



Technical paper

EEA contribution to the “Beyond GDP” conference

Accounting fully for ecosystem services and human well-being

“Because National Accounts are based on financial transactions, they account nothing for Nature to which we don’t owe anything in terms of payments but to which we owe everything in terms of livelihood.”

Bertrand de Jouvenel, Arcadie, 1968

0. Introduction: Ecosystem services and human well-being

An ecosystem is a dynamic complex of plant, animal, and micro-organism communities and the non-living environment interacting as a functional unit. There are a wide range of ecosystems in Europe and globally – from those relatively undisturbed, such as natural forests, to landscapes with mixed patterns of human use, to ecosystems intensively managed and modified by humans, such as agricultural land and urban areas.

Ecosystem services are the benefits people obtain from ecosystems. These include *provisioning services* such as food, water, timber, and fiber; *regulating services* that affect climate, floods, soil, disease, wastes, and water quality; *cultural services* that provide recreational, aesthetic, and spiritual benefits (*see Figure 1*).

Human well-being is assumed to have multiple constituents, including the *basic material for a good life*, such as secure and adequate livelihoods, enough food at all times, shelter, clothing, and access to goods; *health*, including feeling well and having a healthy physical environment, such as clean air and access to clean water; *good social relations*, including social cohesion, mutual respect, and the ability of help others and provide for children; *security*, including secure access to natural and other resources, personal safety, and security from natural and human-made disasters; and *freedom of choice and action*, including the opportunity to achieve what an individual values doing and being.

People are integral parts of ecosystems and a dynamic interaction exists between them and other parts of ecosystems, with the changing human condition driving, both directly and indirectly, changes in ecosystems and thereby causing changes in human well-being. At the same time, social, economic, and cultural factors unrelated to ecosystems alter the human conditions, and many natural forces influence ecosystems. The actions that people take influence ecosystems not just from concern about human well-being but also from considerations of the intrinsic value of species and ecosystems.



1. The GDP debate and EEA's potential contribution

1.1. Building on what exists...

There are clear policy demands within the Beyond GDP process - as well as within the G8+5's Potsdam Initiative to produce a Stern-like analysis for biodiversity/ecosystems goods and services loss.

The Integrated Environmental and Economic Accounting (SEEA) methodological guidelines of the United Nations provide an already agreed methodological framework within which to respond to both the demand for a sound methodological basis for such work and the elaboration of a small number of aggregated indicators that can be a basis for tracking progress.

The power of accounting tables is in their integration; the power of sound aggregated indicators is in their value to support decision making alongside other aggregates like GDP. There is of course no magic in one number – even a monetary value – and decisions are based on multiple criteria where costs and monetary benefits are an essential component, but not the only one. It means that policy makers should not only use one aggregate, but several physical and monetary indicators and accounts. To enable them to do so requires also that these indicators need to be correctly connected to “the” aggregate, hence the link to SEEA.

This is also recognised by the science community and the issue is captured by an opinion of the EEA Scientific Committee in October 2006 on the role of aggregate (and composite) environment indicators in support of policy objectives (see Annex 1).

So, the demand is still clearly on the table; the EEA thinks it can contribute to answering policy demands on the basis of the progress in:

- Economic-environmental accounting: the SEEA describes correctly the statistical infrastructure
- Economic theory (Ecological economics, valuation methods, etc.)
- Ecosystem understanding and assessment of the natural capital (Inclusive wealth of ecosystems with resilience, etc.)
- Data infrastructure and modelling: Networks (Eionet, European Statistical System); Earth Observation; In-situ monitoring; Statistics; Modelling; Spatial Data Infrastructure. All of these are reflected in three major European Union initiatives: Shared Environmental Information System (SEIS), Global Monitoring for Environment and Security (GMES) and INSPIRE.

1.2. Main elements for a methodological proposal....

The proposal is based on the SEEA framework with a focus on what is termed ecosystem accounting. The proposal covers the six following core elements:

1. Natural capital stocks of socio-ecosystems (stocks, internal flows, integrity/health/resilience, services) – are accounted in physical terms in a first step.



2. Non-market benefits from ecosystem services need to be added to GDP for computing the Inclusive Domestic Product (IDP) which acts as a monetary measure of human well-being.
3. Non-financed costs necessary for maintaining and/or restoring the natural capital need to be added to GDP for calculating a Full Cost of Goods and Services (FCGS).
4. Full cost of imported goods and services is part of FCGS – it is a monetary measure of Europe’s footprint on the global ecosystem.
5. Breakdowns by sectors/ products with the national Accounts Matrix for Environmental Accounting (NAMEA) are important as they relate directly to the national accounts and policy action areas (e.g. energy, agriculture, industry, forestry etc).
6. The ratio IDP/FCC measures a “Sustainable Development Gap” aggregate (SDG). $SDG < 1$ means that the costs of our current welfare are not covered, or, in other words, we over-consume today what we should instead invest to secure future consumption.

2. Justification for the proposal

2.1. Arguments

The subtraction of environmental damages from GDP, through former approaches like the so-called “Green” GDP, has often appeared as an attempt at punishing the GDP method rather than a proposal for an efficient tool for policy making. The ambition of shrinking GDP for making it a virtuous welfare indicator – when statisticians, consider that it summarizes the level market transactions independently of any ethical considerations – has been criticized from the first day. Added to this, the prices used in pioneering applications were often uncertain and the theoretical grounds of the adjustment (the general equilibrium conditions) often disputed. With these factors in mind, it is easy to understand that the national accountants have systematically opposed any such adjustment to GDP.

There are other solutions to consider on the basis of two examples of ongoing work related to ecosystems:

- The work in India by the GAISP (the Green Accounting for the Indian States Project). The approach is pragmatic: first account for the non accounted ecosystem services and add them to the GDP; then deduct degradation and depletion. No “General Equilibrium” problem exists in this case. Note that results are generally presented as a ratio between environmental losses and the adjusted (increased...) GDP.
- The work in Spain (*Naredo et al*) on water accounts. The approach doesn’t focus any more on the valuation of ecosystem services but on the costs necessary for maintaining the whole range of services provided by the rivers (water supply for municipalities and irrigation, hydroelectricity, ecological quality, etc) at a level fixed according to “preferences” expressed by society. These preferences combine criteria on economic costs and benefits as well as other parameters; they are expressed in physical terms – the state of the water ecosystem. The calculation of costs is first in physical terms – what has to be



done for meeting the social objective? –and priced according to the physical measurement. The costs are not normative – but strongly indicative.

2.2. The proposal in more detail.....

Considering the above, the elements of the proposal listed in section 1.2 can be elaborated as follows:

1. Accounting of natural capital stocks of socio-ecosystems (stocks, internal flows, integrity/health, services); this can be done in physical terms on the basis of the integration of monitoring, statistical and geographical data. Complete monetary valuation of the natural capital, which requires systematic disentangling of ecosystem services from market values of commodities is more complicated and requires additional research (e.g. choice of discount rates and correlated integration of risk...); complete monetary valuation is postponed to a second step (*See Figure 2*).
2. A major part of ecosystem services are already an input to the GDP i.e. they are in the monetary value of the GDP (under the conditions of the general equilibrium of prices and quantities). The remaining ecosystem services are used for free, i.e. the non-market benefits directly enjoyed by producers and consumers from ecosystem services. They can be counted in physical units (e.g. number of persons x time spent x frequented area) and then valued with shadow or virtual prices. The value of end use non-market ecosystem services should be added to the GDP; the sum total is the Inclusive Domestic Product (IDP) (*see Figure 3*). If GDP is related to the economic welfare, IDP tells about human well-being, in the ecosystem sense. IDP can measure, for example, that the economic product increases at the expense of the previously free services; or that the degradation of the ecosystems has negative consequences on the total amount of goods and services available.
3. On the market, the goods and services made available for consumption (and export) have an economic value equal to their cost. As there is no consumption of natural capital in the SNA, maintenance and restoration expenditures are entangled in current economic flows. When the ecosystems are degrading, or are not at the level decided by the society, it means that the full cost of their use is not covered by any economic expenditure. In this case, the additional necessary maintenance and restoration costs have to be considered as an allowance for depreciation of the natural capital, not covered in the current GDP and therefore forwarded to the future period: in other terms, a liability or debt on nature or on the future generations. It is the amount to be internalised by the economy by means of compensation works or restrictions of resource use and financed by legal or market instruments (full pricing, ecological taxes, environmental liabilities...). Accounting for such depreciation allowances of the natural capital can be done in reference to the level¹ desired by society.

¹ This level (objective, norm) is expressed in physical terms in various policy documents (e.g. UNFCCC, Water Framework Directive, Natura2000...). In reference, the physical costs of meeting it (e.g. tons of CO₂ to be abated, thermodynamic cost of river basin management, protected areas and



This depreciation allowance should be added to the current value of the goods and services for calculating a new aggregate: Full Cost of Goods and Services (FCGS) (see Figure 3).

4. FCGS includes the full cost of imported goods and services, calculated in relation to the necessary depreciation allowance for maintaining / restoring ecosystems in the exporting countries up to the levels acknowledged in international conventions (as a minimum, binding for the importing country). Where they exist, international prices should be used for valuation. Therefore, FCGS in industrial will not decrease by the mere effect of delocalisation of production; in the case when cheaper prices of products in the exporting country are offset by higher hidden costs of natural capital degradation, the full cost of imports will reflect the global human footprint of the importing country.
5. Ecosystem services and physical costs of maintenance/ restoration can be analysed by sectors/ products within the National Accounts Matrix for Environmental Accounting (NAMEA). The Input-Output analysis under NAMEA should be expanded to IDP and FCGS. These calculations are necessary because comparisons between either different industries in a country or between the same branches in different countries are certainly of high policy relevance regarding globalisation. In a domain such as CO₂, where EEA manages IPCC data and Eurostat their translation into NAMEA, this could be candidate for some kind of a FCGS calculation, using carbon shadow prices.
6. When $FCC > GDP$ or $> IDP$, it means that the costs of our current welfare (or well-being) are not covered, that we are living above our livelihood. This could be summarized in a ratio: FCC/GDP or FCC/IDP which is a sustainable development aggregate. It could be named Sustainable Development Gap (SDG).

With respect to the conditions to develop and implement gradually these objectives, the following considerations should be addressed:

- to restrict the proposal at this stage to ecosystem goods and services, but be open to incorporate into the framework, if possible, the depletion of subsoil assets on the one hand and the human / social capital on the other hand;
- to undertake first steps quickly on the basis of existing methodologies; but at the same time undertake research in order to frame and compute more precisely the physical and monetary accounts of ecosystem assets and services;
- to harmonise methodologies and streamline data collection across some of the main indicators referred to in the EEA Scientific Committee opinion: Ecological Footprint (EF), Human Appropriated Net Primary Productivity (HANPP), Material Flows Accounts (MFA) and Landscape Ecological

ecological networks to be restored...) can be calculated and valued using appropriate marginal mitigation costs (carbon, energy ...).



Potential (LEP) since they are all built on the same data and accounting principles as physical accounts of the natural capital (*see Figure 4*).

- stimulate research on solutions to the most recurrent intractable questions:
 - on the revelation of users preferences in the relevant geographical context and subsequent stratification of benefit transfer methodologies;
 - on the estimation of risks to ecosystems as a way of integrating resilience in natural assets valuation;
 - on the multiple scales assessments and on the strategies for sampling and optimal programming of case studies, and especially the reallocation of socio-economic data from administrative boundaries (NUTS) to geographical objects dimensions most relevant for the environment (e.g. river sub-catchments, bio-geographical regions).



3. How to get the proposal working most efficiently?

3.1. Linking up existing processes and resources coherently

IDP and FCGS are straightforward indicators of sustainable development. The proposed adjustment generates no damages to GDP, which may help its acceptance by statisticians, in particular in the context of environmental accounting discussions. The neutrality of the framework can accommodate major positions in environmental accounting and environmental/ecological economics:

- conservation of GDP, a key demand of both statisticians and institutional economists;
- correct recording of accounting periods and balancing of the adjustments in the full set of national accounts (instead of an end of pipe adjustment with no feedback on income, consumption and prices): IDP and virtual income, additional maintenance costs and negative savings balanced with liability on nature (domestic and external); a recurrent criticism by national accountants to former Green GDP;
- calculation of environmental values not included in GDP, as a standalone exercise (traditional approach) and/or in conjunction with natural capital assessment, including its resilience;
- approach by physical costs (the economy and ecosystem metabolism, energy and material flows) and translation in monetary costs
- “additional” maintenance and restoration costs as the ecosystem part for computing World Bank’s Net Genuine Savings (recently renamed as Adjusted Net Savings)
- central position to natural capital accounts in physical terms;
- low normative character of IDP and FCGS; instead, recognition of the relevance of decision processes based on multiple criteria objectives: societal norms stated in legal documents and considered as the level of critical natural capital to be maintained, economic benefits, full costs of maintenance, and possibly ethical and other values.
- openness of the ecosystem approach to further additional adjustments of GDP for depletion of non-renewable resources as resource rent reallocation;
- openness of the ecosystem approach to further additional adjustments for the human, social and institutional capital, following a two stage process of physical, then, monetary accounts.

To make progress requires quickening up the pace and coordinating several processes:

- Production of physical accounts of the natural capital/ ecosystem assets with emphasis on freshwater, grassland systems, forests, wetlands, soils, fisheries as well as intensive agriculture and urban systems.
- Mobilisation of knowledge on valuation methods (especially research projects undertaken by various national and international networks and initiatives...)
- Streamlining the contribution of Eurostat and the European Statistical System by making operational (annual production) long-standing methodologies on



environmental protection expenditure, MFA, NAMEA and elsewhere in the SEEA.

- Streamlining the contributions of EIONET on in-situ monitoring and spatial data infrastructure through the SEIS, GMES and INSPIRE initiatives
- Streamlining Eurostat, JRC and EEA cooperation on this programme
- In all domains, increase substantially the development of modelling techniques to support scenarios and now-casting to support most recent trends analysis

3.2. Build on progress already made with SEEA.....

The UN SEEA 1993 put in a rather exclusive way the focus on the creation of a normative adjustment of GDP by shrinking it from depletion of resources and altogether from “environmental degradation”, a not so clear objective as long as the environment itself (the ecosystems) and the environment services were not part of the system.

The SEEA93 was not successful and in 1994, Statistics Canada, Eurostat and UNSD decided the creation of a UN methodological working group which was hosted by the national statistical office of the UK. The group was accordingly named “London Group” and steered further developments which lead to a decision of revision of the SEEA in 1998, to take stock of the difficulties encountered as well as of a large range of applications around the World and in particular in Europe, under the impetus of Eurostat. This lead to the SEEA 2003 where physical and monetary accounts are put on the same ground in a comprehensive set of accounts well articulated to the national accounts. Natural assets accounts, of which “land and ecosystem” are one type, have been introduced in this revision. However, there is still no complete integration of the modules on the ecosystem side. The ongoing current revision (SEEA 2010) aims at fixing (at the demand of the UN Statistical Commission) a “Statistical standard”. In addition the revised SEEA will keep guidelines for non-standard accounts to foster development.

The leading role of Eurostat in the London Group process (with Statistics Canada and the UN) has resulted in a large number of applications in European countries (sponsored by DGENV/Eurostat) – an essential input to SEEA2003. ESEA2003, the European Strategy for Environmental Accounting has been endorsed by the EU and its Member States and is currently being revised.

EEA has become part of the game, with Eurostat support. A feasibility study of land and ecosystem accounts was started in 2001 and finalised in 2003. On this basis land cover accounts (so-called LEAC for “land and ecosystem accounts”) have been produced for 24 countries in Europe where Corine land cover had been produced for 1990 and 2000. In 2006, the EEA published a report on “Land accounts for Europe 1990-2000” (http://reports.eea.europa.eu/eea_report_2006_11/en) . Land accounts will be updated in 2008 with the results of Corine land cover 2006.

In parallel work on ecosystem accounting continued leading to a framework (*see Figure 3*) presented in an article in the International Journal of Ecological



Economics². On 30 Nov.-1st Dec. 2006, an International Workshop on land and ecosystem accounting was jointly convened in Copenhagen by EEA and the UN Statistical Division. From its conclusions³, the EEA has started in 2007 a feasibility study for EURECA! an ecosystem assessment of Europe, based on ecosystem accounting concepts, that is scheduled for publication in 2012.

3.3. Fast track implementation of the proposal – where to focus?

The methodology for implementation can be categorised as follows:

- **Aggregates and indicators:**
 - Monetary aggregates and indicators have been previously discussed in this paper (IDP, FCGS). They are computed on the basis of physical accounts and specific valuation of services, one the one hand and costs on the other hand.
 - Proposed physical aggregates are: Ecological Footprint (EF), Human Appropriated Net Primary Productivity (HANPP), Material Flows Accounts (MFA) and Landscape Ecological Potential (LEP) since they are all built on the same data and accounting principles as physical accounts of the natural capital.
- **Scales:**
 - Multiple scales assessment is the rule.
 - Three typical scales have been identified for analysis: functional landscapes (bio-geographical regions and sub-regions, ecological networks, river basins and sub-basins), land cover units (supplemented by rivers) and individual/local socio-ecosystems.
 - Reporting will be done by analytical units as well as by reporting units such as administrative regions or countries.
 - Top down and bottom up analysis are carried out in parallel. This will allow producing rapidly a first picture at the continental scale while sampling monitoring networks, local statistics and case studies for improving progressively the resolution and accuracy of the broad picture.
 - The multi-scales approach will facilitate the involvement in the European process of those Member States running similar actions at the national level and at the same time allow Europe to support the proposed follow up to the Millennium Ecosystem Assessment currently proposed for 2015.
 - The multi-scale approach will at the same facilitate as well the open participation of research networks for testing methodologies, both for resilience thresholds and pricing/valuation
- **Framework:**
 - The overall framework which as mentioned already has been presented in Ecological Economics, 2007 and is summarized by *Figure 3*.

² Implementation of land and ecosystem accounts at the European Environment Agency, Jean-Louis Weber, *Ecological Economics*, Volume 61, Issue 4, 15 March 2007, Pages 695-707

³ <http://www.eea.europa.eu/highlights/eea-workshop-leads-to-new-international-declaration>



- Land cover accounts which have been tested for 1990 and 2000 will be updated for 2006.
- Development of basic physical accounts with Member States in relation to the development of the Shared Environmental Information System.
- The involvement of the European statistical system via Eurostat is made possible by this SEIS framework; it is crucial considering socio-economic data, environmental expenditure, integration with input-output analysis and in particular NAMEA as well as with other aspects of national accounts.
- Land and ecosystem accounting methodologies are reviewed of by the UN London Group

The overall process will deliver synthesis results across Europe by 2012 when the EEA will publish the first European Ecosystem Assessment (Eureca!) as mentioned above.



ANNEX 1:

EEA scientific committee opinion on aggregate and composite environmental indicators

1. The scientific committee underlines the necessity for Europe, and more specifically the EEA, to allocate resources to the critical review and development of methods for aggregate and composite environmental indicators⁴.
2. The importance of such indicators is to provide valuable insights into the sustainability of society-economy-environment interactions and in so doing contribute to monitoring progress with strategic and operational policy developments in Europe – in sustainable development strategies, environmental thematic and economic sectoral strategies. Such indicators should be analysed and presented alongside the more elementary indicators that constitute, for example, the EEA core set and the EU structural- and sustainable development indicators.
3. The committee welcomes the increasing interest in the issue of aggregated indicators in policy circles including the initiative of Commissioner Dimas – “Beyond GDP” – to put environmental considerations more central to economic and budgetary decisions. Past debates and initiatives around the concept of “green GDP” have yielded promising methodological developments. The EEA should respond to the policy demand by evaluating the relevance of these various approaches and their feasibility, in total or in part.
4. The committee also advocates the use of such indicators to channel improved communication with the public on the value of maintaining environmental resources in order to maintain the economic and social well-being of Europe’s citizens.
5. The committee’s view is that, to these ends, major breakthroughs will be achieved when attention will be given to the analyzing and further development of several of these indicators and underlying methods rather than just one, because different measurement methods and the computed indicators can serve different knowledge purposes. It is as a package, carefully framed, managed, targeted and communicated, that such methods and indicators can best serve improving understanding of how using the environment the way we do to sustain our socio-economic well-being - and the impacts that result – is jeopardizing the resilience of ecosystems’ goods and services. The Millennium Ecosystem

⁴ In this context, aggregate indicators are made of non-weighted sums or balances of additive variables covering a given realm (country, sector...). Composite indicators are combinations of selected additive or non additive variables that have been assigned weighting factors.



Assessment calls for better information and knowledge in this respect and Europe now has the opportunity to respond positively to this challenge.

6. From the perspective of scientific soundness, the committee recommends that the EEA takes a differentiated approach both in its evaluation and support to the development of different methods and in its use of the different indicators that result from the application of these methods. More specifically, the committee recommends that the EEA provides support to improvements of composites such as the Ecological Footprint and the Environmental Sustainability/Performance Indices of Yale by supplying underlying data provided by Eionet to ensure that the European picture is consistently represented in the global context. The EEA with Eurostat should also assess the practical usefulness of such composites for framing and monitoring European policies and/or their impacts. The committee further recommends that the EEA focuses its resources primarily towards developing composites building on the country analysis produced in The European Environment State and Outlook 2005.
7. For aggregates, the committee considers that the EEA should focus its resources, in co-operation with others such as Eurostat, primarily on methods and indicators which can be specifically related to environmental policy priorities. Of particular interest are the Human Appropriation of Net Primary Production (HANPP) index and relevant elements of the Integrated Environmental and Economic Accounting (SEEA) methodological guidelines of the United Nations. HANPP should be considered in its complexity and could develop into an indicator of pressure on biodiversity, while at the same time contributing to policy needs related to the 2010 target on halting biodiversity loss. The scientific community is close to consensus on the HANPP method, paving the way for its broader implementation. To that end, the EEA scientific committee welcomes the offer to work with Eurostat in developing deeper understanding of HANPP.
8. SEEA could support analysis of the use of energy, land, water and materials and how these impact on the environment, as well as the impacts of economic activities on ecosystem goods and services. Work is already well-established between the main European players (EEA, Eurostat and JRC) and is expected to become more mainstream pending the ongoing process in the United Nations to establish SEEA as an international standard in the official statistical system by 2010.⁵ Moreover, the scientific committee supports EEA

⁵ The UN Statistical Commission has decided in March 2006 to raise the Integrated Environmental and Economic Accounting (SEEA2003) to the level of an international standard by 2010, in relation to the revision of the System of National Accounts (SNA1993). A UN Committee on Economic-Environmental Accounting is mandated to draft guidelines and promote them in areas mature for implementation; organise discussions on specific points to be considered in the SNA revision ; and, develop a longer term research agenda in areas such as valuation, social accounts and ecosystems.



efforts to develop an agreed methodology and standards with Eurostat and member countries for spatial resource accounting, in connection with economic environmental accounting, more specifically, ecosystem, land and water accounts and those for material flows aspects.

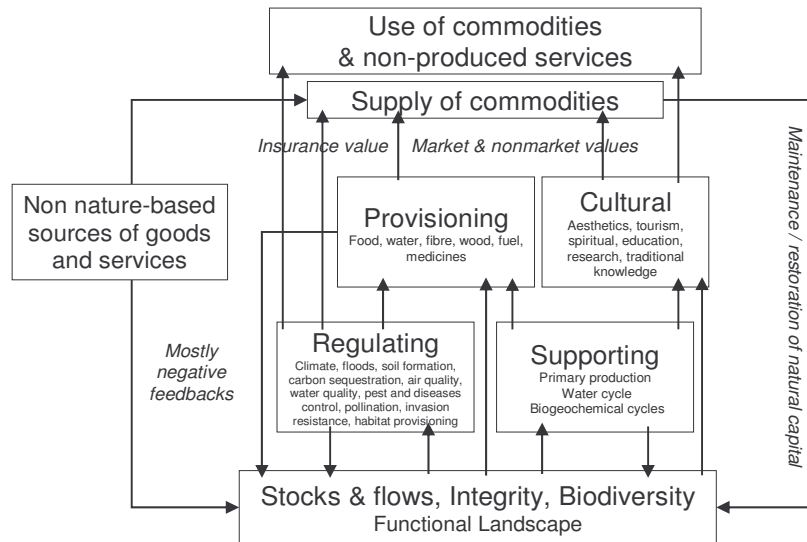
9. Moreover, the complementarities within this package of composites and aggregates should be further explored by the EEA in terms of the research questions being addressed by the different measurement methods and their strengths and weaknesses in terms of policy relevance, communication value and other factors such as possible overlaps and contradictions.
10. The committee wishes to underline the importance of the aforementioned EU institutional co-operation on taking forward this package, and invites the Commission to consider how this package can be supported through activities under the EU's forthcoming seventh framework programme for research (FP7).

Adopted by the EEA scientific committee at its 37th meeting

Copenhagen, 11 October 2006

**Figure (1)**

Ecosystems and services

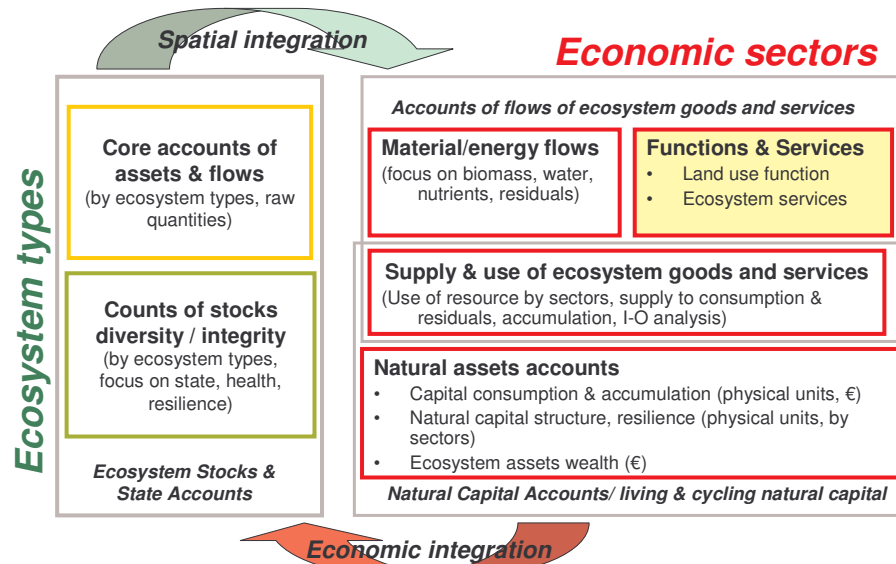


Adapted from Scholes, 2007, Lomas, 2007

European Environment Agency

**Figure (2)**

An Ecosystem Approach of Accounting



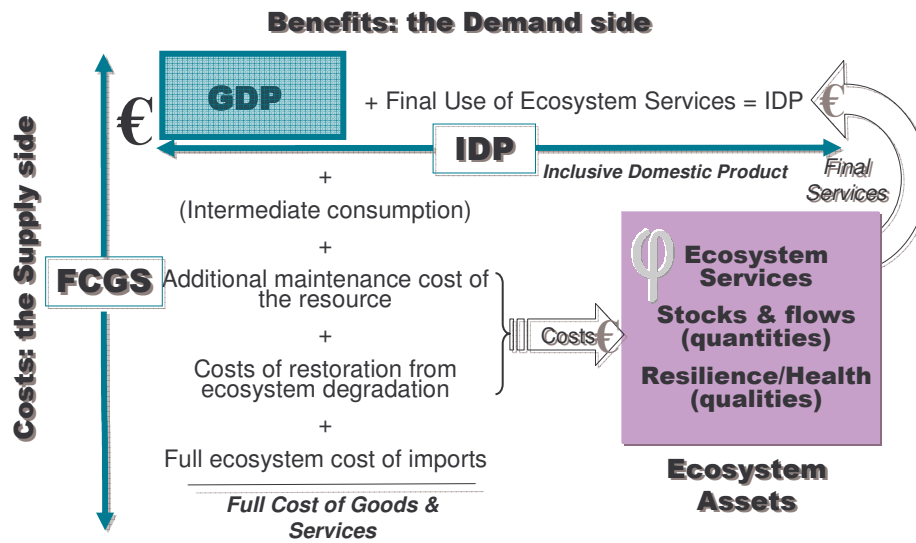
European Environment Agency





Figure (3)

Accounting for environmental benefits and costs

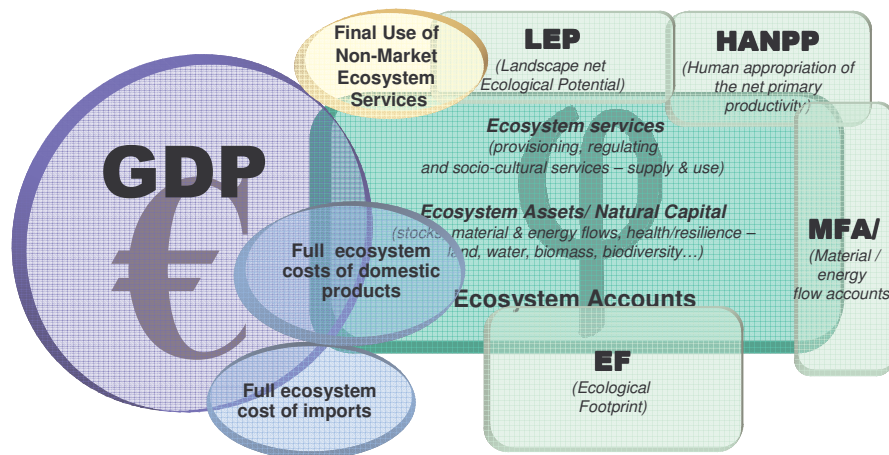


European Environment Agency



Figure (4)

Integrated National Accounts: GDP, Ecosystem Services & Assets, Monetary & Physical Indicators



European Environment Agency

