Expert Meeting on Ecosystem Accounts

5 - 7 December 2011, London, UK

ISSUE 2: Structure of accounts

Issue paper on an experimental framework for simplified ecosystem capital accounts

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Introduction

1. At the end of 2009, the EEA launched an experimental project 'fast-track implementation of simplified ecosystem capital accounts' for Europe — 'fast-track' because of urgent and recurrent policy demands and 'simplified', because full details are not necessary at the macro supra-national level. The approach adopted is top-down, based on Europe-wide datasets and statistics but, as far as possible, data and statistics are compiled at the level of the standard European 1km² grid. The use of the grid is justified by requirements to understandchange detection, and the flexibility needed to report in terms of different geographical units (e.g. regions, river basins, coastal zones).

2. The approach also anticipates the forthcoming expected links with accounting applications at the national level being driven by EU policy processes such as resource efficiency and biodiversity conservation. Such applications are coming from national initiatives and regional research projects focussing on specific areas including, in particular, the complete Mediterranean and Black Sea coastal zones.

3. The test is being carried out with existing monitoring data and socio-economic statistics, with the aim of supplying annual updates and retrospective time series. Boththese elements are essential when considering the policy applications of ecosystem capital accounts jointly with main macro-economic tools..

4. Physical accounts are being developed and computed first; the valuation of costs and benefits is still at an exploratory stage. The framework developed for simplified ecosystem capital accounts in Europe[1]serves asan input to the current preparation of SEEA volume 2.

[1] Weber, J.-L., 2011, An experimental framework for ecosystem capital accounting in Europe, EEA Technical report No 13/2011, European Environment Agency http://www.eea.europa.eu/publications/an-experimental-framework-for-ecosystem
Detailed tables with mock-up data can be downloaded from: http://eea.eionet.europa.eu/Public/irc/eionet-circle/leac/library?l=/cube/ecosystem_23sept2011xls/_EN_1.0_&a=d

5. The purpose of developing ecosystem capital accounts is to assess the sustainability of the economy-ecosystem interaction from the standpoint of nature, to measure the state of the ecosystems, and, when degradation is observed, to calculate the costs of avoiding damage, or of rectificationand compensation. These can all be regarded as measurements of ecosystem capital depreciation or 'consumption' (in the SNA sense). In such a setting, physical accounts provide a measure of the physical constraints that cannot be surpassed by the economy without causing damage to human communities and the economy itself.

6. Approaching the ecosystem as a capital means that assessments will be made of their capacity (capability, potential) to deliver services either to the economy –part of which is entangled into commodities and estates market value and another part which is used as free externalities – and/or directly to human well-being. Such assessments must consider the present situation as well as the future. It means that when the present consumption of ecosystem services exceeds the surplus accessible for human needs without compromising ecosystem reproduction, it translatesto consumption of ecosystem capital or in physical terms degradation of the ecosystem's potential to deliver services in the future.

7. Ecosystems are multi-functional. They capture solar energy and precipitation and deliver food, materials, energy, fresh water and a range of systemic services. These cannot be simply measured by additive units of weight, volume or energy, but require indirect measurement based on the surface covered, the good state of the ecosystem which may supply them and the access of people to such services. All these services matter and ecosystem assessment should reflect their overall performance. This is why ecosystem accounts are necessary. For example, the economy will assess the ecosystem as resource or asset for making economic benefits. However, as these benefits are being made, for example, by growing crops and not by maintaining wild flora, a contradiction may occur in ecosystem management with regard to maintaining biodiversity. Ecosystem accounts therefore cannot be built partially or on top of only one ecosystem service. They cannot either encompass the complete scope of all possible services (at least in present times). Therefore a model of the whole issue has to be sketched, and its capacity to represent the essential variables and interactions tested with real data.

The narrative behind Simplified Ecosystem Capital Accounts (SECA)

8. Ecosystems can be described as a capital which delivers a bundle of services to people, some of which are appropriated and incorporated into products, accumulated and/or consumed. Other services are public goods of common benefit to the economy and human wellbeing. Altogether, these ecosystem services depend on ecosystem capital regeneration which is in turn influenced by ecosystem services consumption.

9. In the **simplified accounts** three groups of ecosystem services are considered:

- Accessible biomass/ carbon,
- Accessible water, and
- Accessible regulating and cultural services.

10. For land ecosystems, the accounts are built up on land cover accounts. Land cover accounts record firstly stocks of land cover by land cover classes and the flows of consumption and formation which take place between two dates. Secondly, they record and map land cover stocks in derived values which express the local importance of each stock in its

neighbourhood (e.g. the pressure of a city outside of its own limits). The addition of neighbourhood values allows calculating aggregates such as the green landscape index[2].

11. Accessible in this context refers to the share of the 'total' or 'available' resource which can be used without damaging ecosystem capital capacity. All three groups of services are generally produced (in variable proportions) by all ecosystems. Accessible biomass/carbon and water together make up 99 per cent of all 'provisioning services' as described in the Millennium Ecosystem Assessment (MA) or Common International Classification of Ecosystem Services (CICES) classifications of ecosystem services. Biomass/carbon and water are recorded in formal balances.Regulating and cultural services are measured indirectly on the basis of the ecosystem's capacity to deliver them which relates in particular to the extent and integrity of landscape green infrastructure and to species biodiversity.

12. For each of these broad groups, biomass/carbon, fresh water and systemic services, the amount of services which can be used must be lower than the accessible surplus, which means that in terms of sustainable development there should not be significant trade-offs between them.

13. **The primary ecosystem service is production of biomass** which can be generated and withdrawn (by agriculture, forestry, fisheries, etc.) up to a surplus which takes into account nature's own reproductive needs. The surplus corresponds to the current 'food of biodiversity' and the maintenance of bio-carbon stocks in soil and perennial vegetation, which is required if the ecosystem is to be self-sustaining.

14. Production of biomass must also be compatible with the maintenance of **accessible water resources** (e.g. limits to irrigation) and the bundle of services supplied by the **green landscape infrastructure**. Similarly, water can be abstracted only up to an accessible surplus, to ensure the good functioning of the water cycle, as well as biomass production, and the needs of landscapes and biodiversity; for example, a new reservoir destroys previous ecosystem functions, over-dimensioned irrigation infrastructures create risks of agricultural shortages in years with rainfall deficit. The development of landscape services may result in the reduction, for example, of biomass production because of subsequent falling yields — which will be recorded in the carbon/biomass account.

15. **'Accessible'** means that not all the available resource can be used because of physical constraints (a large part of the aquifers, flood water greater than needed for reservoirs replenishment), inappropriate location or timeliness, inappropriate quality, and because part of the annual service flow has to be left to the ecosystem for its own needs. In the case of services supplied by green landscape infrastructure, accessibility is dependent on the population which can access it and the inverse of landscape artificiality (including urban areas where most of the population on Europe lives). The concept of resource accessibility is particularly important regarding the demand for ecosystem services and the definition of robust indicators with clear definitions of the limits of sustainable use. Such indicators implemented at the appropriate scale can be associated with population data, considerably increasing their usefulness for policymaking.

16. Figure 1 summarizes the sequence of accounting tables. The left column presents details by ecosystem units (Land Cover Functional Units, Socio-Ecological Landscape Units and their grouping) while right column presents details by economic units (Industries and Institutional

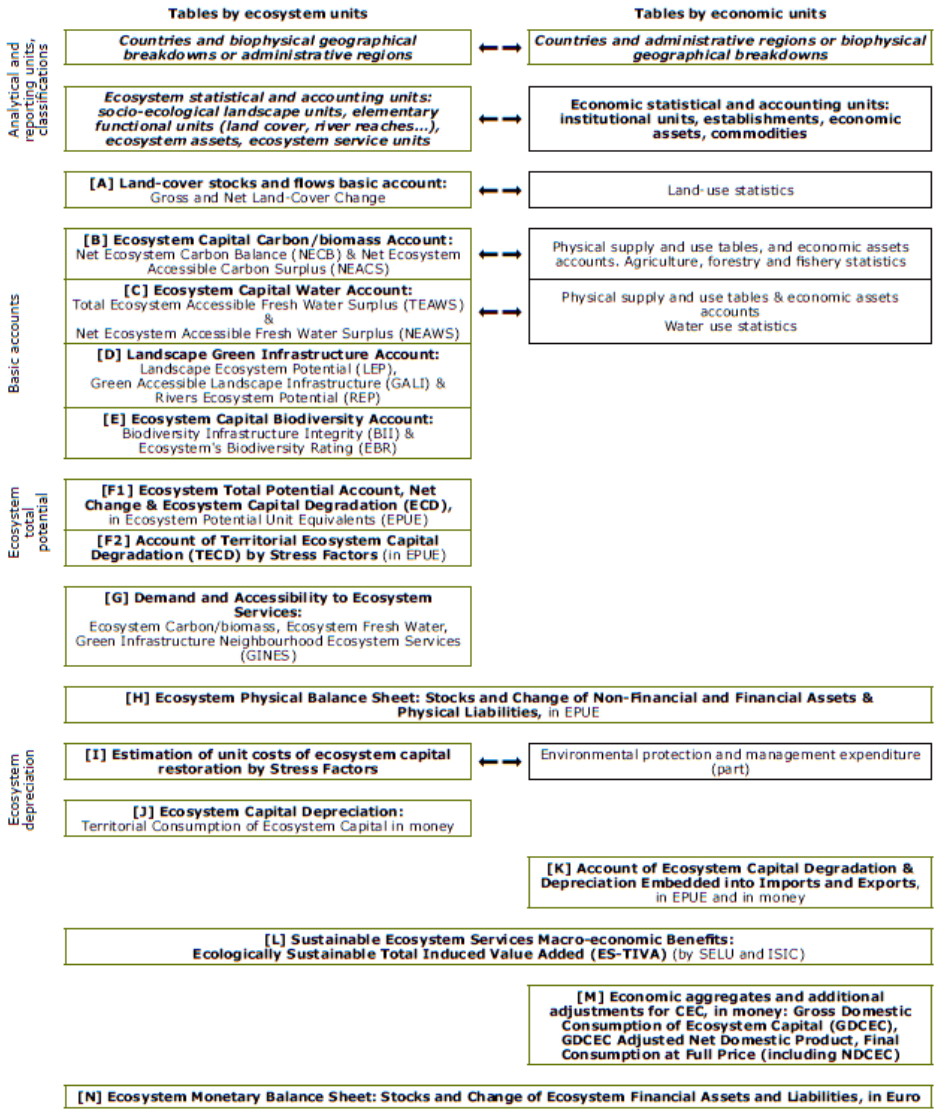
[2] Methodologies are described and documented in Haines-Young, R. and Weber, J.-L., 2006, *Land accounts for Europe 1990*-2000, *Towards integrated land and ecosystem accounting,* EEA Report No 11/2006, European Environment Agency. http://www.eea.europa.eu/publications/eea_report_2006_11

Units). When items by economic units are covered in the SEEA Volume 1, SECA simply bridges to the appropriate balancing tables.

Questions:

1. Is the simplification proposed acceptable as a starting point? Are there important missing elements which absence may bias accounting results? Nitrogen? Others?
2. How does this framework fit with the assets description in volume 1?
3. How does this framework fit with or differ from other frameworks or structures?

Figure1 Simplified ecosystem capital accounting structure (SECA)



Aggregates for ecosystem capital accounts in physical units

17. The calculation of **Total Ecosystem Potential, Net Change in TEP and Ecosystem Capital Degradation** summarises the state of the ecosystem capital. Total inland, sea and atmosphere ecosystem potential measured in the basic balance in tonnes of carbon is weighted by a set of composite indexes which reflect the external factors that limit carbon accessibility: Ecosystem Accessible Water Surplus (EAWS), and Ecosystem Systemic Services

Integrity (which combine Landscape Ecosystem Potential (LEP), River Ecosystem Potential[3](REP) and Ecosystem Biodiversity Rating (EBR).

18. It results in a new measurement unit called **EPUE** for **Ecosystem Potential Unit-Equivalent**. EPUE is a composite index which measures the ecosystem potential to deliver biomass/carbon under sustainability constraints of 1) accessible carbon itself, 2) accessible fresh water and 3) accessible systemic services. 100 EPUE is the value given to an ecosystem rating 100 for each of its 3 components[4].

19. Gain in EPUE means positive effects of restoration programmes and/ or natural improvement, loss means degradation by activities and/or natural disturbance. Particular attention is given to the calculation of **Ecosystem Capital Degradation (ECD)** which is the result of economic activity and will be used in a subsequent step to calculate ecosystem capital depreciation. Ecosystem capital degradation is for that purpose analysed in a special table according to the stress factors that have caused it: land-cover change, restructuring/de-structuring of landscapes and rivers, over-exploitation of biological resources, waste disposal, and pollution. It is then possible to calculate, factor by factor, the cost of restoring one unit of EPUE. Depending on the ecosystems and issues being considered, costs will reflect reductions in yields, abatement of pollution (including GHGs), and programmes such as the replanting of hedgerows and reforestation. In the accounts, cost calculations are based on observed practices not on individual preferences.

From ecosystem capital degradation to consumption

20. Consumption of Ecosystem Capital is similar to Consumption of Fixed Capital (CFC) and should be treated in a similar way as a deduction when shifting from Gross Domestic Product to Net Domestic Product or Net National Income. Another approach is to consider that, unlike CFC, which is included in the value of economic assets and therefore transferred to the value of commodities, CEC is not paid. This means that CEC is not included in the purchaser price of Final Consumption, nor in Imports and Exports. This major price distortion can be corrected by adding up the unpaid CECs to calculate Final Consumption, Imports and Exports at Full Cost. This would not require changing the conventional calculation of GDP, the CEC price adjustment being balanced by an appropriate recording of ecological debts.

21. The proposed way of calculating ecosystem capital degradation (or CEC) diverges from dominant economic theory which defines depreciation as a loss in asset value which is equivalent (in the absence of reliable market prices for assets, which is generally the case for natural capital) to the discounted net expected future benefits (net present value). The difficulty of the latter method at the macro scale is that it implies assessment and valuation of all individual services provided by the multiple functions of ecosystems and their aggregation without double counting. There is no evidence so far that this conventional method, implemented successfully in many case studies, can be used for national accounting. The proposed approach, which combines physical degradation and restoration costs, is probably just a surrogate for the one prescribed by economic theory, but its implementation seems feasible.

[3] In the case of rivers, the potential is equivalent to exergy (or accessible energy regarding water position or potential, itsconcentration in various substances and other elements such as temperature or speed — see Valero, 2006), measured in energyunits.

[4]The best way to weight the 3 components is currently tested. Whatever arbitrary is the adopted solution, it ahs to remain transparent and allow sensitivity tests. The current assumption is that measurement of change being the primary objective, a systematic bias in weighting stocks should not too much the reliability of ECD measurement.