Ecosystem Capital Accounting: 
towards a fast track implementation in Europe

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European Environment Agency 
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“Because National Accounts are based on financial transactions, they account for nothing 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 1968

“The same rule of self-destructive financial calculation governs every walk of life. We destroy the beauty of the countryside because the unappropriated splendours of nature have no economic value. We are capable of shutting off the sun and the stars because they do not pay a dividend.” John Maynard Keynes 1933
Recurrent policy demands

**Environmental performance of the economy**
Decoupling from resource use and generation of residuals
Decoupling from impacts

**Cost of meeting targets**
Water Framework Directive ➔ “full recovery of costs”
EU Climate change programme ➔ carbon emission offset costs
Environmental Liability Directive ➔ remediation costs of impacts
Natura2000 (as application of ELD 2004): restoration or replacement of degraded sites ➔ costs

**Supplement GDP**
“GDP and Beyond” ➔ dashboard of pressure indicators + basket of impact indicators
“Stiglitz/Sen/Fitoussi” report ➔ focus on Income (underinvestment) and Consumption 9overconsumption)
TEEB (G8+5 initiative, UNEP, CBD) ➔ benefits from ES + ecosystem capital accounting
These policy demands address both SNA and the SEEA which has been created to help in that respect when coming to environmental and SD issues.
Future of National Accounts - from Data and Statistics to Aggregates and Communication

Core SNA Accounts

Not so easy to move things regarding data collection and the framework.

What matters for policy people is the top…

JLW from W. Radermacher's presentation at Eurostat National Accounts Conference 2009 “Reading the Present to Prepare the Future”, Brussels, 16 September 2009
National Accounts “deficit”: Core and “Satellite” Accounts at the Same Level

Core SNA Accounts

- Data, Statistics
- Framework
- Sets of indicators
- Aggregates

“Satellite” Accounts – e.g. SEEA

- Data, Statistics
- Framework
- Sets of indicators
- Aggregates

//, %, f()
National Accounts “deficit”: Core and “Satellite” Accounts at the Same Level

Core SNA Accounts

“Satellite” Accounts – e.g. SEEA

Common Aggregates of Income & Consumption

/\, %, f()
Make it happen?

Be outcome oriented
Working with existing data and statistics
Time matters
Space matters
Simplified framework
Make it happen? Make it simple! : a “Cubist” Approach

Depreciation of Ecosystem Capital = Change in TEP * €

No valuation of ecosystem services or assets is needed
In the tool box: innovative methodologies

Multi-criteria rating

Mean statistics:
unitary
remediation costs extracted
from statistics on
environmental protection and
management expenditure

Traceability of products
<table>
<thead>
<tr>
<th>Expenditure accounts</th>
<th>Sectors</th>
<th>Basic physical balances</th>
<th>Services</th>
<th>Spatial Units</th>
<th>Health counts</th>
<th>Indexes</th>
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</thead>
<tbody>
<tr>
<td>Maintenance/ Restoration Costs</td>
<td>mean €</td>
<td>Ecosystem capital depreciation</td>
<td>$\Phi$ degradation</td>
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<tr>
<td>Change in Total Ecosystem Potential</td>
<td>European Environment Agency</td>
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<td>Implementation priorities</td>
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<td>Land protection &amp; management</td>
<td>Water protection &amp; management</td>
<td>Carbon/biomass Protection &amp; management</td>
<td>Biodiversity protection</td>
<td>Health protection</td>
<td>Agriculture &amp; fishery subsidies</td>
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<tr>
<td>Water resource, supply &amp; use</td>
<td>Carbon/biomass resource, supply &amp; use</td>
<td>Fishing, hunting, harvesting of wild species (non cultivated)</td>
<td>LCA: impacts of chemical, on human and wildlife health</td>
<td>Virtual land, water, and carbon use (domestic and in imports)</td>
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<tr>
<td>Land Use (surfaces &amp; commodities)</td>
<td>Water bodies resource &amp; abstraction</td>
<td>Carbon/biomass resource and extraction/harvesting</td>
<td>Natural and semi-natural habitats &amp; species distribution</td>
<td>Distribution of critical areas for health</td>
<td>Water, C, energy, NPK, subsidies</td>
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<tr>
<td>Land functions &amp; ecosystem services</td>
<td>Carbon/biomass functions &amp; ecosystem services</td>
<td>Biodiversity related ecosystem services</td>
<td>Human morbidity/environment &amp; food security</td>
<td>Dependency from regulating ecosystem services</td>
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<td>Land cover stocks &amp; change</td>
<td>Carbon/biomass productivity</td>
<td>Ecosystem health factors</td>
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<td>Water quantity &amp; quality</td>
<td>Biodiversity factors</td>
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<td>Landscape patterns</td>
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Integration of carbon accounts

<table>
<thead>
<tr>
<th>Ecosystems</th>
<th>Economy</th>
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<tr>
<td><strong>PHYSICAL BALANCES</strong></td>
<td><strong>USE OF ECOSYSTEM RESOURCE</strong></td>
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<tr>
<td>Stock</td>
<td>Extraction/ harvesting</td>
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<tr>
<td>Natural production</td>
<td>Returns/ Formation (sectors)</td>
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<td>Natural consumption</td>
<td>Final Consumption (sectors)</td>
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<td>Storage/Accumulation</td>
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<tr>
<td>Stock</td>
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<tr>
<td><strong>QUALITY/HEALTH INDEXES</strong></td>
<td><strong>USE OF FOSSIL RESOURCE</strong></td>
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<tr>
<td>Vigour</td>
<td>From resource</td>
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<td>Stability, integrity</td>
<td>From fossil resource</td>
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<tr>
<td>Resilience</td>
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<tr>
<td><strong>LINKAGE TABLES</strong></td>
<td><strong>EMISSIONS, RESIDUALS</strong></td>
</tr>
<tr>
<td>To land accounts</td>
<td>From resource</td>
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<td>To water accounts</td>
<td>From fossil resource</td>
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<td>To biodiversity indexes</td>
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<td><strong>EXPENDITURES</strong></td>
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<td>Taxes, voluntary payments</td>
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<td><strong>IMPORTS-EXPORTS</strong></td>
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<td>Actual</td>
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<td>Virtual (embedded)</td>
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### Ecosystem Asset Account

**Bio-C balance**

**Opening stocks by ecosystems**
- Formation of bio-C (Net Ecosystem Production)

**Final stocks by ecosystems**
- Withdrawals by activities
- Net transfers between ecosystems
- Returns from activities
- Imports/Exports
- Storage in the user system
- Consumption/combustion of bio-C

**Changes due to natural & multiple causes**
- In situ bio-C storage

### Accounts & Indexes:

**Carbon/Biomass Ecosystem Accounts**

**Sector Accounts**

*(Supply & Use, MFA, NAMEA, Expenditures)*

**Consumption of C / Emissions of CO₂ CH₄**
- Consumption/combustion of bio-C
- Combustion of fossil fuel
- CO₂/CH₄ emissions

**Net Carbon Offset Expenditures**
- C taxes and subsidies
- Net purchase of C permits

**Virtual C embodied in Import-Export**
- Virtual C by products

### Ecosystem C-Productivity Counts

- NPP trends
- NPP perturbation
- Change in NPP profiles

### Linkage table

- Landscape ecological potential
- Water availability (quantity*quality)
Mean NPP of vegetation (2000 - 2008)
Trends in NPP and cumulated annual change 2000-2008
Need for thematic integration of bio-carbon accounts with land, water & biodiversity

Example from southern Spain: NPP increase in dry region

- Much of the increased NPP in semi-arid Spain is due to new irrigations (water taken from fossil reservoirs or directly taken from nature/rivers …)
- And so more NPP brings also some functional simplification of the ecosystem
- If such causal relations exist they should be reflected in some “biodiversity account” (but the species responses are usually delayed due to nature’s buffering capacity) (from Emil D. Ivanov, EEA-ETC LUSI)
Fast track implementation of ecosystem accounts in Europe by 2011

- Dual accounts of Ecosystems (EEA) and Economy (Eurostat)
- 4 priority areas: Carbon [C], Land [L], Water [W] & Biodiversity [B]
- Deadline 2011 with intermediate delivery by Sept. 2010 (Post-Copenhagen, Biodiversity Year, CBD COP10)
### Ecosystem Asset Account

**Land cover balance**

**Opening land cover stocks by ecosystems**

- LCF1 Urban land management
- LCF2 Urban residential sprawl
- LCF3 Sprawl of economic sites and infrastructures
- LCF4 Agriculture internal conversions
- LCF5 Conversion from other land cover to agriculture
- LCF6 Withdrawal of farming
- LCF7 Forests creation and management
- LCF8 Water bodies creation and management

- LCF9 Changes of Land Cover due to natural and multiple causes
  - Change in land cover (formation - consumption)

**Final land cover stocks by ecosystems**

- LCF1 Urban land management
- LCF2 Urban residential sprawl
- LCF3 Sprawl of economic sites and infrastructures
- LCF4 Agriculture internal conversions
- LCF5 Conversion from other land cover to agriculture
- LCF6 Withdrawal of farming
- LCF7 Forests creation and management
- LCF8 Water bodies creation and management

### Sector Accounts

**(Supply & Use, MFA, NAMEA, Expenditures)**

**Land use** (main use, ha + tons + number of units)

- Agriculture (by crop types)
- Forestry
- Infrastructure, transport
- Economic activities
- Residential

### Landscape Ecological Potential

- Green Landscape Index
- Landscape nature value
- Landscape fragmentation

### Linkage table

- Carbon/Biomass productivity & storage
- Water availability (quantity*quality)

### Accounts & Indexes:

**Land Ecosystem Accounts**

- Carbon/Biomass productivity & storage
- Water availability (quality)

**Landscape Protection and Management Expenditures**

- Taxes and subsidies
- Investments

**Virtual land embodied in Import-Export**

- Virtual land by products

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**LCF = Land Cover Flows, as in EEA Land Cover Accounts 2006 report**

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**European Environment Agency**
Corine land cover map (CLC is derived from satellite images)

Green Landscape Index (derived from CLC)

Nature Value (Naturilis, derived from Natura2000 designated areas)

Fragmentation (Effective Mesh Size (MEFF) derived from TeleAtlas Roads and CLC)

Land Ecosystem Account: Landscape Ecological Potential

Landscape Ecological Potential (LEP) 2000, by 1km² grid cell

LEP 2000 by NUTS 2/3

European Environment Agency
DLT Forested landscape:
Cumulative difference NPP 2000 - 2008

Change in C sequestration (gC/m²/yr)
NPP * Intensive agriculture * Bio-geographic regions

DLT Broad pattern intensive agriculture:
Cumulative difference NPP 2000 - 2008

Change in C sequestration (gC/m²/yr)
**Ecosystem Asset Account**

*Water balance*

- Opening stocks by ecosystems/water bodies
  - Precipitations
  - Natural Inflows
- Withdrawals by activities
- Net transfers between ecosystems/water bodies
- Returns to the water system from activities
- Imports/Exports and return to the sea
- Storage in the user system
- Consumption/evaporation in the use system

- Real evapotranspiration
- Changes due to natural & multiple causes
- Natural outflows

*Final stocks by ecosystems/water bodies*

**Ecosystem Water Quality Accounts**

- Water net availability
- Water bio-chemical quality
- Ecological quality of river basins

**Linkage table**

- Landscape ecological potential
- Carbon/Biomass productivity & storage

**Accounts & Indexes:**

Water Ecosystem Accounts

**Sector Accounts**

*(Supply & Use, MFA, NAMEA, Expenditures)*

- Withdrawals by activities
- Net transfers between ecosystems/water bodies
- Returns to the water system from activities
- Imports/Exports and return to the sea
- Storage in the user system
- Consumption/evaporation in the use system

*In situ water usage*

- Returns of waste water
- Storage in dams
- Rainfed agriculture
- Evapotranspiration by irrigation

**Water Protection and Management Expenditures**

- Taxes and subsidies
- Purchase of water
- Investments

**Virtual water embodied in Import-Export**

- Virtual water by products

**European Environment Agency**
Water accounts meeting WFD requirements

**PHYSICAL ACCOUNTS**

- Water use
- Degradation of water quality
- Impacts on ecosystems

**MONETARY ACCOUNTS**

- Cost of water supply including sewage & treatment (service) - CWS
- Cost for mitigating impacts of use over water bodies - CMI
- Cost of ecosystem restoration - CER

**Full recovery of water costs of the WFD = CWS + CMI + CER**

*Cost of the “effective measures” for meeting the objective of the WFD considered in the Program me of Measures of River Basin Management Plan*

JLW adapted from: Joan Escriù, Jose Manuel Naredo, Antonio Valero 2007
Virtual Land Use & Agriculture Footprints in Imports-Exports

Net virtual land use between EU and major trade partners

Ecosystem services

Physical accounts at the macro and micro levels
Valuation on a case by case basis
Work on CICES
Fast track implementation: as simple as possible, as accurate as necessary

Based on QA/QC existing monitoring data and statistics

- Mine/sample monitoring networks (space, in situ…)
- Verification, counter-expertise to be considered from the start because of foreseeable use in policy making, legal cases, money allotment
- Joint use with National Accounts
- Extensive use of statistics: agriculture, demography, transport, energy, trade…

Spatially explicit

- Hot issues not concealed within national average values
- Acceptability of global messages by local stakeholders
- Relevant geographical units: countries, regions + catchments, socio-ecological systems
- Standard EU 1 km² grid as a tool for geographical integration
- Consider EU within the Global Environment

Time relevant

- Hot issues not concealed within annual average values: work from frequent monitoring when necessary
- Results delivered in time for policy making: at least for annual budgetary debates
- Nowcasting is part of the quick start package (e.g. EEA “QuickScan” tool)
2 approaches to ecosystem economics:
*maximisation of benefits* (the **financial value of nature**) vs. maintenance of options (the **quantity*quality of nature**)

- **Maximisation of benefits from nature** → measurement of benefits & losses (e.g. TEEB’s COPI study) or of ecosystem services value entangled into commodities or real estates (WB current proposal for SEEA revision). Requires measurement and **valuation of ecosystem services & ecosystem assets**. Ecosystem depreciation calculated as the difference in ecosystem asset values at two dates. Accounting prices: depends on services and purposes (market prices, production functions, contingent values, assets as NPV of future benefits = financial approach) → relevant for planning, project impacts assessments (CBA).

- **Maintenance of options** (ecosystems potential of delivering services) → measurement of ecosystem capital degradation in physical units (quantity*quality) & **valuation limited to (non-paid) remediation costs**. Equivalent to the calculation of capital maintenance cost (Consumption of Fixed Capital). **No valuation of ecosystem services nor of ecosystem assets**. Accounting prices: derived from observed remediation costs (statistics) → relevant for National Accounts, as well as for business accounting (options and risks)… and for CBA in addition.
“Economic Theory”: asset value = financial value = NPV of expected future benefits

Financial value of natural assets = “Net Present Value” of expected future benefits

= NPV

If surveys or econometric models tell how much homo economicus is willing to pay for ecosystem services, there is no need to monitor Nature!
Ecosystem capital account: asset “quantity*quality”

\[
\phi \rightarrow \phi \
\Phi \leftarrow \Phi
\]

Degradation

\[\text{Purchaser price} + \text{Remediation cost} = \text{Final Consumption at the full cost}\]
Ecosystem Accounting: Green National Accounts and Costs-Benefits Analysis

National Accounts = the macro-economic picture adjusted for natural capital depreciation

Benefits & Costs Assessments = extended accounts for projects, sectors...

Ecosystem public good protection (all services)

Ecosystem Stocks & Flows
- Land cover
- Biomass/Carbon
- Soil
- Species/populations
- Water catchments
- Sea
- Atmosphere

Ecosystem Health
- Vigour
- Organisation
- Resilience
- Autonomy
- Support to healthy populations

Ecological Tax or/and Tradable Offset Certificates (fair use of ecosystem public good)

Operation costs E.S n
Operation costs E.S 5
Operation costs E.S 4
Operation costs E.S 3
Operation costs E.S 2
Operation costs E.S 1

Ecosystem Services values
- Bottom-Up, Individual preferences, Costs-Benefits Analysis
- Market and Shadow prices, General equilibrium modelling

European Environment Agency
Consumption of Natural Capital & Adjustment of National Accounts for “under-investment” ⬇️ and “over-consumption” ➔

\[
\text{Final Consumption at Full Cost of Goods & Services} = \text{Final Consumption at Purchaser’s Price} \\
+ \text{Depreciation of (domestic) Ecosystem Capital} \\
+ \text{Virtual Consumption of Ecosystem Capital in Imports (minus in Exports)} \\
- \text{Consumption of Fixed Capital} \\
- \text{Depletion of Sub-soil Assets} \\
- \text{Transfers with the Rest of World}
\]

\[
\text{Gross Domestic Product} = \text{Gross National Income} \\
\text{Gross National Income} = \text{National Income (NI or NNP)} \\
\text{National Income (NI or NNP)} = \text{Gross National Income} - \text{Consumption of Fixed Capital}
\]
[future] Integration with National Accounts aggregates

**Environment**: alleviation/mitigation of nature degradation

- Consumption of Material/Energy GDP
- Consumption of Ecosystem Capital GDP

**Economy**: capital maintenance

- Adjusted Disposable National Income
- National Income
- Ecosystem Adjusted Net Savings
- Net Savings
- Domestic + Foreign Ecological Liability
- Domestic + Foreign Ecological Financial Assets

**Sustainable Development = Thriving ecosystems producing altogether:**
- economic resources
- carbon
- biodiversity
- clean air, clean water
- options for the future ("development as freedom" – A. Sen)

**Social**: sustainable consumption, new skills and jobs
Integration within SNA/SEEA framework

Natural capital / assets

Subsoil Assets [stocks]

Material & Energy Flows

I-O Tables / NAMEA

Ecosystem Capital [stocks, flows, services and health]

Residuals

Ecosystem Functional Services

Ecosystem Mean Remediation Costs

Ecosystem Remediation Costs in Imports (less in Exports)

Rest of the World

Physical flows

Monetary flows

Natural Capital Depreciation

SNA flows, assets & adjusted aggregates

Environmental Expenditures, Taxes

Subsoil Assets [stocks & flows]
SNA extension vs. interacting systems

G. Questions to the London Group

Q1: Do you agree that the classification of assets presented in Volume 1 should take the economy as the system of reference and thus structure the classification as an extension to the 2008 SNA asset classification?

Current proposal

Figure 2. Schematic presentation of the coverage of the classification

- Fixed assets
- Inventories (excluding cultivated biological resources)
- Natural resources
- Cultivated biological resources
- Land
- Water resources
- Uncultivated biological resources
- Soil resources
- Mineral and energy resources
- Contracts, leases and licenses
- Stock of ecosystem services such as regulatory services, including biodiversity, protection, carbon sequestration, etc. (to be developed on the basis of ecosystem classification)

What is a stock of services in physical units???

Complete environment asset accounts exist only in money

SNA asset classification revamped

Valuation: Depletion + “Stocks of ecosystem services” to be surveyed (WTP) or disentangled within market prices (commodities, real estates…)

Complete environment asset accounts only in physical units

SNA asset classification untouched

Valuation:
- ecosystem: only (non-paid) remediation costs
- subsoil: income maintenance cost
Ecosystems: why resource depletion **should not** be separated from degradation...

Extract from a paper in Financial Times of 26 Nov. 2009 explaining why banks should get inspiration from ecosystems...

“Fisheries management has interesting parallels with financial regulation, says Lord May. For the past 50 years fish stocks have been managed on a species-by-species basis that aims to maximise the “sustainable yield” of individual fish such as cod or herring – an approach analogous to regulatory risk analysis that focuses on individual banks. But with the collapse of some important fishing grounds, marine scientists are coming to recognise that what really matters is the wider ecosystem and environmental context. You cannot protect cod, for example, without considering the sand eels, whiting, haddock, squid and other species on which cod feed.”