

Finally, it is important to note that if different methodologies are used for monetary valuation (such as in the UK National Ecosystem Assessment), the outcome values of different ecosystem services should arguably not be aggregated and are not fully comparable. This may pose a problem if monetary valuation is to be used for accounting purposes (Brouwer *et al*., 2013).

In summary, many challenges as regards integrating monetary aspects of natural capital in accounting remain and national experimentation is crucial to be able to highlight potential promising ways forward.

4 ACTUAL AND POTENTIAL POLICY INTEREST / USE OF NATURAL CAPITAL ACCOUNTS

Ecosystem capital accounting is a potentially useful tool to policy makers across the policy cycle and also at different governance levels – from EU to national to regional level.

The added value of the approach depends on the maturity and quality of the accounts, the data they contain and on what other existing indicators and measurement tools already contribute to the evidence base for policy making. This will differ between accounts and policy areas as well as across countries.

Potential policy benefits of ecosystem capital accounts are likely to be provided by organic carbon, water and land use accounts for the policy areas related to biodiversity, agriculture and water, as well as for cohesion policy, in particular in the areas of climate change and resource efficiency.

The policy utility is expected to grow over time, both across the policy cycle areas, across more geographic scales, and for more policy areas. However, ecosystem capital accounting will always remain one among several sources of evidence base for policy making and monitoring.

4.1 Overview: key policy issues

The focus of this chapter is on the policy benefits of ecosystem capital accounts, i.e. the accounts addressing the biotic elements of natural capital. The benefits of other natural capital accounts and indeed wider accounting approaches are outside the scope of this chapter. Similarly, private sector accounting for natural capital, which has seen significant interest in the past two years[16], is also outside the scope of this NCA pilot.

Environmental policy making needs to be supported by reliable information in order to be effective. There are different examples of policy decisions on environmental issues that were taken without all relevant scientific evidence being available, such as for example the biofuel targets established by the EU Directive 2003/30/EC on biofuels (5.75 %) and by the EU Directive 2009/28/EC on renewable energy (10 %). In fact, such targets were set in advance of a sufficiently comprehensive understanding of their consequences in terms of the real CO_2 emissions benefits or the land requirement in extra-European countries.

Accounting for natural (ecosystem) capital, in biophysical and, when relevant and feasible, also in monetary terms, can help bring issues into the policy agenda, by analysing degradation of ecosystem capital stock over time, and the consequent loss of ecosystem services. In addition, it represents an important support to the different phases of policy making, from the European to the regional level. Information derived from ecosystem capital accounting can help in prioritising policy actions, discussing trade-offs and potential

[16] See the Natural value initiative (http://www.naturalvalueinitiative.org/content/005/501.php) and the Natural Capital Declaration (http://www.naturalcapitaldeclaration.org).

synergies, establishing strategies and plans, choosing policy actions and assessing the impact of environmental policies.

The added value of ecosystem capital accounts with respect to already existing indicators will depend on the country and the kind of accounts. In general, accounting approaches allow trade-offs between issues to be identified and quantified. For example, combining an accounting approach with spatial mapping can show the link between carbon biomass and land use types. Accounts can also offer additional data verification and checking, which can improve (the confidence in) the robustness of the indicators. Where a common approach is used across regions and countries, accounting can also help in dealing with comparability, which is crucial in multi-country and cross border issues (carbon storage and sequestration, water management and quality).

This chapter discusses a range of policy areas where the potential application of ecosystem capital accounting could offer benefits. It focuses on biodiversity, water, and agriculture. It also discusses the potential application of ecosystem capital accounts for Cohesion Policy, given the recent interest from DG Regio on integrating the natural capital concept in its policies (see Hjerp *et al.* 2013). There are also important benefits in the area of climate change (mitigation and adaptation) and resource efficiency, but these will be treated elsewhere.

Table 2 provides a general overview of the potential policy applications of the ecosystem capital accounts, with details presented in section 4.2.

Table 2 Potential policy applications of ecosystem capital accounts

Biodiversity	Water	Cohesion Policy
Biodiversity Strategy to 2020: ***Target 2, Action 5*** & commitment to accounting. Supporting a range of other targets, including restoration and halting biodiversity loss.	**Water Framework Directive (WFD):** Good status for groundwater and good ecological status/potential for surface waters (2027). **Floods Directive (FD):** Flood risk areas (2015).	**2014-2020 EU Cohesion Policy:** Thematic objectives related to: low-carbon economy; climate change adaptation, environmental protection, promotion of resource efficiency.
Collecting information on the state of ecosystem capital stocks and flows and providing information on the pressures on ecosystems and ecosystem services – e.g. fragmentation and degradation.	WFD: Synthesising information on water intake, water availability and water quality and exploring the links between water use and land cover. This will help to identify areas of water surplus and stress. FD: Where ECA is linked to demographic data: Identifying which areas are at risk from flooding (2015), e.g. linking water surpluses and proximity to population centres.	Helping to select policies, set regional strategies and objectives, and allocate funds across different cohesion policies priorities.
Providing complementary information for the development of biodiversity policies (e.g. on key pressures)	Helping support the 2nd river basin management plans, RBMP (2015). Ecosystem capital accounts, where sufficiently detailed, may help with WFD legal requirements re detailed ecological flow objectives (by 2020), as they may help identify limits of abstraction that are consistent with the objectives.	Helping set programme priorities (at least at regional level), and possibly informing project prioritisation (pending sufficient quality data),
NCA can help track progress regarding the degradation and restoration objectives (not on the local scale, but as regards broad objectives at a larger scale). Complementing Natura 2000 reporting.	Accounts (where available) could contribute to the review of the WFD (2018).	Regional programmes' effects on biomass carbon and carbon neutrality commitments can be monitored. Ecosystem capital accounts could also highlight trade-offs and synergies between different developments paths.
Evidence from water, land use, and biomass-carbon accounts and the links between these. Accounts cannot deal with biodiversity directly, they need to be complemented by biodiversity indicators.	River basin level ECA most likely to be useful. There is a growing body of existing water accounts work to build on. 2015 targets likely to be too early for accounts to help in most countries and regions. Existing indicators already fit-for-purpose in many areas.	Opportunities for using Cohesion Funding to invest in accounts. New momentum for integration of natural capital into Cohesion Policy.

4.2 Where is accounting already in use or called for? Current needs and priorities

4.2.1 Water Framework Directive and Floods Directive

The Water Framework Directive 2000/60/EC (WFD) establishes as an objective for all EU MS to reach a good status for groundwater and a good ecological status/potential for surface waters (rivers, lakes, transitional waters, and coastal waters) by 2015. The concept of good ecological status refers to the quality of the biological community in water bodies as well as their hydro-morphological and chemical status.

Another important water directive is the Floods Directive 2007/60/EC (FD), whose objective is to reduce and manage flood risk. The FD requires the EU MS to carry out a preliminary assessment to identify the most threatened river basins and coastal areas. For each of these areas, a flood risk map is to be prepared by 2013, and a Flood Risk Management Plan is required by 2015.

Developing a comprehensive accounting system would help to establish an integrated data and analytical platform to support key water management issues. Ecosystem capital accounts can inform water policies by collecting and synthesising information on water intake, water availability and water quality and the relationship to land use, complementing insights from SEEA-CF accounts. Furthermore, they may help to collect information on the land cover by river basins and major tributaries; the role of protected areas and their link with water availability, water quality and water productivity; the link between forest areas and water productivity. Also, they can be combined with other kinds of indicators. For example, combining water indicators with demographic indicators may help getting insight on the link between water and cities, such as dependency on neighbours and also responsibility (e.g. upland/upstream areas) vis a vis neighbours.

Ecosystem capital accounts, when more developed, will also include potentially useful quality issues, via the provision of information on ecosystem services. In particular, they may help identify and quantify non-provisioning ecosystem services (e.g. water purification, sediment treatment).

Ecosystem capital accounts may also contribute to the application of the FD, providing a link between water and land use, and possibly give information on soil moisture, soil saturation, and the link between soil water content and changes in the soil.

Box 4 shows an example of re-using information collected in water resources management for developing environmental accounting modules.

Box 4: Country insight - Bulgarian experience in information re-use

The IT support for integrated water management in Bulgaria is being implemented in a staged approach and modular manner. A previous project, called "The study on integrated water management in Republic of Bulgaria" (2007), created the common database model. In 2009-2012, a joint project with the Norwegian Water Resources and Energy directorate created the first six modules in a service-oriented geographic information system structured to cover all institutions responsible for water management. The system currently maintains the basic geo-information used for the development of the River Basin Management Plans and serves the effective management, monitoring and control of the permits under the Water Act and the IPPC permits and will be extended with new financing.

The information it provides on the permitted water abstraction and discharge quantities is used by the National Statistical Institute (NSI) for securing the scope of statistical water observations and quality control. The system also informs on the Ecological taxes and fees module of the national reporting under Regulation 691/2011. Its new functionality will include, among others, new Marine Strategy Framework Directive and nitrates modules, support for WFD reporting, and data integration with a flood management system. The NSI experts are to be included in the stakeholder group defining the system functioning and outputs to ensure continued support for statistical reporting.

Data re-use helps eliminating a major bottleneck in reporting capacity – the need to collect a huge number of data from multiple economic operators which would otherwise create new administrative burdens and severely strain NSI's administrative capacity.

4.2.2 Biodiversity strategy

The European objectives on protection and enhancement of biodiversity and ecosystem services are established by the EU biodiversity strategy to 2020 (COM (2011) 244 final), which states that by 2020 the EU biodiversity and the ecosystem services it provides shall be protected, valued and appropriately restored. The EU Biodiversity Strategy sets as an objective to restore at least 15 % of degraded ecosystems and to ensure no net loss of ecosystem services by 2015. In addition, the Habitats Directive (92/43/EEC) and the Birds Directive (2009/147/EC) provide a framework for biodiversity protection.

A primary focus for ecosystem capital accounting in relation to the EU Biodiversity Strategy is to support parts of target 2, Action 5, i.e. the commitment to map and assess the state of ecosystem and their ecosystem services, to assess their economic value (when possible) and to promote the integration of this information in EU and national reporting systems. There is similarly a need to integrate accounting into the national biodiversity strategies and action plans (NBSAPs)[17], called for under the Strategic Plan for Biodiversity 2011-2020, and the corresponding Aichi Biodiversity Target 2, adopted at the 10th meeting of the Conference of the Parties to the CBD (COP 10)[18].

[17] See Incorporating Biodiversity and Ecosystem service Values into NBSAPs: Guidance to support NBSAP practitioners by UNEP-WCMC and IEEP (2013). http://www.ieep.eu/assets/1200/Guidance_doc_A4_FINAL.pdf

[18] Target 2: By 2020, at the latest, biodiversity values have been integrated into national and local development and poverty reduction strategies and planning processes and are being incorporated into national accounting, as appropriate, and reporting systems.

With appropriate scientific and methodological guidance, data gathered to compose different kind of accounts included in ecosystem capital accounting can support biodiversity policies by collecting information on the pressures on ecosystems. For example, water accounts, carbon accounts and land accounts, and the underlining data, provide some relevant information for key pressures on biodiversity, such as fragmentation and degradation. Similarly, the interface between water and land accounts, as well as the use of indicators on accessible water, can help identify land or areas at risk of or under degradation. This can be particularly relevant, for example, for certain protected areas (e.g. wetlands), where either over-extraction or climatic effects threaten conservation.

In this context, ecosystem capital accounting provides a useful analytical frame because it helps link information on changes in land cover with information on other relevant variables, e.g. population, water use and availability, carbon storage and sequestration in biomass and soil. Within this unifying frame, ecosystem capital accounts can (over time) offer additional indicators on the state of natural capital, related changes (including drivers of degradation), which can help inform policies to reduce pressures, help biodiversity proofing policies and programmes and facilitate the integration of biodiversity into other policies (see also section on Cohesion Policy below).

The complexity of biodiversity means that it can only be partially integrated into and reflected in accounts. It is clear therefore that ecosystem capital accounting can only be one tool, albeit one of potential growing utility, to support the objectives of biodiversity conservation and other biodiversity-related policies.

4.2.3 Cohesion policy

Cohesion Policy (CP) will be the policy area receiving the biggest share of the next EU budget. The proposals are for CP to receive €336 billion (33 % of Multiannual Financial Framework - MFF) for the period 2014-2020. Furthermore, the EC established that at least 20 % of the MFF is allocated to climate-related activities, which means approximately €200 billion for 2014-2020. There will therefore be major scope for climate mitigation and adaptation activities to be supported by Cohesion Policy (Hjerp *et al.* 2011; Volkery *et al.* 2012).

An integrated accounting approach seems particularly suited to the breadth of policy objectives under CP as it provides one analytical frame under which benefits, trade-offs and synergies of and between different CP policy instruments can be evaluated.

Nature's potential role in helping meet the objectives of CP is increasingly recognised (Hjerp *et al*., 2013). Ecosystem capital accounts (especially at regional level) can play a role in supporting CP programmes and projects, and in particular in the thematic objectives of:

- Supporting the shift towards a low-carbon economy in all sectors. Ecosystem capital accounts can provide useful information regarding carbon stored in biomass;
- Protecting the environment, and promoting resource efficiency. Ecosystem capital accounts can offer insights on land use as well as water use and availability and support resource efficiency; in addition ecosystem capital accounts can potentially help monitor environmental trends and impacts and help inform policy and investment priorities.

For example, even though CP policies and projects do not currently focus much on soil and living biomass – beyond some biomass for energy generation, and some ecosystem restoration / investment in green infrastructure projects - organic carbon accounts could become more important in the future if ecosystem-based mitigation becomes a core point of CP (Volkery *et al.* 2012) and commitments to carbon neutrality by regions increases (see Box 5).

Box 5: Cohesion Policy, accounts and utility for carbon neutrality and no net loss of biodiversity

Under the current programme there are already examples of regions and operational programmes as a whole committing to being carbon neutral (for examples please consult Hjerp *et al.* 2011). Where regions commit to carbon neutrality or simply to regular measurement and reporting, then the transition from the current accounting activities (which only focus on emissions from energy use) to newer protocols that also include stocks and sequestration and emissions from biomass carbon will be facilitated by the existence of biomass accounts. This has the potential to be a major added value area, especially if links between carbon accounts, land accounts and water accounts are made to help identify areas of special importance for carbon biomass such as peatlands (Russi *et al.* 2012).

Water accounts are potentially useful for data provision to regions, water river basin managers, as well as for cities (to the extent that the accounts can be linked to cities). Information from land use accounts, combined with water accounts and linked spatially to settlements could offer information on ecosystem-based clean water for cities, issues of water surplus or deficit (and relation to floods and droughts) can inform planning, priorities and investment choices. If and when data is sufficiently detailed, the accounts could potentially help support integrated projects (such as in many national programmes, or LIFE+) and integrated territorial investment more broadly.

The usefulness of ecosystem capital accounts for CP will be dependent on country data sets and the level of regional disaggregation and representation. As the accounts and data develop (and there is potential to fund capacity building and the development of accounts under the CP) there will be increasing use of accounts for monitoring and reporting on the impact of the programmes (policy and investments). This can help identify policy impacts, including win-wins and trade-offs of policies and investments – e.g. win-wins for coastal restoration or trade-offs (win-loss) of road building programmes. This can help improve CP governance, help in implementation of legislation (including SEA and EIA directives, integrated coastal zone management) and over time improve policy integration.

5 REVIEW OF USE IN MEMBER STATES: EXISTING PRACTICE

5.1 National practice: overview

This section builds on the results of a survey among EEA member countries on national activities on natural capital accounting as well as an associated workshop in Copenhagen in June 2013. Material from that workshop and the twelve country responses received are available under: http://biodiversity.europa.eu/ecosystem-assessments/events-1/eureca-meetings/natural-capital-accounting-2013/

The questionnaire covered the following main topics:

a) Concept of and approach to natural capital accounting (questions 1a – 1c)

b) Valuation of natural capital (questions 2a – 2c)

c) Organisation and process at national level (questions 3a – 3d)

d) Actions planned to 2020 (questions 4a – 4d)

The main outcomes for each topic are presented in table 5.1 and briefly reviewed below.

The results show a substantial diversity of activities across countries, with some responses indicating that natural capital accounting is still in the beginnings at national level. Each respondent country has its strengths and weaker points in different areas. Equally diverse are the responses with regard to future action to be taken until 2020. That is not surprising as related concepts and methodologies are still being consolidated – this document being an example of such an exercise.

Table 5.1: Overview of country responses to survey on NCA (status November 2013)

Country group	Approach to NCA	Work on valuation	Organisation & process	Actions by 2020
Significant progress to date	BG, CZ, DE, NO, PL, SE, UK *Included: countries reporting either a national system of NCA (ready or under development), or specific national legislation concerning ecosystem services (BG and PL for forestry)*	DE, FI, UK *Included: countries reporting (fully or partially) both questions 2a (integration of ESS values in accounting) or 2b (taking into account depreciation/appreciation of natural capital*	DE, FI, NO, SE, UK *Included: countries with a legally formalized/officially designated inter-institutional process*	***Key messages, needs & plans:*** AT: - Understanding of NCA varies a lot between countries; - Quality of natural capital is important BG: - Monetary valuation may derive less funding for countries with rich biodiversity but small GDP; - Simplify reporting for business

Some progress to date	AT, FI, LV, PT *Included: countries reporting national or local research and/or pilot projects including other initiatives (such as TEEB, NAMEA,)*	BG, CZ, EE, NO, SE *Included: countries reporting (fully or partially) at least one of questions 2a or 2b being addressed institutionally, and not merely in research or single projects*	BG, PL *Included: countries reporting cooperation on national accounts between national statistics and other competent bodies on ad-hoc or project basis*	(Directive 2003/34/EC), inter alia by maximum data reuse; - Lots of methodological work ahead, exchange of best practices is key. CZ: Missing demand for natural capital accounts slows down their adoption DE: - Insufficient spatial detail of land use maps for high value ecosystems - Need for valid methods on flood damage prevention EE: Need for data gap analysis FI: - Use ES approach to develop sustainable alternative to GDP - Systems model of ES processes and derived ESS - Fully interlinked economic model on I/O in "foodweb" NO: Need for good biodiversity indicators in key areas PL: Value of protected species and habitats is not accounted for, need for EU methodology PT: Need for cooperation between academics and statistical office SE: - Need for international data to measure the impact of Swedish consumption on countries exporting to Sweden - Specific research: o Added social data to accounting systems o Hazardous chemicals indicators
Work at the beginning or some responses missing	EE *Included: countries reporting only the minimum EU legal requirements*	LV, PL[19], PT, SE *Included: countries reporting none of questions 2a or 2b*	CZ , EE, LV, PT *Included: countries reporting single-institution (statistic institute) implementing NCA, or project not directly managed by national env. administration*	

Note: Not all countries have responded to all questions. This might have led countries missing in certain columns or misplacement of countries for some categories.

Ad a): The concept of and approach to natural capital accounting varies across the countries that responded. Most report a diverse set of activities that can be grouped under natural capital accounting but were not initially devised to respond to that agenda. The focus or

[19] Poland reports the water permits regime under question 2a but does not specify the manner in which they are used to estimate the value of ESS and which ESS are targeted.

inspiration of ongoing work is often current EU policy processes, whether it is the EU Regulation on environmental accounting or the objectives on ecosystem assessment at national and EU level set out in the EU biodiversity strategy. Lack of concrete policy demand for natural capital accounting is visible in some responses, and specifically noted as problem by the Czech Republic.

No country has yet reported covering in its national efforts all identified ecosystem services on its territory. The most advanced countries have started by assessing some of ecosystem services (ESS) and have ongoing national projects to increase the number of services covered. In terms national approaches to assessing ecosystems (ES) and ESS, some countries (notably the UK) have developed a number of ESS accounts for certain ecosystems. Individual countries use the data from existing NCA accounts both for statistical and reporting needs (e.g. Germany reports the use of NCA for Target 5 efforts, national biodiversity strategies, the WFD reporting).

Ad b) Work on the valuation of natural capital is generally in its infancy, with only Germany, Finland and the UK reporting dedicated activities. The majority of countries cover some of the NCA components, notably provisioning services and abiotic factors as per Regulation 691/2007. However, beyond these basics, country practice, research and policy priorities vary widely. The same holds true for the needs in guidance and cooperation. The policy demand for NCA information seems to be an important driving force even in countries without a formal NCA process (e.g. FI, SE). However, in countries with a more limited formal process for developing NCA (such as CZ or PT) the weaker policy demand seems to account for limiting ESS related work to academia.

Ad c): There is a notable difference in policy approach to NCA across the countries consulted. Depending on the level of backing and institutional set-up, the NCA process ranges from being mostly statistics-driven (i.e. in AT, FI) to dedicated national processes (i.e. in UK, DE, NO). A shared challenge for many countries, however, is the placement of NCA in the national decision making process. Most countries have institutional processes – either formalized or *ad hoc*. Not surprisingly, there is a correlation between the involvement of diverse institutions in a formal process and the progress in covering various aspects of ESS valuation and integration into national accounts.

Ad d): Only some countries have so far mapped out actions for the coming years to 2020, which reflects the challenge of dealing with this new policy area as well as the resource constraints that most countries are facing in the current economic situation. The other pole consists of respondents stating there is no formal NCA process (even if ESS research is being conducted by research bodies) – such as EE, PT and FI.

5.2 National practice: NCA Pilot country contributions

This section could present a very wide ranging set of examples but for reasons of brevity and clarity focuses on one example each for the first three topics set out above.

a) Example for concept & approach: Nature index, Norway & cooperation with Bulgaria

Under international agreements, Norway has undertaken to obtain an overview of status and trends for biodiversity in major ecosystems. The Norwegian Nature Index is intended to provide this, and to indicate whether Norway is succeeding in halting the loss of biodiversity.

The Nature Index is the most extensive compilation of information on Norway's biodiversity to date. It measures the state of biodiversity in Norway's nine major ecosystems. A set of indicators has been chosen to represent biodiversity in each of these ecosystems.

More than 300 indicators were chosen from a variety of species groups for each ecosystem, and measure deviation from a reference state, which is intended to represent ecological sustainability. All indicators and the overall Nature Index have values between 1 (for the reference state) and 0 (very poor state).

The first edition of the Nature Index was published in 2010, and values were calculated for 1990 and 2000 as well as 2010. More information is available on the following webpage:

http://www.environment.no/Topics/Biological-diversity/The-Norwegian-Nature-Index-/

The scientific approach underlying the Nature Index will also be used to support the ecosystem services mapping effort in Bulgaria in the course of programme BG03 on Biodiversity and ecosystem services approved for funding by the European Economic Area (EEA FM). A scientific council of Bulgarian stakeholders and the Nature index co-maintainer NINA (Norway) is to be formed in the framework of a dedicated project to produce the methodologies for ecosystem mapping and biophysical valuation for the national mapping exercise.

b) Example for valuation: Restoration costs of priority habitats, Germany

Given that the results of the frequently applied neo-classical stated preference methods for the valuation of nature are often not considered sufficiently credible the exploration of potential alternative approaches is necessary.

A German scientific study applied one such alternative approach, the calculation of restoration costs taking account of restoration time, to the case of priority habitats at national level. These are considered to be represented by the ca. 10% of the terrestrial landscape of Germany covered by natural and semi-natural ecosystems which are understood to be essential for the conservation of threatened species.

The study adopted an approach similar to the "habitat equivalency analysis" method used in the USA to calculate for compensation in cases of liability for ecological damages (NOAA, 2006) and is also in line with a proposal for determining compensation fees for the German "Eingriffsregelung" (regulation for the mitigation and compensation of impacts on nature and landscape) (Schweppe-Kraft, 1998).

While this approach remains part of scientific development rather than national policy, the study has demonstrated that a methodological approach based on restoration costs leads to substantial values being estimated for a core part of Germany's natural capital. The study estimated a total value of about 740 billion € - this is slightly more than 10% of the net fixed capital in Germany (Schweppe-Kraft, 2009).

c) Example on organisational set-up: Natural Capital Committee, UK

The Natural Capital Committee (NCC) was established in 2012 as an independent advisory body to UK government and reports to the UK economic affairs committee. The NCC's role is to:

- help the Government better understand how the state of the natural environment affects the performance of the economy and individual well-being; and
- advise the Government on how to ensure England's 'natural wealth' is managed efficiently and sustainably, thereby unlocking opportunities for sustained prosperity and wellbeing.

The Committee consists of eight members from academia and business who collectively bring expertise and experience in ecology and environmental science, economics and business. The Committee is supported by a full-time secretariat, based in the UK environment ministry (DEFRA).

The NCC's work programme includes:

- producing an annual State of Natural Capital Report;
- working with Defra and the Office for National Statistics (ONS) to ensure the timely development of experimental natural capital national accounts and to explore links with corporate natural capital accounting;
- working with land owners, businesses and accounting bodies to encourage the take up of corporate natural capital accounting; and
- working with academics and the Research Councils to identify research priorities that will improve future advice on managing our natural assets.

For further information please consult: *http://www.defra.gov.uk/naturalcapitalcommittee/*

5.3 Key practical issues & needs

Difficulties in implementing a more rigorous approach beyond single pilot actions appear to be due both to:

- the huge amount of multidisciplinary scientific work and data compilation that need to be performed to account for the specifics of each new account,
- the need for international alignment in adopting uniform and statistically correct procedures for NCA data collection and reporting, and
- differences in policy interest and focus between countries.

Not surprisingly in the diverse European landscape, guidance needs vary between countries, regions and stakeholders. The key priorities and needs are summarized in the overview below. More issues identified by the country survey can be found in Annex 3.

The following practical issues were listed by the countries responding to the survey:

a) <u>Building suitable data platforms:</u>

- Missing data for forming the whole picture is reported by most respondents to a different extent. The differences in the policy approach and adopted national processes account for a difficulty in analysing this topic across Europe, and a data gap analysis was suggested by Estonia. While some countries go for rigorous scientific approaches (e.g. UK, France), others adopt more pragmatic, sometimes data driven methods (i.e. Lithuania). Hybrids between these two approaches are also to be found (i.e. Germany, the Czech Republic).
- Handling and integration of existing data is a challenge both on EU and on Member State level. Available data is found on different carriers (some historic ones in need of digitalization) and in many formats, its scope, methodology of obtaining, quality, ownership, etc. differs between countries, and in some cases (i.e. Germany) also between regions.
- Data collection from a number of operators presents a challenge in itself. Reporting all the necessary information for a number of complicated processing needs at once is challenging both to operators and to the administrations collecting the data. In this respect, data integration and the optimal use of data collected by different authorities and for different policymaking needs is crucial for simplification of data gathering (see also box 4.1 on the Bulgarian water information system).

b) <u>Developing an effective organisational set-up:</u>

The national process in most countries is divided between various institutions but in most cases the national statistical office is the main driving force as the institution responsible for the proper implementation of national accounts.

Since NCA cover a much wider area than ecosystem accounting, challenges met by the participants in the process typically include:

- A number of different datasets being developed and held by different institutions both on EU and Member State level, in needs of methodological alignment and integration.
- Developing capacity among bodies that are not necessarily biodiversity experts, to deal with the scientifically challenging area of ecosystem services as part of their sometimes quite significant workload.
- Use of NCA for informed policy decisions requires a coherent national process. This is essential for dealing with complex issues beyond data collection and reporting and beyond the single institution's view on any given topic in the policymaking mix. Development/improvement of specific capacity in several countries is needed as a response.
- Involvement of stakeholders across countries varies in its scale and approach. They range from Switzerland's very inclusive ES packages mapping approach to national working groups (developed or being set-up in the UK, Norway, Bulgaria), to single process coordination institutions (i.e. Germany).

c) Integration of policies and programmes:

- Timing of national and EU wide efforts: while the need for EU-wide guidance was identified by several countries, in some cases, especially where the national process is less attuned, it is important that such guidance is delivered in time to be used for significant nation-wide efforts.
- National activities had to be planned in the process of preparation of several funding regulations (such as LIFE+, HORIZON 2020) and national operational programmes in order to secure funding, while countries also struggle to meet deadlines set by EU strategies and legislation (i.e. the 2014 deadline for mapping ecosystems set in Target 5 which will coincide with the end of one and beginning of the next programming period). In cases where international and national processes run in parallel, the member states have to opt for a "LEGO approach" - decide on the optimum scope of data to be collected that can be fitted into a number of possible methodologies under consideration on EU level.
- Mixed policy signals: while preserving biodiversity and conservation is a longstanding priority backed by significant funding, the economic valuation of ESS may depreciate monetary value assigned to rich ecosystems in countries with lower GDP. Also, adjustment is needed between various policies currently not conducive to sustainable use of ecosystems and favouring grey instead of green infrastructure.

6 TAKING NATURAL CAPITAL ACCOUNTING FORWARD – OPPORTUNITIES AND CHALLENGES

6.1 The analytical promise of accounting approaches

The objectives of the pilot study on Natural Capital Accounting (NCA) are set out under Target 2, Action 5 of the EU Biodiversity Strategy to 2020 (see underlined text):

"Member States, with the assistance of the Commission, will map and assess the state of ecosystems and their services in their national territory by 2014, assess the economic value of such services, and promote the integration of these values into accounting and reporting systems at EU and national level by 2020".

While 2020 is still some time away conceptual and operational foundations have to be laid now for the above targets to be achievable. This reference document under the NCA pilot has helped defining the concept of 'natural capital' as well as describing and developing suitable accounting approaches with regard to the state of ecosystems and their services. In doing so, the focus was on accounting for the physical dimension of natural capital. This is seen as laying the foundation for subsequent assessment of their economic value.

In the context of the MAES process a key focus has to be on the interaction between the compilation and structuring of data for ecosystem assessment and ecosystem accounting purposes. Both aim to tackle similar questions and can clearly benefit from each other. As ecosystem assessments will be carried out first in most Member States they establish a potentially very important data platform for the subsequent accounting and valuation of ecosystem capital and ecosystem services. For that to work they need to conform to accounting data standards with regard to information on meta data and the structuring of data sets.

At the same time, the ongoing efforts to develop ecosystem capital accounting at EU level by the EEA can support EU level ecosystem assessment processes. Substantial investments have been made to derive spatial reference data sets at 1 km grid level on many ecosystem variables that are also important for ecosystem assessment objectives.

It should be noted that, if set up correctly, ecosystem capital accounting also provides a useful unifying frame for tackling integrated analytical questions. For example, water accounts, carbon accounts and land accounts, and the underlying data, provide very relevant information for key pressures on ecosystems and biodiversity, such as fragmentation and degradation. Similarly, the interface between water and land accounts, as well as the use of indicators on accessible water, can help identify areas or ecosystems at risk of water stress. Linked with other accounts or data sets such a system would also help to analyse which are the most important pressures (linked to sectoral drivers) that influence state and trends in ecosystem condition.

Also, data obtained through accounting for ecosystem capital allow interconnections between issues (e.g. the water-land-carbon nexus), between data outputs and relevant administrative or functional regions (e.g. river basins and administrative units, such as NUTS II and III) and between environmental and other sources of data (e.g. on city populations, protected areas, infrastructure), thereby maximising the potential to offer a basis to policy

making. Linking different sets of data (e.g. water accounts with data on land use) will help discuss synergies and trade-offs of alternative policies.

With appropriate scientific and methodological guidance, data gathered to compose different kind of accounts included in ecosystem capital accounting can support biodiversity policies by collecting information on key trends that influence ecosystem state. This can help inform policies to reduce pressures, help biodiversity proofing policies and programmes and facilitate the integration of biodiversity into other policies (e.g. agriculture or cohesion policy).

Overall, natural capital accounts have the potential to support and inform a wide range of sectoral and environmental policies. The degree to which they will be used for policy making will depend on data availability and quality, robustness and level of disaggregation.

Refining the methodologies, investing in data and extending the scope of current accounts will improve the benefits of ecosystem capital accounting and the use of the natural capital concept in policy making. Policy use now and recognition of policy use in the future should lead to further investment in the tools to help realise their potential.

6.2 Developing the data foundation

Undoubtedly, setting up natural (and ecosystem) capital accounts is a time and resource-intensive task. Success with this task will depend on building a data foundation that is appropriate to the ecosystem processes to be studied and aligned to the methodology of accounting approaches. This requires understanding what kind of data are needed but also how to integrate them into structured data platforms that allow for efficient queries and analysis.

A first aspect to review is the availability, suitability and use of different data sets for the foreseen analysis in the EU Member States and/or at EU (European) level. This links to which kind of data are ideally needed, what characteristics they should have and what the possibilities are for utilising proxy data. A further question is how to organise such data sets in databases that are suitable for putting together integrated ecosystem/natural capital accounts.

The potential contribution of ecosystem capital accounts to policy making depends on a range of factors including the input data, the tools used to explore the data and the interconnections made between accounts. Key issues are the following:

- Data availability - does it cover the relevant issues (e.g. does it include carbon content in soil, carbon in living biomass)?
- Data quality – has it been validated?
- Spatial resolution – is it at relevant scale to the issue (e.g. do the accounts provide data in sufficient spatial detail?)

- Timeliness – is it sufficiently recent to allow relevance for the issues being explored (e.g. data on water availability need to be taken per season, as average data are not enough to provide a clear picture)?
- Time series – is there a time series to be able to show trends and possibly build on for projections (e.g. changes in water availability or carbon in soils to show climate impacts or impacts of management choices)?
- Choice of the used models and their data requirements
- Data gaps – identification, bridging solutions (possibly by proxies)

Ecosystem accounting is informed by many different types of data, ranging from traditional statistics, environmental monitoring data, satellite observation data to reporting under environmental legislation. These have to be brought into a common reference frame. How to do that while respecting the nature of the input data are often very technical questions. There are a range of tools and methods to work with the data within accounts and as inputs to accounts – for example turning statistical data into spatial data sets at a $1km^2$ resolution. The details of these approaches are not elaborated here but different components of annex 2 provide detail on key technical issues.

6.3 Valuation approaches – opportunities and limits

Section 3.4 has revealed that there are substantial challenges in the economic valuation of ecosystems and their services. As stated, the most recent reference document for these questions is Brouwer *et al*., 2013. In addition, the question of how to move forward on the valuation of natural capital and linked ecosystem services was discussed at a workshop on natural capital accounting in Copenhagen in June 2013. The report back from the respective break-out session provides a useful summary of the current state of play:

Report back from working group 2 on concepts and development of valuation approaches:

The introductory presentation, set the scene by inviting participants to reflect on the (i) aim of valuation exercises, (ii) listing of relevant ecosystem services; (iii) understanding of relevant valuation principles; and (iv) selection of appropriate valuation methods.

Participants stressed the importance of understanding the specific 'opportunity space' for the development of natural capital accounting. Key questions in this respect include: What is the demand for natural capital accounting? How will it be used? How can it help respond to policy priorities?

- *Given the interest of most politicians in issues such as impact on employment, impact on growth, return on investment – it is important to develop a narrative ('business case') to convince policy-makers of the potential usefulness of NCA.*
- *Action 5 of the EU Biodiversity Strategy provides an important mandate for developing natural capital accounting*

It is crucial to understand what it is we want to achieve with the final methodological framework for use in developing natural capital accounting. There are, broadly speaking, two options:

- *A first option consists of 'adjusting' the existing System of National Accounts. It was stressed that the SNA uses well defined rules however and, in developing alternative indicators of progress in this context, there is a need to respect such established rules. This was deemed a challenging option fraught with technical difficulties (coherence, need to be additive).*
- *A second option consists in developing satellite accounts around SNA, a more cautious, step by step, approach. This focuses less on how one may change the SNA and more on how one can fit existing data into the SNA framework.*

In this context, Roy Brower provided an overview of the use of satellite accounts on water in the Netherlands. Such an approach allowed for:

- *Determining which sectors are more polluting*
- *Identifying the extent to which GDP depends on environmental inputs*
- *Revealing the eco-efficiency of GDP over time*
- *Disaggregated observations at river basin level*
- *Use in macro-economic modeling scenarios*

The group also discussed valuation methodologies and challenges. It was stressed that different methods target different aspects of value and, in this context, the distinction between welfare values vs. exchange values was stressed (extent to which the different methods calculate consumer surplus). How to inflate to current values, how to capture differences between public and private goods, how to deal with changing preferences over time were listed as some of the complexities inherent with such exercises. Bearing these challenges in mind, it was suggested that confidence ratings or ranges could be used.

Data challenges were also listed. The paucity of data on valuation results, its irregularity, incoherence and inconsistency do not lend themselves well to SNA requirements. In this context, the development of a standard on valuation studies was suggested.

Participants discussed the use of Benefit Transfer (BT) methodology. It was stressed that these can still generate relatively big error intervals despite good explanation of variables. In spite of such challenges, it was stressed that BT results can still prove useful to policy makers, especially at the formulation stage (although typically not for accounting purposes), for instance to get a sense of proportionality. It was stressed that poor BT results do not invalidate individual, location-specific valuation studies.

As a way forward, participants stressed the need for more valuation studies; suggested that a mapping of different valuation methodologies be developed so as to clarify what techniques measured what and as a step towards standardization. It was also stressed that the development of physical ecosystem accounts can facilitate economic valuation as it improves an important part of the data foundation required for valuation purposes.

Finally, it should be noted that ecosystems provide benefits to people, society and the economy through the provision of ecosystem services – hence the use of the natural capital concept. However, nature also has an intrinsic value beyond its utility to mankind. Both types of values are important to recognise and reflect in decision making. The wider values of nature were recognised in the recent Rio+20 outcome document which reaffirms *"the intrinsic value of biological diversity, as well as the ecological, genetic, social, economic, scientific, educational, cultural, recreational and aesthetic values of biological diversity and its critical role in maintaining ecosystems that provide essential services, which are critical foundations for sustainable development and human well-being"* (para 197 UNCSD 2012).

This means our relationship with nature and its role in decision-making processes should not be reduced to the economic and other benefits it provides. An ethical concern for the value of nature in its own right needs to continue to inform public and private decision-making.

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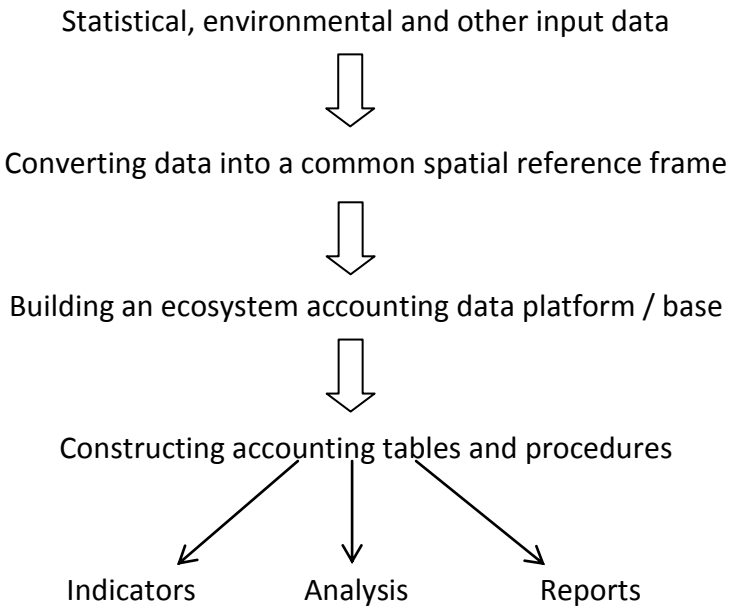
ANNEXES: COMPONENTS FOR BUILDING NATURAL CAPITAL ACCOUNTS

ANNEX 1: Steps in developing a suitable data platform and work flow

Accounting systems only function if they build on clearly categorised, well-structured and comprehensive input data sets. Other aspects of data that are important for their analytical value are sufficiently detailed spatial referencing and comparability across space and time. Ensuring these two dimensions is a challenging task for ecosystem-related data sets.

Figure A1 below sets out the key phases in developing a data platform suitable for ecosystem / natural capital accounting. These different steps are further supported or explained by technical reference documents (see annex 2) or internal working documents available from the EEA (see list below).

Figure A1: Example of data organization & analytical work flow:



The following internal working documents can be made available from EEA on request:

ETC/SIA report on 'Available data for mapping and assessing ecosystems in Europe'

Internal EEA working papers on:

- data structure, source and spatial referencing of data underpinning EEA simplified ecosystem capital accounts (sECA)
- methodological steps for converting input data sets into spatially referenced data layers for compiling sECA accounting tables

Annex 2: Links of activities & data sources:

There are quite a few sources that provide information on critical components for natural capital accounting. These are listed below with web links to the original sources – consulting these directly is considered the best way for understanding the issue concerned.

a) Global methodological reference document for ecosystem accounting: System for Environmental Economic Accounting – Experimental Ecosystem Accounting (SEEA-EEA); see:

http://unstats.un.org/unsd/envaccounting/eea_white_cover.pdf

b) Methodology of ecosystem capital accounting: EEA, 2011

http://www.eea.europa.eu/publications/an-experimental-framework-for-ecosystem

c) Webpage of UK Natural Capital Committee on key concepts, economic terms and academic information related to for natural capital accounting:

http://www.defra.gov.uk/naturalcapitalcommittee/natural-capital/

d) CICES (Common International Classification of Ecosystem Services): CICES has been developed with an accounting utilisation in mind and hence is a key platform for ecosystem accounting-related approaches: www.cices.eu

e) Advice on set-up and organisation of transparent and stakeholder-focused processes:

The objectives and outputs of TEEB (The Economics and Ecosystems and Biodiversity) provide the most comprehensive and relevant advice here; a key publication is the TEEB guidance manual for country studies, see:

http://www.teebweb.org/publication/guidance-manual-teeb-country-studies-4/

f) Example data sets for ECA component accounts: sECA cubes [link to be provided]

Annex 3: List of practical issues identified in country survey

This annex lists additional issues identified by the country survey on implementing natural capital accounting at national level. The following additional points were identified when reviewing the twelve available country responses (status November 2013):

- The implementation of the resident principle when compiling accounts related to NCA;
- cross-border NCA of ecosystem services with cross-border impact (e.g. carbon sequestration, services whose value may be integrated in the income from international tourism, etc.);
- the use of other data (such as WISE data, quality and quantity monitoring data for waters, etc.) in NCA related to ESS;
- using the NCA related to ESS and especially their monetary valuation, in other policies (e.g. in RBMP under the WFD, activities under MSFD, NATURA 2000 reporting, for agricultural and fisheries needs, etc.);
- integration of ESS considerations in cost-benefit analysis performed for major projects in relevant sectors (e.g. wastewater treatment under Directive 91/271/EEC); and/or other means of considering limited social affordability under multiple legislation efforts;
- reuse of data to ensure maximal leverage with minimal funding, especially in member states (e.g. Bulgaria) that are rich on biodiversity but hardly pressed to afford funding for its protection. Such reuse may be fostered, for example, by better use of common platforms (EEA, JRC data, WISE, etc.), improved implementation of INSPIRE across legislative implementation, etc.;
- ensuring data consistency and avoiding double counting between policies when accounting for NCA and/or between NCA statistics and other mandatory national reporting;
- achieving best value for money in spending that covers multiple policies and across relevant funding sources (some EU funding programmes are currently under preparation for the 2014-2020 programming periods, and other donors outside the EU provide additional funding);
- handling small but valuable ecosystems in less detailed land use sets;
- socially responsible ESS related research including also cross-border transfer of ESS;
- quality assessment of ESS.

Annex 4: Compilation of key terms relevant to natural capital accounting

This annex provides an explanation of some concepts and definitions for key terms relevant to natural capital accounting with a particular focus on the ecosystem component.

Definition and use of terms relevant to natural (ecosystem) capital accounting varies slightly between international processes and research communities. Rather than add new or slightly modified definitions this section draws mainly on the work developed by the United Nations Statistical Commission on experimental ecosystem accounting (SEEA – EEA) via an expert group and with support from the London Group on Environmental Accounting. Further work in this regard will be considered when revising this first draft.

Figures A2 and A3 aim to provide a graphical illustration of the concepts 'stock' and 'flow' in relation to ecosystem capital.

Figure A2:

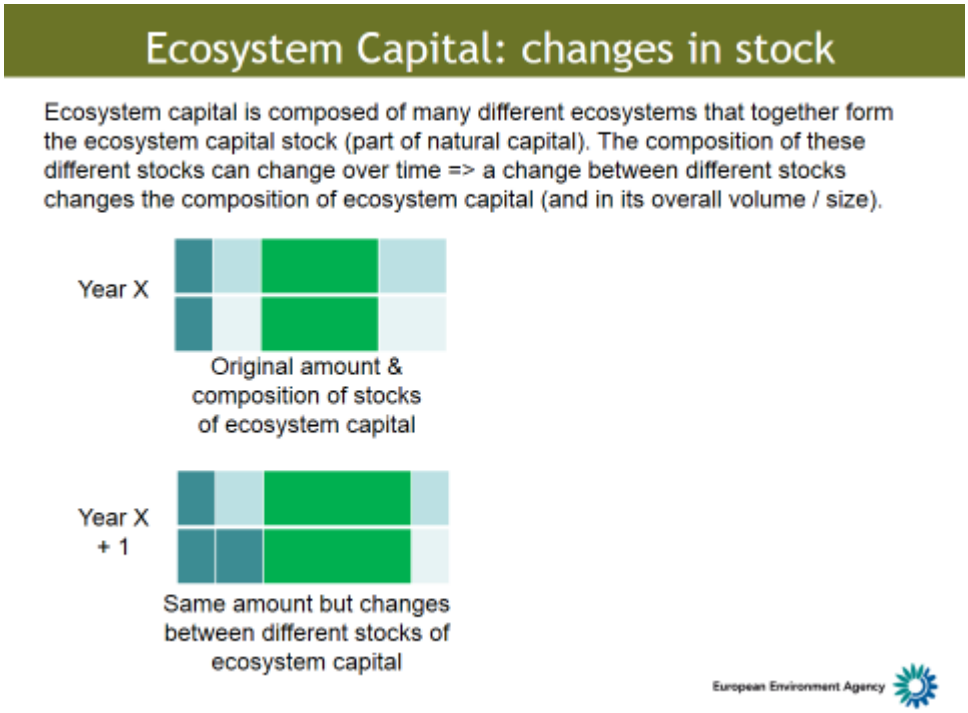
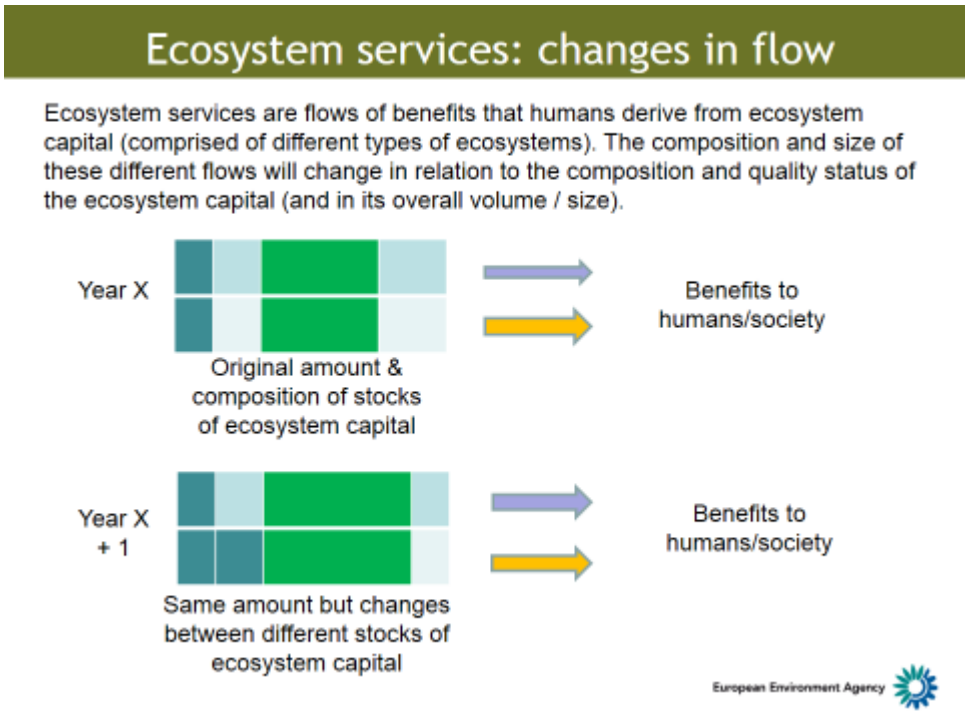


Figure A3:



<u>Selection of terms from the glossary of the UN publication SEEA–EEA (Experimental Ecosystem Accounting):</u>

Biodiversity:

"Biodiversity is the variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part, this includes diversity within species, between species and ecosystems." (Convention on Biological Diversity (2003), Article 2, Use of Terms).

Generally, in SEEA Experimental Ecosystem Accounting, the measurement of biodiversity is focused on the assessment of diversity of species although changes in the diversity of ecosystems is also an important output from the measurement of changes in ecosystem extent and condition.

Ecosystems:

"Ecosystems are a dynamic complex of plant, animal and micro-organism communities and their non-living environment interacting as a functional unit." (Convention on Biological Diversity (2003), Article 2, Use of Terms).

Ecosystems may be identified at different spatial scales and are commonly nested and overlapping. Consequently, for accounting purposes, ecosystem assets are defined through the delineation of specific and mutually exclusive spatial areas.

Ecosystem assets:

Ecosystem assets are spatial areas containing a combination of biotic and abiotic components and other characteristics that function together.

Depending on the analysis being conducted, an ecosystem asset may be defined to contain a specific combination of ecosystem characteristics (e.g., a tropical rain forest represented by an LCEU) or it may contain areas that contain a variety of combinations of ecosystem characteristics (e.g., a river basin containing wetlands, agriculture and settlements represented by an EAU).

Ecosystem assets should be distinguished (a) from the various individual components (e.g. plants, animals, soil, water bodies) that are contained within a spatial area; and (b) from other ecosystem characteristics (e.g., biodiversity, resilience). In different contexts and discussions, each of these components and other characteristics may be considered assets in their own right (for example in the SEEA Central Framework many individual components are considered individual environmental assets). However, for ecosystem accounting purposes, the focus is on the functioning system as the asset.

The term “ecosystem assets” has been adopted rather than “ecosystem capital” as the word “assets” is more aligned with the terminology employed by the SNA and also conveys better the intention for ecosystem accounting to encompass measurement in both monetary and physical terms. In general however, the terms “ecosystem assets” and “ecosystem capital” may be considered synonymous.

Ecosystem or ecological capital:

Ecosystem or ecological capital is not explicitly defined in SEEA Experimental Ecosystem Accounting. Instead the term “ecosystem assets” is employed to refer to the individual spatial areas that are the focus of measurement. In many discussions, the term “ecosystem capital” may be considered to relate to a broader concept of the stock that provides a foundation for future well-being, together with human capital, produced/man-made capital and social capital.

These various types of capital are regularly brought together in models of sustainable development and wealth accounting. While there is no difference between the application of the terms “capital” and “assets” in SEEA Experimental Ecosystem Accounting and their use in other contexts (e.g. wealth accounting), some care is needed to understand the potentially different measurement scopes of these types of capital/assets. Specific considerations concern the treatment of mineral and energy resources and the distinction between natural and cultivated biological resources.

Ecosystem capacity:

The concept of ecosystem capacity is not defined from a measurement perspective in SEEA Experimental Ecosystem Accounting but it is linked to the general model of ecosystem assets and ecosystem services that is described.

In general terms, the concept of ecosystem capacity refers to the ability of a given ecosystem asset to generate a set of ecosystem services in a sustainable way into the future. While this general concept is very relevant to ecosystem assessment, definitive measurement of ecosystem capacity requires the selection of a particular basket of ecosystem services and in this regard measures of ecosystem capacity are more likely to relate to consideration of a range of alternative ecosystem use scenarios than to a single basket of ecosystem services.

Ecosystem characteristics:

Ecosystem characteristics relate to the ongoing operation of the ecosystem and its location. Key characteristics of the operation of an ecosystem are its structure, composition, processes and functions. Key characteristics of the location of an ecosystem are its extent, configuration, landscape forms, and climate and associated seasonal patterns. Ecosystem characteristics also relate strongly to biodiversity at a number of levels.

There is no classification of ecosystem characteristics since, while each characteristic may be distinct, they are commonly overlapping. In some situations the use of the generic term “characteristics” may seem to be more usefully replaced with terms such as “components” or “aspects”. However, in describing the broader concept of an ecosystem, the use of the term characteristics is intended to be able to encompass all of the various perspectives taken to describe an ecosystem.

Ecosystem condition:

Ecosystem condition reflects the overall quality of an ecosystem asset, in terms of its characteristics.

Measures of ecosystem condition are generally combined with measures of ecosystem extent to provide an overall measure of the state of an ecosystem asset. Ecosystem condition also underpins the capacity of an ecosystem asset to generate ecosystem services and hence changes in ecosystem condition will impact on expected ecosystem service flows.

Ecosystem services:

Ecosystem services are the contributions of ecosystems to benefits used in economic and other human activity.

The definition of ecosystem services in SEEA Experimental Ecosystem Accounting involves distinctions between (i) the ecosystem services, (ii) the benefits to which they contribute, and (iii) the well-being which is ultimately affected. Ecosystem services should also be distinguished from the ecosystem characteristics, functions and processes of ecosystem assets.

Ecosystem services are defined only when a contribution to a benefit is established. Consequently, the definition of ecosystem services excludes the set of flows commonly referred to as supporting or intermediate services. These flows include intra- and inter-ecosystem flows and the role of ecosystem characteristics that are together reflected in ecosystem processes.

A range of terms is used to refer to the concept of ecosystem services defined here. Most common are the terms “ecosystem goods and services” and “final ecosystem services”. These two terms highlight particular aspects of the definition above. The first recognises that ecosystem services includes flows of tangible items (e.g. timber, fish, etc.) in addition to intangible services. The second recognises that only those ecosystem services that contribute to a benefit – i.e. they are final outputs of the ecosystem – are within scope.

Ecosystem services as defined in SEEA Experimental Ecosystem Accounting exclude abiotic services and hence do not encompass the complete set of flows from the environment. A complete set of flows from the environment may be reflected in the term “environmental goods and services”.

Three main types of ecosystem services are described: provisioning services, regulating services and cultural services. The Common International Classification for Ecosystem Services (CICES) is an interim classification for ecosystem services [*but adopted as working standard at UN and EU level*].

Environmental assets:

Environmental assets are the naturally occurring living and non-living components of the Earth, together constituting the bio-physical environment, which may provide benefits to humanity.

This definition of environmental assets is intended to be broad and encompassing. As explained in the SEEA Central Framework the measurement of environmental assets can be considered from two perspectives. First, from the perspective of individual components, i.e., individual environmental assets, that provide materials and space to all economic activities. Examples include land, soil, water, timber, aquatic, and mineral and energy resources.

Second, environmental assets can be considered from the perspective of ecosystems. However, the scope of environmental assets is not the same as ecosystem assets as it includes mineral and energy resources which are excluded from the scope of ecosystem assets.

Also, the scope of environmental assets is broader than natural resources as it includes produced assets such as cultivated crops and plants (including timber, orchards), livestock and fish in aquaculture facilities.

In the SEEA Central Framework, the measurement scope of environmental assets is broader in physical terms than in monetary terms as the boundary in monetary terms is limited to those assets that have an economic value in monetary terms following the market valuation principles of the SNA.

Expected ecosystem service flow:

Expected ecosystem service flow is an aggregate measure of future ecosystem service flows from an ecosystem asset for a given basket of ecosystem services.

In general terms the measure of expected ecosystem service flows is an assessment of the capacity of an ecosystem asset to generate ecosystem services in the future. However, the focus is on the generation of a specific, expected combination of ecosystem services (the given basket) which may or may not be able to be produced on a sustainable basis. Thus the measure is not necessarily reflective of sustainable or optimal scenarios of future ecosystem asset use. At the same time the expectations of future ecosystem service flows must be informed by likely changes in ecosystem condition noting that the relationship between condition and ecosystem service flow is likely to be complex and non-linear.

Inter-ecosystem flows:

Inter-ecosystem flows are flows between ecosystem assets that reflect ongoing ecosystem processes. An example is the flows of water between ecosystem assets via rivers.

These flows may relate directly or indirectly to flows of ecosystem services. Most commonly, inter-ecosystem flows relate to the flows considered supporting or intermediate services.

Intra-ecosystem flows:

Intra-ecosystem flows are flows within ecosystem assets that reflect ongoing ecosystem processes. An example is nutrient cycling.

These flows may relate directly or indirectly to flows of ecosystem services. Most commonly, intra-ecosystem flows relate to the flows considered supporting or intermediate services.

Natural capital:

The term natural capital is not defined in SEEA Experimental Ecosystem Accounting. Commonly, natural capital is used to refer to all types of environmental assets as defined in the SEEA Central Framework. Used in this way natural capital has a broader scope than ecosystem assets as defined in SEEA Experimental Ecosystem Accounting since it includes mineral and energy resources.

Generally, natural capital incorporates broad notions of the set of services from ecosystems in line with the accounting for ecosystem assets described in SEEA Experimental Ecosystem Accounting. In this regard, although aligned in bio-physical terms, natural capital may be considered a broader measure than the measures of environmental assets that are described in the SEEA Central Framework which are limited to consideration of material/SNA benefits.

It is noted that while natural capital would usually incorporate all ecosystem assets there is ample evidence to indicate that very few, if any, ecosystems are uninfluenced by humans

and hence there are few ecosystem assets that might be considered purely “natural” [*in an ecological science perspective*].

Natural resources:

Natural resources include all natural biological resources (including timber and aquatic resources), mineral and energy resources, soil resources, and water resources.

In the SEEA, unlike the SNA, natural resources exclude land which is considered a distinct type of environmental asset.

Following the SNA, natural resources are defined in the SEEA to include only non-produced environmental assets, i.e., they are not considered to have come into existence as outputs of processes that fall within the production boundary of the SNA. A distinction is thus made between “natural” and “cultivated” environmental assets.