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VALUATION OF ECOSYSTEM SERVICES IN THE SEEA

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*Background document**

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European Environment Agency

Valuation of Ecosystem Services in the SEEA

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Approaches to ecosystem valuation at the European Environment Agency

in the context of the fast track implementation of ecosystem capital accounts in Europe and the SEEA revision.

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The European Environment Agency is a body of the European Union (EU) in charge of reporting on the state of the environment, supporting the policy making process and supplying relevant information to its stakeholders, European Commission (EC) and member countries as well as to the general public. It cooperates closely with Eurostat and the Joint Research Centre of the European Commission. The EEA is not a research organization but it has close links with national European research organizations via its own network as well as via participation in the steering of main EU funded environmental research programmes. The EEA steers environmental data collection in Europe, develops the so-called shared environmental information system, disseminate data on an open contents basis, maintains a core set of indicators and participates in programmes such as economic-environmental accounting and the SEEA revision, "GDP and Beyond", Green Economy, or TEEB.

Environmental accounts at the EEA are implemented in the context of the European Strategy for Environmental Accounting (ESEA) established under the authority of the Statistical Programme Committee. One of the four priority items of ESEA, ecosystem accounts is EEA's responsibility, the three others (MFA, NAMEA and expenditures) being implemented by Eurostat.

In November 2009, a joint seminar of EEA's management board, DIMESA (the Eurostat environmental statistics network) and EC representatives has discussed of the **fast track implementation of simplified ecosystem capital accounts for Europe**. Three tiers have been identified:

- basic resource accounts for land, carbon and water, balancing supply by the ecosphere and use by the economic sectors;

- accounts integrating the various resources and biodiversity for assessing ecosystem state (quantity and health);

- and ultimately, adjustment of macro-economic aggregates.

The need for monetary tables within the ecosystem accounting framework has been boosted by the multiplication of signals from policy makers, the most noticeable being the Beyond GDP Conference and the G8+5 TEEB initiative, the Green Economy process of UNEP, the so-called Stiglitz-Sen-Fitoussi Commission on the measurement of progress with national accounts as well as recent moves within the climate change process and the apparition of novel proposals such as REDD+ attempting at combining economic instruments for carbon sequestration with biodiversity objectives.

Environmental policies bring benefits and bear costs in their own and they cross-cut with all general and sector policies. Their economic effects are at the core of the decision process. From the point of view of environmental policy making, the EEA can appreciate the demand for operational tools which can be used for assessing environmental policy impacts, benefits and costs, including within the macro-economic debate. It is possible to define the characteristics of the monetary indicators wished by policy makers; they have to be:

- backed upon physical accounts and indicators;

- robust which means based on verifiable statistics and monitoring data

- regularly updated for meeting the policy agenda, at least once per year

- and clearly interconnected with the regular macro-economic tools, the national accounts.

The progress of ecosystem accounts in Europe and their prioritization reflects a sense of urgency of the policy demand altogether with these implicit terms of reference. Regarding both nature science (measurement of ecosystem resilience) and economy (measurement of benefits and costs), a clear distinction must be made between research agenda (and well known theoretical as well as observational issues) and empirical development which can be started now from existing statistics and monitoring data.

1. Why is valuation an important issue now?

Policy demand. The systemic issues. Famed or blamed, GDP remains the central macroeconomic indicator. Standalone indicators don't do the complete job. The basic policy questions.

Policy demand for "Beyond GDP" macro-economic indicators is high in Europe. Incompleteness of national accounts has been highlighted in the context of EU structural and sustainable developments "strategies" as well as in the context of the current financial and economic systemic crisis. European sector policies as well are in demand of improved evidence bases. The main environmental policies currently concerned are climate, sustainable production and consumption, water and last but not least biodiversity, currently revamped "post 2010" on the basis of an ecosystem approach aimed at broadening the traditional species-habitats conservationism. These environmental policies interact strongly with EU common sector policies in agriculture, fisheries, energy and regional development.

They are envisaged in the international context (the European global responsibility). In the current debate on national accounts for policy making, the social dimension has come as well to the front (the 2009 "Stiglitz report"[1]) altogether with economic losses from climate change (the "Stern report"[2]) and the value of ecosystems and biodiversity (TEEB[3]).

The systemic issues: As compared to earlier times, current debates reflect now the systemic dimension of the current financial, economic, food, energy, climate and ecological crises and their similarities: global market (and global ecosystem, climate…), short term horizon, lack of transparency of accounting practices, accumulation of risks and forwarding of debts to others and the collectivity… The SEEA should aim at providing information for policy making in that context.

Famed or blamed, GDP remains the central macroeconomic indicator. Although incomplete and imperfect, national accounts provide an holistic view from the economic standpoint (flows and stocks, non-financial and financial assets, closure of the macro-economic model, complete coverage of sectors, activities and products). They are efficiently used by policy makers for this reason. First of all, GDP growth can be closely correlated to employment as well as to government income (the taxes), two basic short term variables essential for policy decision. Other more or less direct correlations are established (via modeling) with public debt service, financing of pensions, external trade or consumption. Whatever limitations of national accounts and in particular their incapacity at reflecting the main economy-nature interactions they are genuinely indicative for policy makers – and they are used. Whatever solution proposed by the SEEA, it has to be clearly related to SNA macro indicators.

Standalone indicators don't do the complete job. In front of that central vision provided by national accounts and GDP, standalone physical indicators are (again) asked for supplementing the GDP. Such indicators have certainly a role to play, but just a limited one. Sets of indicators may deliver very incomplete and even contradictory messages. Their "flat" aggregation is suspected of being based on conventional or even arbitrary weighting factors. Discussions around "aggregates" or "composites" such as TMR or Ecological Footprint show it clearly (after and before others). In many cases benefits and costs are not clearly related to the physical issues. Even formal integration of physical and monetary data may not be sufficient and forward only partial messages. The well established measurement of economic environmental performance via the ratio of resource use (input to production and waste generation) to economic output (value added) is currently discussed in order to support "double decoupling" assessments: decoupling from resource use on the one hand and decoupling from environmental impacts on the other hand.

Current approaches to beyond GDP accounting still refer to small sets of indicators (the EC's "basket of 4" indicators for sustainable consumption and production, the "mini-dashboard" recommended by the Stiglitz report…) and/or to composite indicators (e.g. the Composite Environmental Index currently discussed in the EC's "GDP and Beyond" process). Such indicators are helpful for description but their operational character is limited to specific issues or sectors. Because the SEEA aims at being an "integrated system" it can help overcoming these difficulties and shortcomings – it has to do it.

[1] Joseph Stiglitz, Amartya Sen and Jean-Paul Fitoussi , eds. *Report by the Commission on the Measurement of Economic Performance and Social Progress*, Paris 2009. http://www.stiglitz-sen-0fitoussi.fr/en/index.htm
[2] http://webarchive.nationalarchives.gov.uk/+/http:/www.hm-treasury.gov.uk/independent_reviews/stern_review_economics_climate_change/stern_review_report.cfm
[3] http://www.teebweb.org/

The basic policy questions to be addressed by the SEEA are fairly well known and relate to the sustainable use of the natural resource – and the consequences of non sustainable use, directly for renewable systems and indirectly for people. They include physical dimensions (How much? Which impacts? Does it matter? Who benefits or suffers?) as well as monetary's (How much benefit? Which cost? Who benefits or pays – or should pay?).

One sentence extracted from the Stiglitz report (op. cit. page 67) summarizes the core challenge for national accounts: *"In other words, what we need are measures of overconsumption or, to put in dual terms, of underinvestment."*

2. Valuation and the SEEA

SEEA is national accounting. The purpose of the SEEA revision is to raise it up to the level of an international standard = the SNA. Make the best use of SNA, mobilize the statistical system. Meet the policy agenda.

SEEA is national accounting. This reminder is essential for our priority setting. SEEA is novel in the sense that it quantifies the interaction between the economy and nature combining physical data and monetary statistics (the latter being standardized by the SNA). It is novel in the sense that it highlights economy's responsibility regarding sustainable use of resource and degradation of ecosystem functions (in the broader sense, of the ecosphere including land based systems, oceans and the atmosphere) and subsequently their capacity of delivering services in the future. It should measure as well the economic benefits made possible by the natural capital.

SEEA is a development of the SNA and an extension. It is not a replication.

This means firstly that the **SEEA should not seek at the construction of a general inclusive model** for economy+nature but focus instead at the interaction of two co-evolving systems. In accounting terms, SEEA should is not be based exclusively on double or quadruple entry rules, as SNA is. SEEA acknowledges double entry type rules (conservation of value) when relevant (e.g. Supply and Use Tables of particular natural resources) but it has to reflect as well non linear relations, thresholds, scale effects… Considering valuation issues, the SEEA should not be submitted to the general equilibrium accounting paradigm of the core SNA. Interconnections have to be developed instead (more hybrid accounts and decoupling analysis) or established at various levels, from the headlines (focused adjustments of aggregates) to social functions (accounts by purposes).

When addressing monetary transactions and valuation of economic natural assets, the SEEA should rely on the well defined SNA categories.

This is firstly the case of **SNA economic asset boundaries for natural assets** (resource and land): they don't need to be modified. This point has been raised by the EEA about land and soil at the London Group meeting of Brussels, 2008[4]. Soil is not an extractible resource but an ecosystem with dual

[4] Jean-Louis Weber, *Land & ecosystem accounts in the SEEA revision*, Position paper for the 13th London Group meeting Brussels, 29 September-3 October 2008.
http://unstats.un.org/unsd/envaccounting/londongroup/meeting13/LG13_25a.pdf

characteristics of private good and public good (its quality). Its economic value depends on what is made of land.

Measuring and valuing non economic assets as if they were economic assets, operated primarily for a particular resource is even a more important concern; it should not be core SEEA's valuation. The SEEA has to develop ecosystem asset accounts including economic natural resources into a broader picture, not to present an alternative valuation to SNA's economic natural assets. Valuation of economic assets as well as measurement of resource depletion are the responsibility of SNA.

Access to appropriate NA tables is part of the SNA-SEEA articulation and named as **"satellite accounts"**. Monetary tables relate mostly to specific recorded transactions such as subsidies, taxes and other expenditures for environment purpose. Another area comes to the front when analyzing production and consumption benefits provided by ecosystems. In principle, all material goods are considered as commodities in the SNA and priced in reference to similar products on the market. In practice, a noticeable share of such products is ignored or/and underpriced – because they don't enter the market, are uneasy to observe with conventional trade surveys and benefit very low income populations, and represent anyway a small share in GDP (the "GDP of the Poor" issue – see below). The main issue is not in that case of valuing services excluded from NA definitions but of improving official statistics and the SNA coverage.

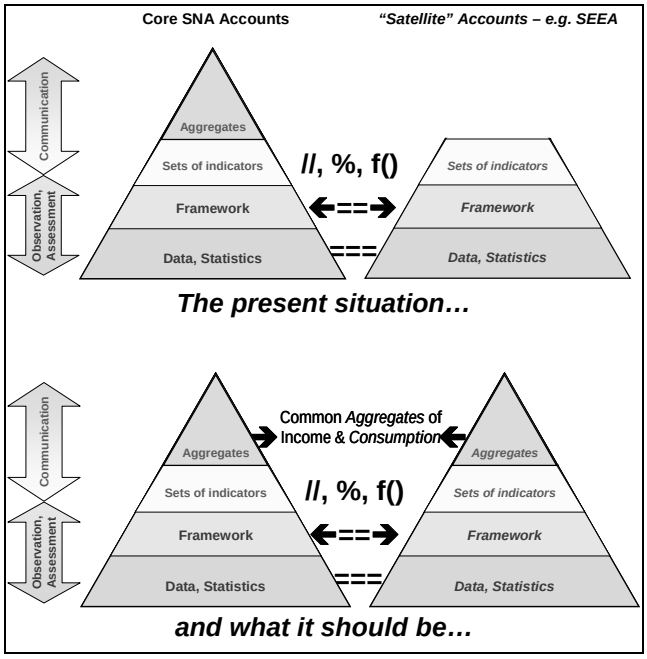
The purpose of the SEEA revision is to raise it up to the level of an international statistical standard = the SNA. This is the UNCEEA and London Group mandate given by the UN Statistical Commission. SEEA rev2012 will be no more a (structured) collection of best practices as SEEA2003 was, but an international statistical standard. Valuation issues have to be considered from that standpoint: monetary tables bridging the SEEA physical accounts and the SNA.

During its introduction to the Eurostat National Accounts Conference 2009[5], the EU Chief Statistician invited to **raise the policy level of the satellite accounts** at the same level as the core SNA, the SEEA revision being given as a first example of such mutation. His argument was supported by the figure of a triangle which low part deals with primary data and their compilation into (accounting) frameworks and the upper part of indicator sets topped by composites. The vertical axe represents a shift from statistical work to communication. The discussion addressed then the reality of this elevation of SEEA to the SNA level, knowing that the top of the triangle – aggregates or composite indicators – is essential in the policy debate.

Elaborating on these ideas, the following comparison regarding the present situation and what it should be has been subsequently established[6].

[5] Walter Radermacher, Introductory speech to Eurostat National Accounts Conference 2009, *Reading the Present to Prepare the Future*, Brussels, 16 September 2009

[6] Jean-Louis Weber and Jock Martin , *Fast track implementation of simplified ecosystem capital accounts for Europe*, Working Paper, European Environment Agency, 10 February 2010



The figure highlights current shortcomings and the fact that although physical aggregates are the basis of ecological sustainability assessments, they are not the heading message. In particular, ecosystem degradation must be translated into monetary aggregates of benefits and costs of remediation.

Make the best use of SNA, mobilize the statistical system

Meeting the policy demand means using all available data and in particular making the best use of the SNA:

- Lean on the accounting paradigm as long as it supports prudential assessments.

All accounting guidelines and laws have been established against opaque handling of money and possible manipulation of statistics, in order to get sincere statements which inform companies themselves, their shareholders, clients and suppliers – as well as the fiscal authority, and for national accounts, budgetary authority and Parliament. Completeness of the financial statements[7] and full deduction of capital maintenance cost in the determination of profit[8] are in particular targeted in IASB guidelines. Requirements for national accounts are similar[9], which justifies the equivalence of

[7] "To be reliable, the information in financial statements must be complete within the bounds of materiality and cost. An omission can cause information to be false or misleading and thus unreliable and deficient in terms of its relevance." (IASB 2009, §38)

[8] "...only inflows of assets in excess of amounts needed to maintain capital may be regarded as profit and therefore as a return on capital. Hence, profit is the residual amount that remains after expenses (including capital maintenance adjustments, where appropriate) have been deducted from income." (IASB2009, §104-110)

[9] "Income is the maximum amount that a household, or other unit, can consume without reducing its real net worth provided the net worth at the beginning of the period is not changed by capital transfers, other changes in the volume of assets or real holding gains or losses." (World Bank 2009)

Net National Income and Net National Product. However, both business and national accounts omit to follow the rules that they decree when coming to the natural capital as long as it is a free externality. Therefore, just by following the basic accounting principles, the headline element common to SNA and SEEA can be identified as the **consumption of natural capital**[10].

- Make use of accounting by purposes (functional analysis)

One of the difficulties with valuation in a national accounting framework is with excessive and inappropriate reference to the double/quadruple entry accounting rule instead of recognizing the role of functional analysis as the SNA does[11]. Functional accounts are closely adjusted to the core accounts but established separately for social functions such as health, education, R&D, environment, households' consumption… In the case of research carried out in a university department based in an hospital on environmentally caused illness, the same amount will be recorded four times. It makes sense for analyzing each of the individual function, compare their weight between themselves or analyse their share into a general aggregate (GDP or Value Added of a given sector…). But of course, the sum total of these functions is meaningless because of double counting issues. When **measuring benefits** made possible by ecosystems – which are multifunctional in essence – the first step should be to assess broad ecosystem services in a functional way, irrespectively to multiple accounting. The aggregate could be like "share of national income made possible by sustainable ecosystem" (fisheries, forestry, agro-ecosystem as priority items). Such aggregate is of immediate use for policy making (see below).

- Be in a position of using powerful analytical tools such as input-output tables and social accounting matrixes.

Tracking environmental degradation alongside the causal DPSIR[12] chain, valuing benefits and costs at the macro level as well as beneficiaries and sectors accountable requires details which can be for a broad part obtained from input-output tables and social accounting matrixes.

- Be in a position of mining the statistical databases on which NA are based.

Critical challenges of ecosystem sustainable use take place in agriculture, forestry and fishery systems where abundant statistics exist which can be used for ecosystem accounting, alone or in combination with monitoring data. International trade statistics are as well a honey pot, the more interesting as they (partly) overcome the traditional statistical gap due to recurrent lack of means in developing countries NSOs.

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[10] This option is "suggested" in SNA 2008: "Clearly this leads into the area of so-called green accounting and the possibility of allowing for consumption of natural capital as well as consumption of fixed capital in an alternative presentation of national accounts in a satellite account." (SNA2008, §20.48). It is proposed here for non-renewable natural economic assets only.

[11] "**Functional analysis**: In order to analyse the purpose of transactions, it is necessary to apply a functional classification to the basic transaction. For example, instead of disaggregating household consumption by type of product, it may be disaggregated to show how much is spent on food, housing, health, recreation and so on. For government consumption a distinction may be made between consumption related to law and order, defense, health or education, for instance. As compatible but different classifications are used according to the sector concerned, these partial analyses by purpose cannot be integrated in a single table and, in most cases, no exhaustive total for the total economy can be calculated in the central framework." (SNA2008, §2.154).

[12] DPSIR is the Drivers-Pressures-State-Impact-Response framework for environmental indicators; it can be named also PSR.

- Offer NSOs the opportunity to enhance their skills and knowledge by cross-fertilization of socio-economic statistics and physical monitoring.

In too many cases, environmental statistics in statistical offices are restricted to a limited number of specific surveys (e.g. waste) and to compilations from other agencies, with the only purposes of national state of environment reports and responses to international questionnaires. Fully fledged environmental accounting offers them the possibility of playing the role of "statistical hub" and support the general policy process. Other statistical programmes can be slightly modified at the marginal cost in order to deliver highly relevant information (household budget surveys and farms surveys are candidates for such extensions, successfully implemented in some countries). Again, such development favours cross-fertilization of socio-economic statistics and physical monitoring.

- Be part of the SNA policy communication with fit for purpose and credible adjustments of monetary aggregates.

This is an important benefit of defining an operational interaction between SNA and SEEA at the macroeconomic level. Communication stops being an issue for the SEEA. The price to pay for that is that of attention to policy relevance, data robustness and last but not least, timeliness without which effective participation into the policy debate is not possible.

Meet the policy agenda.

Meeting the policy agenda requires addressing environmental policies as well as economic sector policies (agriculture, energy, transport, land planning…) and ultimately macro-economic decision, during key regular decision processes such as the preparation of the annual Government budget and its approval by the Parliament... In this latter case, data will be genuinely considered only if they are fit for use, reliable and timely. This is firstly another argument for topping physical indicators (important for specific policies) with monetary aggregates. Secondly, it means that environmental aggregates have to be deep rooted in verifiable statistical and monitoring systems. Lastly, it is an invitation at considering that timeliness matters: environmental headline indicators must refer to the previous budgetary year – not only to periods considered as ancient by policy people.

This recurrent demand for fresh data from economists of the European Environment Directorate General has been now integrated into the European strategy for environmental accounting. Accounts of the past will be supplemented with estimates produced from nowcasting techniques. Finding the right balance between available statistics and monitoring data, on the one hand and estimation methodologies on the other hand is part of the environmental accounting challenge. It means in particular that simplified version of environmental accounts have to be designed for fast track implementation and participation into the policy debate.

3. Benefits and costs in macroeconomic accounting: recent developments

Economic value of sustainable benefits from ecosystems. Costs of maintaining ecosystem functions.

Valuation of benefits from ecosystems at the macro scale

In the context of TEEB, the EEA has carried out a case study on ecosystem accounting for coastal Mediterranean wetlands[13]. It covered three scales: the whole Mediterranean basin, country level and local scale with four protected areas for which information was expected to be abundant enough for accounting. The practical conclusions from that study are that:

- Partial accounts have been produced for the four test sites, with interesting assessments but it was not possible to develop a common framework for accounting at this scale.
- Accounts at the national or regional scale cannot be derived from the addition of local accounts, because of the difficulty of compiling such accounts in a systematic way as well as because of elements which cannot be captured at the local level (e.g. the value of wetlands for maintaining migratory birds flyways and benefits in terms of control of pandemic risks in the case of bird flu).
- That the right approach to start ecosystem accounting implementation is top-down and not bottom-up.
- That simplified ecosystem accounts focusing on major issues are the starting point.

These conclusions meet to some extent those of other recent projects aiming at producing operational accounts useful for decision making at the macro level, with a focus on benefits measurements.

One of these projects is the Green Accounting for Indian States Project. Because key researchers from GAISP are participating in this present meeting, the project will not be presented further on in this paper, beyond a hint with the following box:

www.gistindia.org

Green Accounting Methodology for India and its States

Authors

Haripriya Gundimeda, Pavan Sukhdev, Pushpam Kumar, Rajiv Sinha, Sanjeev Sanyal

… Green Accounting Methodology for India

Firstly, to introduce the system of Green Accounting for India, we believe it suffices to begin with what we describe as a "top-down" approach to measure the sustainability of growth across all of India's States and significant Union Territories. All databases chosen for primary data inputs for calculating Green Accounting adjustments must preferably be national databases, which house data state-wise, such that regional biases or regional variations in data collection methods do not come in the way of a true and fair accounting framework…

Secondly, the use of standard models and standard projections is essential across all States. This will not only ensure a common and consistent methodology, it will also enable us to bridge time gaps between the publication of various slices of official data by the States and the Government of India.

The third consideration is that our selected areas of externalities must be material as a component of adjusted GDP and policy relevant as well in terms of being potentially targeted by policy change. As regards natural capital, our aim is to select those categories which are (a) material in an overall context, (b) measured by existing statistical databases, or soon to be captured by NRSA databases, and (c) realistically manageable as components of national or state government policy

[13] Roy Haines-Young, Marion Potschin, Pushpam Kumar, Jean-Louis Weber et al., *Ecosystem accounting and the cost of biodiversity losses: the case of coastal Mediterranean wetlands*, EEA Technical report No 3/2010, European Environment Agency, April 2010.

over the next decade or so. Following these three criteria, therefore, we include in our evaluation forests, agricultural cropland & pasture land, cattle, known mineral deposits, and surface freshwater resources, but we shall exclude subsoil water, undiscovered mineral deposits, and livestock other than cattle…

A second inspirational project for ecosystem accounting in Europe is the research carried out in Zanzibar[14]. As for GAISP and for the same reason, only a reference is given here:

Titre du document / Document title

Economic value of marine ecosystem services in Zanzibar: Implications for marine conservation and sustainable development

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Résumé / Abstract

Marine ecosystem services are seriously undervalued, resulting in under-investment in conservation and lost opportunities for economic growth and poverty reduction. Economic valuation provides a powerful tool for sustainable development by showing how dependent the economy is on an ecosystem and what would be lost if the ecosystem is not protected. This paper estimates the value of marine ecosystem services in Zanzibar, links the values to the national income accounts, and quantifies how the benefits from each ecosystem service are distributed among five different stakeholder groups. Marine ecosystem services contribute 30% of GDP, yet the ecosystem is seriously degraded due to both human and natural causes. The paper explores the reasons for this, focusing on the distribution of benefits and the (dis)incentives this creates for conservation, especially among local communities that steward the marine ecosystem.

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A recent study follows a similar approach of benefits valuation with national accounts at the core.

Facing the difficulty of calculating ecosystem rents for fisheries, the authors of the report on *"the economic value of sustainable benefits from Mediterranean marine and coastal ecosystems"*[15] pose a question noticeably different from the conventional approach of benefits in the case of fishes. Instead of trying to disentangle the respective shares of labour, capital and nature in benefits from fisheries, the authors address the question of the income made possible by fisheries. This income is then split into ecologically "sustainable" and "non-sustainable" in proportion to the status of the stocks from which the various fish catches originate – an information available in scientific and policy reports.

The advantages of this approach of **benefits as ecologically sustainable income** are important:

[14] Glenn-Marie Lange, Narriman Jiddawi, *Economic value of marine ecosystem services in Zanzibar: Implications for marine conservation and sustainable development*, Ocean & Coastal Management, Volume 52, Issue 10, October 2009, Pages 521-532

[15] A. Mangos, J-P. Bassino, D. Sauzade, 2010, *Valeur économique des bénéfices soutenables provenant des écosystèmes marins et côtiers méditerranéens*, Plan Bleu, Centre d'Activités Régionales PAM/PNUE, Sophia Antipolis, Mars 2010

- The question of benefit is fairly simple to understand: no fish, no fishermen, no transporters of fish, no transformers/processers, no retailers and no final consumption.
- The benefit can be considered either at the primary level (price paid to fishermen) or at the end level of the trade chain; benefits can be measured at each stage, for each socio-economic category;
- Simple calculation of "**ecological sustainability coefficients**" from physical ecosystem accounts or more simple data to start, is feasible;
- Statistics do exist for quantities and values. In Europe, Eurostat compiles Input-Output Tables (currently available in Europe annually for 25 countries, 27 next year) which can be analysed to track income creation and distribution;
- The same approach can be used for **agriculture**; in that case, sustainable agriculture can be defined as respecting soil; soil conservation results from farming practices (moderate mechanical intensity and use of chemical) and landscape diversity; hedgerows which protect from erosion are niches for wildlife … when agriculture statistics are available with sufficient geographical breakdown, the main categories of crops can be mapped and assessed in terms of their sustainability.
- The same approach can be used as well for **forests**; forest sustainable management is an operational concept; statistics and databases exist, including for certified timber – and illegal trade.
- The same approach makes sense for countries' internal market and the global market.

Translated into the European **Simplified Ecosystem Capital Accounts** project, sustainability coefficients can be derived from the six indexes currently considered (land, bio-carbon, water, biodiversity, interdependency and health). Once the ecologically sustainable income from fisheries, agriculture and forestry is computed, the following steps are then to measure how much it is unsustainable (annual loss of total ecosystem potential – in the sense of ecosystem capital accounts) and the restoration cost (by type of ecosystem).

The policy messages supported by such approach are particularly important:

- the complete chain being described ("from field to food" – in the case of agriculture) the blame for degradation (overfishing, overharvesting, intensive practices…) doesn't fall anymore on the primary producer alone (fisherman, farmer or forester) or on the final consumer; the responsibility of every links of the chain is measured.
- the inclusive, complete income being considered as benefit (approx. 25% for food against 2% for agriculture) and the ecologically non-sustainable share being recorded (approx. 20 to 30% in the case of income from fisheries), the justifications for nature policy get much stronger grounds and louder voice in general sector policies (CAP, CC...). The cost of nature protection is not referred to a conservationism ideal but to the sustainability of agriculture, forestry and fisheries.

Note that this valuation of ecosystem services in the case of provisioning services via commodities market price doesn't cover all possible cases and doesn't exclude multiple accounting, e.g. when looking at food processing . This is why it should be considered as "functional accounting". Other functions should be considered, as it is done or envisaged in the three studies presented in reference to this section.

Tourism is the first additional function currently considered as a candidate in the European project. In the case of tourism, which can be motivated by natural landscapes as well as by cultural heritage or business, disentangling what can be assigned to ecosystem services is a particular issue to be fixed. Another point will be measuring which part is ecologically sustainable; physical ecosystem accounts can contribute on that point.

Regulating services are as well to be considered starting with the most basic functions: protection against risks (floods, erosion…), waste assimilation, carbon sequestration, regulation of biological processes (pollination, nursery…). Their value is likely to be considerable, as several case studies show it and definition of national accounting standard methodologies should be a priority of the SEEA research agenda.

Costs of maintaining ecosystem functions

Costs are the other side of economic assessments. The approach foreseen for ecosystem capital accounting in Europe is holistic but restrictive. The objective is to measure ecosystem capital consumption. The method is to measure ecosystem degradation with physical accounts combining resource balances and ecosystem health diagnosis and to convert it into a measurement of depreciation on the basis of mean observed remediation costs (see Annex 1).

Ecosystem capital consumption is holistic in the sense that it is based on the maintenance of ecosystem functions, whatever the particular services will be. It is not identical to maintaining any ecosystem asset value (and calculating depreciation as the difference between assets values at two dates). Ecosystems are not valued in ecosystem accounts; only economic assets are valued within the SNA. The target is the maintenance of the ecosystem potential or capacity of delivering services.

This target can be defined in two ways: in reference to the situation at a given date or according to restoration policy targets.

The first case follows the accounting general rules of capital maintenance. If ecosystem maintaining is not observed at the end of the year, an allowance has to be set aside for restoration. It will correspond to the assessment of remediation costs (restoration works, alleviation of withdrawals, pollution abatement). This current ECC allowance will be used for adjusting net income and savings (deduction) or/and final consumption (addition to compute the full price of products instead of purchaser's). ECC will be balanced with a debt in financial assets accounts (see in Annex 2).

At the end of the following year, a new calculation will take place in the same way, starting from ecosystem state observation. If no improvement has taken place, a new allowance is computed (for a same amounts at constant prices). This amount is used for new adjustments of income and consumption but doesn't change the corresponding ecological debt (or liability). This debt will increase (or decrease) when degradation and therefore ECC increase (resp. decrease).

In the second case, a stated target requests restoration from historical damages[16]. In that case, the total amount of foreseen restoration costs is recorded as an ecological liability of a second type. This financial liability is then amortized (annualized) to compute a second element of ECC and adjust income and consumption accordingly.

As such, ECC and its ecological debts counterpart are just accounts adjustments. Because they are the counterpart of physical ecosystem degradation, they can support policies which aim at reducing this degradation with economic instruments such as ecological taxes, mitigation banking or tradable

[16] It can be necessary because individual efforts are not effective because of landscape fragmentation or general pollution; in other cases, recovery or improvement standards result from policy decisions for reforestation, carbon sequestration, river basins good ecological quality, cleansing of brownfields in cities…

permits[17]. They can be used for correcting environmentally harmful effects of international trade when ecosystem based commodities are sold at dumping prices which don't cover the maintenance of the ecosystem capital in the country of origin and therefore of the global ecosystem.

4. Conclusive remarks:

ECC recording in national accounts is a prudential rule; it links the last accounting period and the new one (as FCC does). ECC doesn't tell how ecosystems will be restored from degradation (FCC doesn't tell either how obsolete facilities will be replaced); therefore, there is no need to calculate opportunity costs for this kind of accounting.

Maintaining ecosystem potential is not identical to strong ecosystem conservation (although conservation may be necessary in many cases). For a country, a region or the planet, what matters is the conservation of a capital of ecosystem capacity. It allows adapting to human increasing needs and climate change and implement mitigation or compensation mechanisms.

Ecosystem degradation and depreciation are not identical to environmental damage, although it is part of the latter. Environmental damage valuation gives a large place to benefit losses. ECC accounting only considers costs related to remediation of ecosystem degradation. There is therefore no possible linear accounting relation between ECC and ecosystem services and/or asset value. The underlying relation in ecosystem capital accounting is instead: ECC maintains physical ecosystem capital which supplies in turns options for economic benefits.

Grounding ECC calculation on physical ecosystem accounts and valuing only marginal change protects from two other major difficulties.

- The first one is the need to address separately private values (appropriated resource/services) and public goods values (life support functions, ecosystem health and renewal). The user in the ECC case has to repay for the ecosystem degradation caused[18] (not for the services lost), as requested e.g. in the EU Environmental Liability Directive of 2004.

- The second is that of valuing non-financial ecosystem assets. There is no need to value physical assets in ecosystem accounting, which avoid difficulties with prices when they turn to be versatile. From this point of view, the solution for ECC has common points with the El Serafy User Cost method for non-renewable assets – the difference being that the User Cost aim is maintaining a flow of income when the aim of EEC is maintaining ecosystem physical capacity of delivering services.

[17] In the case of tradable permits, initial allocation of ecosystem rights (financial assets) can be calculated in the same way.

[18] The User Pays Principle (Naredo, 2007) expands the Polluter Pays Principle from pressures to environmental impacts.

A last remark on SEEA's NA dimension and valuation issues is the need for clarifying what should be a comprehensive **research agenda on valuation** from what could an **interim standard** for short term implementation of simplified accounts of ecosystem capital and valuation "beyond GDP".

5. Short term (this year) and medium term (2012) priorities

Priorities for fast track implementation of simplified ecosystem accounts in Europe can be summarized by the following table:

Natural assets:
Natural resources: accounts in physical units for selected resources: land, carbon, water. Accounting balances for ecosystems – economic sectors/commodities. Trade (see below).
Ecosystems: Simplified accounts. Quantity and quality/health. Degradation/improvement. No asset valuation beyond SNA.
p.m. Subsoil assets: Economic sector accounts. Quantity and physical depletion. No asset valuation beyond SNA.

Benefits:
Functional analysis, accounts by purpose: accounts of main ecosystem services according to importance and data availability
Macro economic benefits made possible by ecosystems:
- analysis of benefice sharing alongside the income chain (using IO Tables);
- ecologically sustainable income and consumption by using sustainability coefficients;.

Priority services:
- Provisioning services: agriculture, forestry, fishery, water
  - Valuation: market prices (net VA)
  - price of ancillary goods and services: is Purchasing Power Parity as a solution?
  - sustainability coefficients from physical accounts; needs some mapping of harvesting/extraction areas
- Regulating services: protection against risks (floods, erosion…), waste assimilation, carbon sequestration, regulation of biological processes (pollination, nursery…)
  - valuation methodology ?
  - sustainability coefficients ?
- Socio-cultural services: tourism
  - Market prices
  - typology of "ecosystem based tourism" and statistics
  - sustainability coefficient from physical accounts; needs some mapping of tourism areas with frequentation

Maintenance costs
Maintenance of the ecosystem capital structures and functions: total capacity (potential) of delivering multiple ecosystem services, state and change
- Annual maintenance according to the general accounting rule
- Restoration of historical damages according to stated policy targets
- Compensation, mitigation, remediation costs

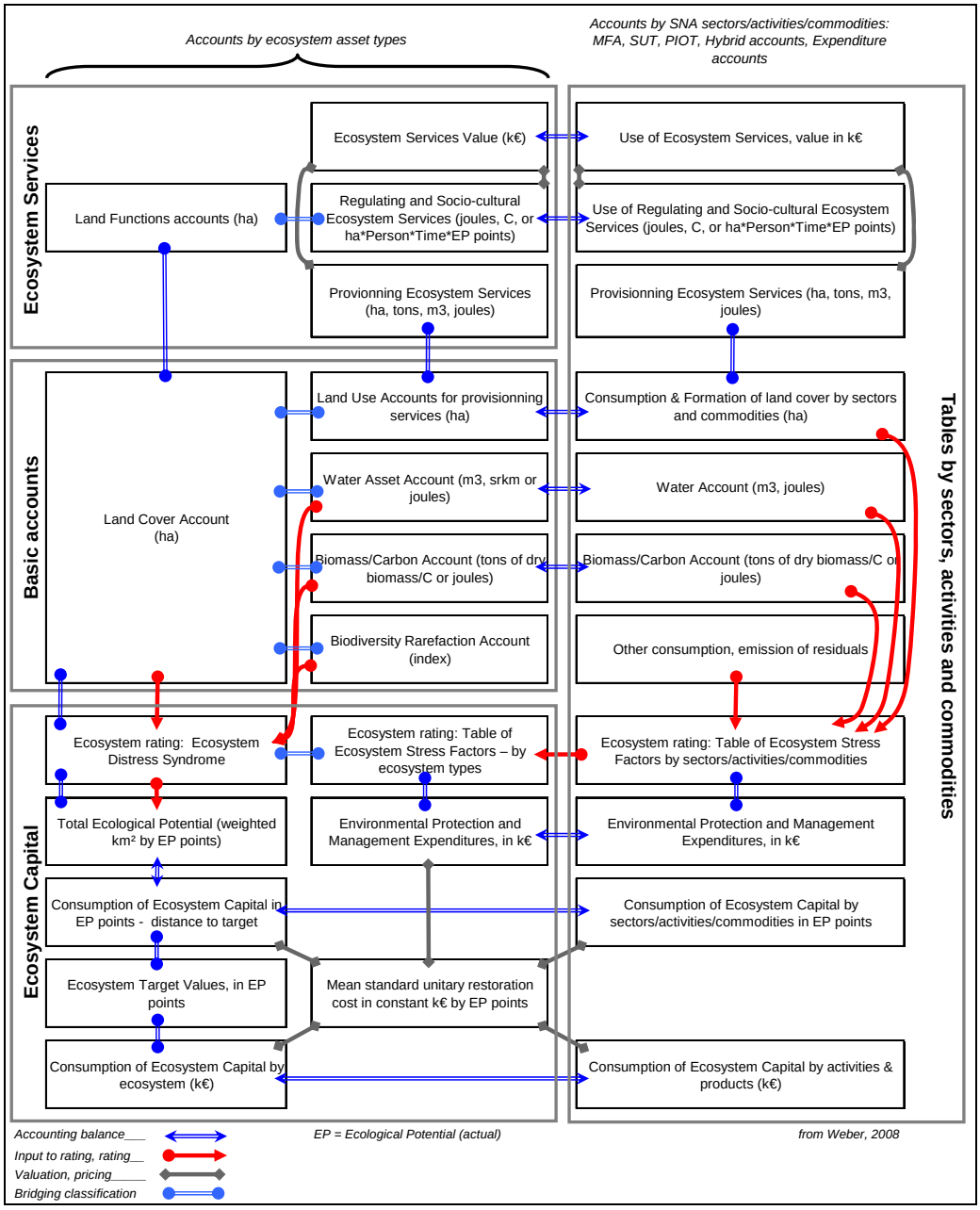
Consumption of ecosystem capital and ecological debts
Accounting for ecosystem improvement: in financial assets

Trade
Actual and virtual flows (land, carbon, water)
By default, North-South trade on the basis of North statistics
Sustainability coefficients to be established with FAO, GEOSS

Adjustment of national accounts aggregates:
Adjusted Real Income: from Ecosystem Capital Consumption & Non-renewable Assets Depreciation
- Ecosystem Capital Consumption
- User Cost for non-renewable resource only

Final Consumption at Full Cost: only Ecosystem Capital Consumption
Imports and Exports at Full Cost: only Ecosystem Capital Consumption
Change in Liabilities and Financial Assets: only Ecosystem Capital Consumption (and Improvement).

Annex 1: Ecosystem accounting framework: relations between tables

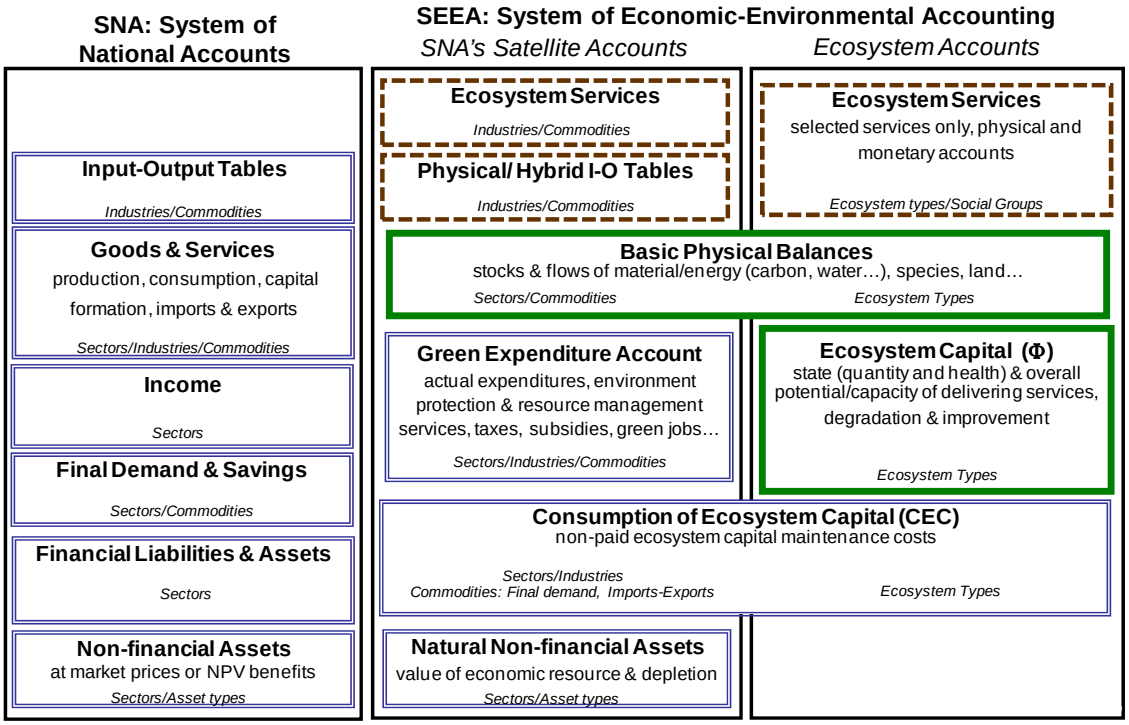


(Presented to the UN London Group[19])

[19] Weber, J.-L., Land & ecosystem accounts in the SEEA revision. Position paper for the London Group meeting, Brussels, 29 September-3 October 2008
http://unstats.un.org/unsd/envaccounting/londongroup/meeting13/LG13_25a.pdf

Annex 2

National, satellite and ecosystem accounts



Adjustment of national accounts for ecosystem depreciation