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Accounting for soil in the SEEA

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ACCOUNTING FOR SOIL IN THE SEEA

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Soil is just mentioned per memory in the SEEA2003.

Soil is an ecosystem and a natural capital. It is a slowly renewable resource in many cases, a non renewable in extreme conditions. As an ecosystem, soil can be described by stocks of components, resilience (stress and distress), functions and services. Soil has an economic value associated to land use. Other soil services benefit to people out of any production process. The maintenance costs of soils are well known by agronomists.

Stocks, threats and resilience of soils

Stocks of soil can be measured inclusively as a complex material described by soil typology. It can be measured as well for each main components: minerals, biomass, Carbon, Nitrogen, Phosphorus, Potassium (N, P, K, the 3 main fertilizing elements), fauna, flora and water.

The resilience of soil is its capacity of regenerating after stress. When traditional agriculture in Europe , made of small farming combining cultivation and husbandry generated rich soils, intensive practices have lead directly or indirectly to various types of soil degradation. At the same time, towns, generally settled in food-rich areas are sprawling over the best soils which make their neighbourhood. The concern is serious all over the World, made worse now by climate change or new perspectives of intensification for agro-fuels production. In Europe, it has lead to an attempt of defining a soil strategy which addresses the issues detailed in the following box:

Over the last few decades, there has been a significant increase in soil degradation processes. These processes are likely to further accelerate if nothing is done to protect soil.

- **Erosion**: 115 million ha (12% of Europe’s total land area) are affected by water erosion and 42 million ha are affected by wind erosion, 2% of which are severely affected.
- **Organic matter decline**: Around 45% of soils in Europe have low or very low organic matter

content (0-2% organic carbon) and 45% have a medium content (2-6% organic carbon). Organic matter decline is an issue in particular in Southern Europe but parts of France, the United Kingdom, Germany, The Netherlands and Sweden are also concerned.

- **Compaction**: estimates of risk areas vary between 36% and 32% of European subsoils being very vulnerable and 18% moderately so.
- **Salinisation** - around 3.8 million ha in Europe are affected by the accumulation of soluble salts. The most affected areas are Campania in Italy, the Ebro Valley in Spain and the Great Alföld in Hungary.
- **Landslides** tend to occur more frequently in areas with clayey sub-soil, steep slopes, intense and abundant precipitation and land abandonment, such as the Alpine and the Mediterranean regions.
- **Contamination**: approximately 3.5 million sites may be potentially contaminated. 0.5 million sites are expected to be really contaminated and need remediation.
- **Sealing**: the area of soil surface covered with an impermeable material represents around 9% of the total area in Member States. Between 1990 and 2000, the sealed area in EU15 increased by 6% and the demand for both new construction and transport infrastructures due to increased urban sprawl continues to rise.

Soil functions and ecosystem services

As soil is the main substrate for land ecosystems, including agro-ecosystems (“fertility”) and urban systems (“carrier function”), it is often only described as an attribute of land, which influences land price (the SNA solution).

Functions of soil are multiple. “The following functions are often mentioned: (a) the production function, producing crops; (b) the carrier function, bearing traffic and buildings; (c) the filter, buffer and reactor function, allowing transformations of solutes passing through; (d) the resource function, providing base material for industry; (e) the habitat function, providing a living environment for plants and animals and (f) the cultural and historic function, reflecting past practices.”[1]

To this list should be added [or isolated from (c)] (g) the climate regulating function, by storing organic and inorganic carbon and sequestrating soil organic carbon (SOC) and by regulating water storage and evapotranspiration.[2]

In terms of ecosystem services contributing to human wellbeing functions (a), (b) and (d) refer clearly to market commodities. Function (c) and (d) are partly internal to the ecosystem [not services as such] and partly a regulating services of collective use. Function (e) is a cultural service mostly not valued by production.

Focus on Carbon storage and sequestration by soil

A special focus should be put on (g), where major challenges are faced to-day. A few facts[3] help summarizing the question:

1 Johan Bouma, *Soils Functions and Land Use, in Soil: Basic Concepts and New Perspectives,* ed. Giacomo Certini and Riccardo Scalenghe, Cambridge University Press, 2006
2 See *Ecosystems and Human Well-being: Current State and Trends*, Millennium Ecosystems Assessment, 2005
3 Christine Jones, *The Soil Carbon Manifesto*, Carbon Coalition Against Global Warming

- The terrestrial biosphere currently sequesters 2 billion metric tons of carbon annually. (*US Department of Agriculture*)
- Soils contain 82% of terrestrial carbon.
- "Enhancing the natural processes that remove CO2 from the atmosphere is thought to be the most cost-effective means of reducing atmospheric levels of CO2." (*US Department of Energy*)
- "Soil organic carbon is the largest reservoir in interaction with the atmosphere." (*United Nations Food & Agriculture Organisation*) - Vegetation 650 gigatons, atmosphere 750 gigatons, soil 1500 gigatons
- The carbon sink capacity of the world's agricultural and degraded soils is 50% to 66% of the historic carbon loss of 42 to 78 gigatons of carbon.
- Grazing land comprises more than half the total land surface
- An acre of pasture can sequester more carbon than an acre of forest.
- “Soil represents the largest carbon sink over which we have control. Improvements in soil carbon levels could be made in all rural areas, whereas the regions suited to carbon sequestration in plantation timber are limited.”

The atmospheric carbon balance sheet looks like this:

Carbon flux into atmosphere (gigatons C/year)	
Fossil fuel burning	*4 - 5*
Soil organic matter oxidation / erosion	*61 - 62*
Respiration from organisms in biosphere	*50*
Deforestation	*2*
Movement of C out of atmosphere (gigatons C/year)	
Incorporation into biosphere through photosynthesis	*110*
Diffusion into oceans	*2.5*
Overall Annual Net Increase in Atmospheric Carbon	*4.5 - 6.5*

“Sequestering carbon in the soil represents about 89% of the mitigation potential. The most prominent options are improved management of crop and grazing lands (e.g. improved agronomic practices, nutrient use, tillage and residue management), restoration of organic soils that are drained for crop production, and restoration of degraded lands. Lower but still significant reductions are possible with improved water and rice management; set-asides, land use change (e.g. conversion of cropland to grassland) and agro-forestry; and improved livestock and manure management.”[4]

Discussions on carbon credit trading system for farmers should benefit from soil accouting.

<u>Soil and water</u>

Soil humidity is essential for vegetation. Wet soils are generally the most productive of biomass. However, hydromorphic soils handicap agriculture and are drained. Deficit in soil humidity during the growing season of plants is compensated by irrigation, with the risk of salination in the beneficiary areas or/and of drying out of soil and wind erosion in the supply areas. The Aral sea ecological disaster illuminates the point. Water is as well responsible of a large part of soil erosion, which is worsened and even generated by inappropriate land use practices such as deforestation in tropical or/and mountain regions, long periods of bare soils or/and mechanical cultivation of very large fields.

4 UNEP's press release, Bangkok, 4 May 2007

The SEEAW assets accounts presents a column for “soil”. This linkage will have to be detailed with the implementation of soil accounts.

Soil biodiversity

Soil is probably one of the more species-rich habitats of terrestrial ecosystems, especially if extending the definition of soils to related habitats like vertebrate faeces, decaying wood, humus of hollow trees. The diversity of soil communities (sensu lato) thus probably encompasses a large part of terrestrial animal species.[5] Soil's fauna is certainly not the most fashionable but the functions it carries out are essential for biodiversity in general, i.e. for life.

Implementation strategy

Knowledge on soils in countries and international organisations, first of all FAO, is huge. To some extent the risk is to be lost in the many databases and maps developed all around the world – on the basis of non-harmonised methodologies.

Accounting for soil ecosystems is not aggregating these many databases. They are an essential input, but only an input. The way of doing is to structure the accounting framework starting from the analysis of ecosystem services. From this identification of services, descriptors of stocks and flows can be established – starting with a small number of them for which sufficient information. This exploration can start from the FAO portal on soil http://www.fao.org/AG/agl/agll/prtsoil.stm . Resilience, the stress and distress analysis will be carried out in the same way. The interpretation of resilience thresholds and the generalisation of soil accounts will involve the consideration of databases and maps.

Valuation of flows will be twofold:

- The valuation of the non-market end use ecosystem services, cultural and regulating, including climate regulation.
- The calculation of the full maintenance and restoration costs of domestic soils and the allocation to goods and services of an additional element when soils are not maintained
- The calculation of the full maintenance cost of imports

“Given the difficulty of measuring a change in productivity [of agriculture], it is common to estimate the damage to agricultural land as the cost of replacing lost nutrients by artificial fertilizer—although the fertilizer cost may exceed the value of crops produced.” [6] The advantage of the methodology is in its relative ease of implementation and is candidate for fast track applications. However, soil maintenance involves more than crop yields and the valuation should cover other services[7].

As an asset or natural capital, soil can be accounted in physical units. Valuing of the natural capital is not necessary at this stage for calculating services and costs. However, the value of soil has an interest per se, beyond the market prices which reflect mostly conflicts between short term uses (urban land being always manifold more expensive than cropland) but ignoring longer term values linked to soil conservation.

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5 Thibaud Decaëns, Juan José Jiménez, Christophe Gioia, Patrick Lavelle, *The values of soil animals for conservation biology*, European Journal of Soil Biology, Volume 42, Supplement 1, November 2006

6 ESA/STAT/AC.131 UNCEEA/2/12, *Issues Related to Valuation* - Paper prepared by the World Bank

7 e.g. purification of groundwater, impaired by excessive use of fertilizers on above fields.