SOILS4EU: SOIL ECOSYSTEM SERVICES

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Why Motivation and problem statement

The presented report provides the most comprehensive overview of soil ESS. All ESS included in this report meet the criteria of being goods or services that are provided by the ecosystem, used by humans, and contributing to human well-being. Besides, they are clearly depending on soil. A number of the soil ESS are often not overlooked in general ESS assessments or in soil ESS assessments

What Approach, results and key messages

Soil ecosystem services, as all ecosystem services, are fundamental for meeting societal needs such as food and energy provision and for overcoming societal challenges like climate change mitigation and adaptation. The MAES Soil Pilot is aimed to increase awareness of the importance of soil functions and related ecosystem services and to show their value. The pilot also aims to show the need for protection, management and restoration of soil ecosystems and the need to make a more sustainable and efficient use of it. In the context of the EU Biodiversity Strategy to 2020 the MAES Soil Pilot provides practical guidance and capacity building to the EU institutions and Member States on methods and tools for assessing soil ecosystem services. The pilot also supports other EU policy frameworks such as the Soil Thematic Strategy and the 7th Environmental Action Programme 2014-2020.

The process of mapping and assessing soil ecosystems and their services starts with assessing ecosystem status (also called 'condition'). Ecosystem status determines the capacity of an ecosystem to yield services, and soil pressures influence the ecosystem status. In the next step of the MAES process, ecosystem services supply are assessed and mapped. Methods and data availability vary between ecosystem services. Indicators for ecosystem services are collected in MAES pilots for six ecosystems: 1) Forest ecosystems, 2) Cropland and grassland ecosystems, 3) Freshwater services ecosystems, 4) Marine ecosystems, 5) Urban ecosystems and 6) Soil ecosystems. The presented report is developed in the context of the latter ecosystem.

Structural analysis by policy makers and soil managers on the impact of their decisions on soil ecosystem services will enable them to make well informed decisions. A good understanding of the role of soil ESS for human well-being will enable practitioners to develop soil management practices that have a positive impact on human well-being. When analysing the impact of soil management practices on ESS, it is recommended to consider the entire list of soil ESS to prevent that less obvious aspects are overlooked. Even when there is an indirect impact of changes in soil characteristics on ESS, the impact may be high. For example, temperature regulation by vegetation through transpiration may be severely impaired by a lack of available soil moisture.

There is no standard recipe for good soil management or land management. Since there are trade-offs between services, the optimal management depends on which ESS are demanded by society and on local soil characteristics that determine potential for ESS. Information on the status of potential provision and demand for ESS can be used to prioritize management actions. Some practices impact many ESS or specific bundles of ESS as is demonstrated in this report. Policy makers could stimulate management practices that enforce multiple ecosystem services or to mitigate adverse impacts on them. Still, priorities in soil management will always be determined by the demand for ESS and the value that decision makers or the people that they represent assign to certain services. Enhancing ESS to soil therefore starts with an integral assessment of current and future needs of humans, potential provision of ESS, and trade-offs between ESS. By comparing potential supply and use, it is possible to determine whether the use of soil is sustainable. Examples of this type of analysis from Flanders and the Netherlands are provided in this report. These examples demonstrate that many soil ESS are used unsustainably.

The availability of indicators for quantification and data on soil ESS varies between services.

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For provisioning services, production and abstraction are well documented. It requires further assessment to find out what causes the increase or decrease in and what role is played by soil (condition). For example, agricultural outputs in Europe increased between 2000 and 2010 while at the same time, potential supply of these goods seems to decline based on available arable land and soil fertility. This may indicate unsustainable use of the crop production service and studies in Flanders and The Netherlands support this impression. From the European studies that we considered, it is hard to determine if regulating services are improving or declining. One reason is that the role of soil is hidden in integrative indicators, soil being only part of the equation. Examples of integrative indicators are water retention capacity and relative water purification capacity of freshwater ecosystems. It would require more in-depth investigation to identify the role of soil in these indicators. However, the integrated indicators are valuable because they acknowledge the importance of an entire ecosystem, with all its components and processes, for provision of ESS. Extracting the role of soil may be useful for soil scientists and soil managers for the development of soil management practices that enable sustainable use of specific bundles of soil relates ESS.
Another difficulty with several regulating services is that their use is strongly spatially specific on sometimes fine spatial scale. For example, traffic noise reduction by bare soil and vegetation is provided at a level of spatial detail that is lost in assessments and maps at European scale.

The estimation of the economic value of soil ESS can inform decision-making on soils use and management. However, the economic valuation of soil ecosystem services is still a nascent area of research where research gaps abound. Conceptually, there is no unified framework and most common approaches lag behind the developments in general economic valuation research. There are generally very few studies available, most of which focus on a handful of soil ecosystem services and there are very few economic valuation studies of soil ESS conducted in Europe. Moreover, virtually all economic valuation studies of soil ecosystem services focus on agricultural contexts. This means a huge lack of insight in value of soil ESS in an urban context.

The available studies use very diverse, qualitatively divergent methods and approaches, which makes their results hardly comparable. Thus, economic valuation studies do not provide much information that can be informative for decision-making processes beyond the available biophysical data. This means there is significant potential for new research in this area. More focus on other contexts (e.g. urban soil ESS) and more research in Europe will improve the availability of information for decision makers in Europe.

Key Conclusion and take home message

A good understanding of the role of soil ESS for human well-being will enable practitioners to develop soil management practices that have a positive impact on human well-being.

There is no standard recipe for good soil management or land management. Since there are trade-offs between services, the optimal management depends on which ESS are demanded by society and on local soil characteristics that determine potential for ESS.

The availability of indicators for quantification and data on soil ESS varies between services. Extracting the role of soil may be useful for soil scientists and soil managers for the development of soil management practices that enable sustainable use of specific combinations of soil relates ESS and contributes to the awareness of the value of soil to a broader public.

The estimation of the economic value of soil ESS can inform decision-making on soils use and management. However, the economic valuation of soil ecosystem services is still a growing area of research with many research gaps and little common approaches.

More Further reading recommendations

Website: www.worldsoilday2017.eu/soils4eu.html
Twitter: @soils4eu

SOILS4EU:

Providing support in relation to the implementation of the EU Soil Thematic Strategy

Soil ecosystem services

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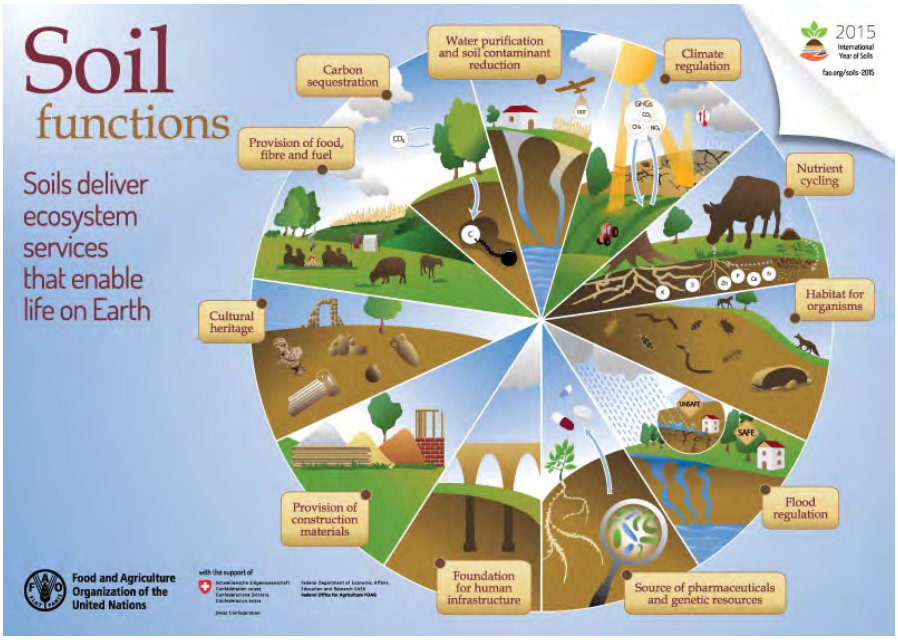
MAES Soil working group

EC DG Environment

The contribution of soil ecosystems to well being



Picture: sustainablesites.org

Ecosystem Services

Goods and services provided by ecosystems that directly and indirectly contribute to human well-being

The Common International Classification of Ecosystem Services (CICES)

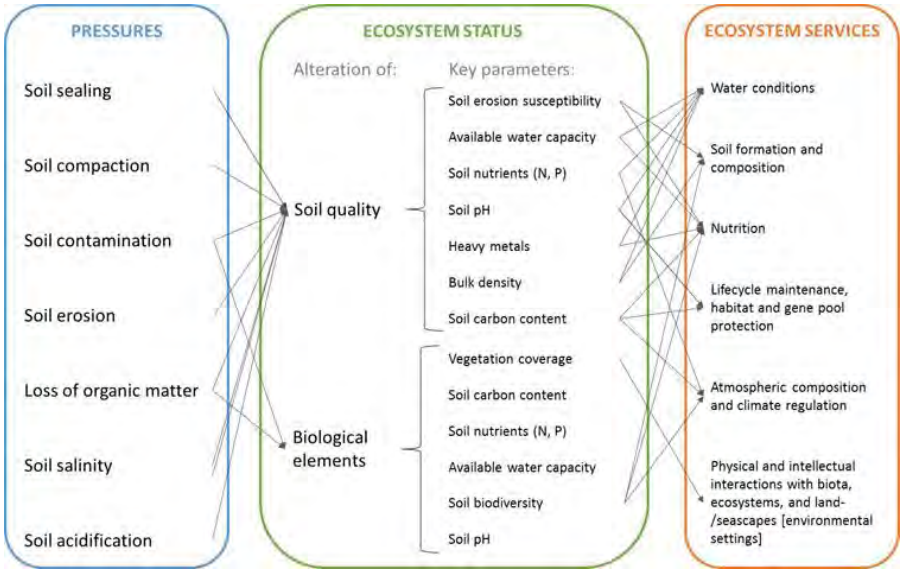
- Provisioning services
- Regulation & Maintenance services
- Cultural services

Soils4EU & MAES Soil Pilot

Increase awareness of the importance of soil functions,
related ecosystem services and
to show their value.

Show the need for protection, management and restoration
of soil ecosystems
and the need to make a more sustainable and efficient use of it.

Soil ecosystem services:
the goods and services provided by ecosystems that directly and indirectly contribute to human well-being,
which are depending on soil



Picture: JRC, 2017

Soil ecosystem services

Provisioning services	Biochemical and pharmaceuticals
	Food, wood and fibre
	Fresh water
	Carrying capacity for infrastructure, buildings and animals
Abiotic provisioning services	Raw materials
	Thermal energy
Regulation and maintenance services	
Cultural services	

Soil ecosystem services

Provisioning services	Biochemical and pharmaceuticals
	Food, wood and fibre
	Fresh water
	Carrying capacity for infrastructure, buildings and animals
Abiotic provisioning services	Raw materials
	Thermal energy
Regulation and maintenance services	Water purification and soil contamination reduction
	Water regulation
	Biological control of pests and diseases
	Carbon Sequestration
	Regulation of greenhouse gasses
	Regulation of local climate/temperature
	Noise abatement
	Air quality regulation
Cultural services	

Photo by Merijn de Jong

Soil ecosystem services

Provisioning services	Biochemical and pharmaceuticals
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	Regulation of greenhouse gasses
	Regulation of local climate/temperature
	Noise abatement
	Air quality regulation
Cultural services	Recreation and tourism
	Knowledge/scientific research, Cultural heritage and education
	Spiritual and symbolic experience

Quantification of soil ecosystem services

USE  ECONOMIC VALUE 

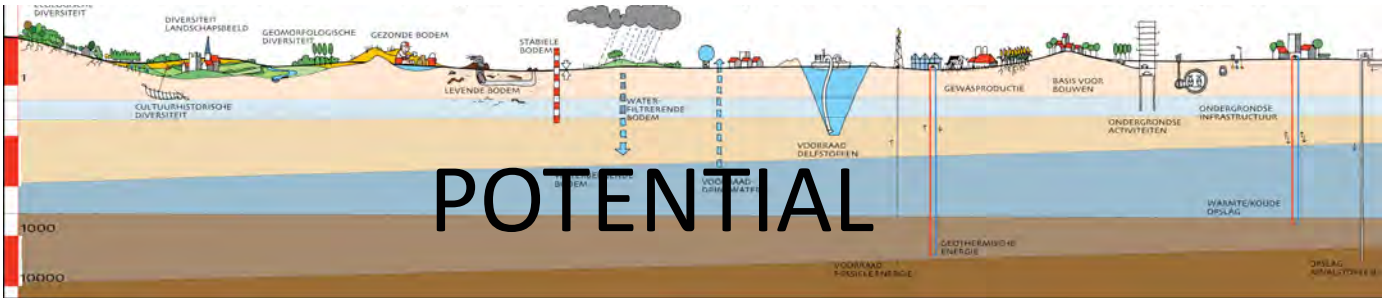
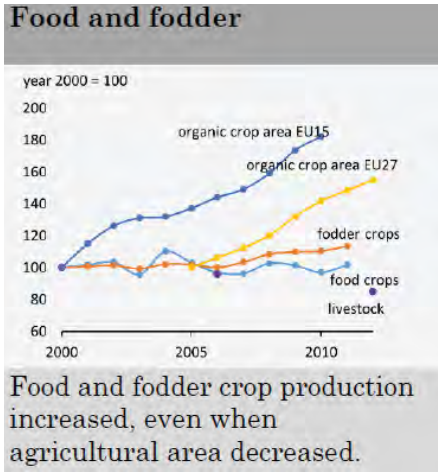


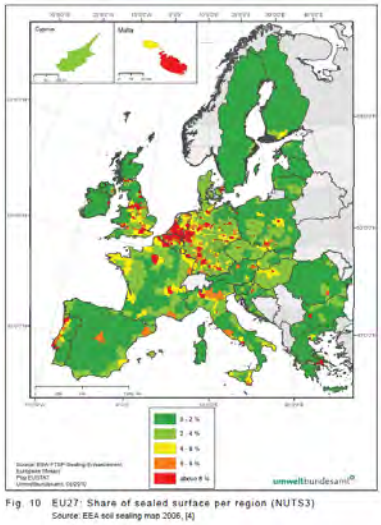
Figure subsurface: bodemvisie Groningen (Peter Dauvellier) en Ruimtexmilieu

Quantification of soil ecosystem services

some examples



Food, wood and fibre production



Regulation of local climate/temperature
Sealed surface

Knowledge/scientificresearch,Cultural heritage and education
Organics preservation capacity

Pictures: MAES et al., 2015; Prokop et al., 2011, Kibblewhite et al., 2015

Impact of land- and soil management practices on soil ecosystem services

Urban areas:

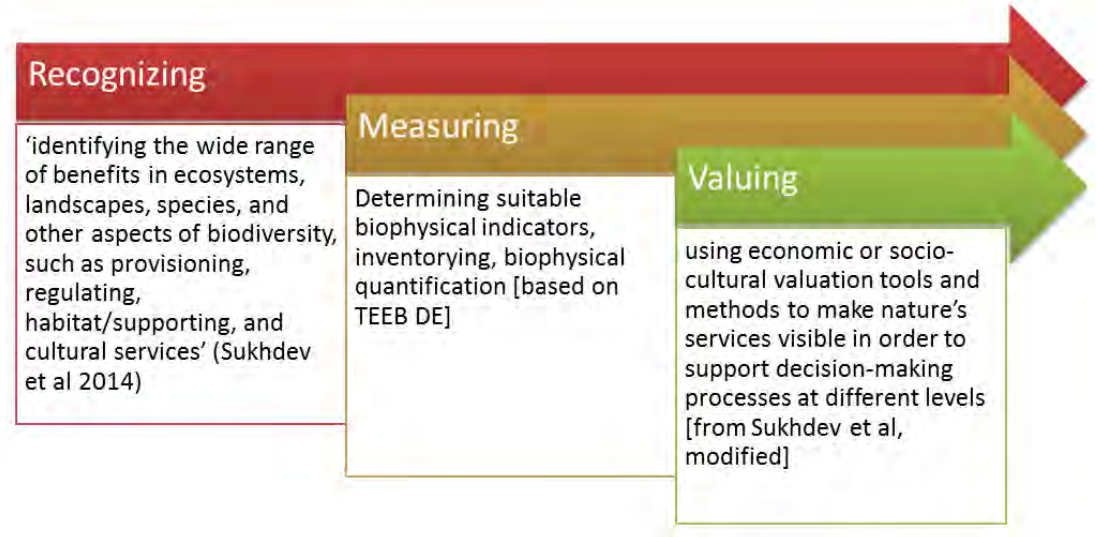
- Measures to reduce soil sealing by buildings and infrastructure
- Measures to reduce compaction
- Management of man induced soil subsidence
- Prevention and remediation of contamination and salinization
- Maintaining or increasing carbon storage in urban soils

Impact of land- and soil management practices on soil ecosystem services

Agricultural areas:

- Conservation agriculture:
  Tillage reduction, crop residue management, crop rotations
- Water management
  Land management oriented to increase soil water infiltration, Land management oriented to decrease soil water pollution
- Grazing management

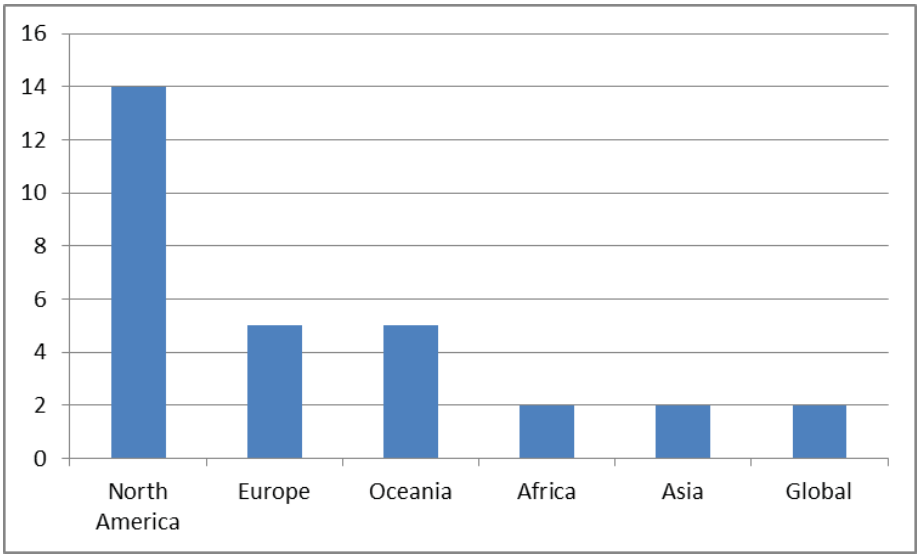
The value of benefits from soil ecosystem service



The valuation cascade from recognition and identification, through (biophysical) measurement to (economic) valuation (based on Sukhdev et al. 2014 and Natural Capital Germany – TEEB DE 2017).

Valuation studies soil ecosystem services

Geographic coverage of economic valuation studies



Distribution of economic valuation studies of soil ESS according to Jónsson and Davíðsdóttir (2016)

Conclusions

Which ecosystem services to include in a soil assessment?

- Overview of soil ESS
- Some less obvious, especially in urban context
- Cultural services: overlaps between services and the role of soil could be further elaborated

Conclusions

The impacts of land and soil management practices on ESS

- Optimal management depends on ESS demand and on local soil characteristics.
- Some practices impact many ESS or specific bundles of ESS.
- Information on the status of potential provision and demand for ESS can be used to prioritize management actions to enforce specific services.
- Stimulate management practices that enforce multiple ecosystem services or to mitigate adverse impacts.

Conclusions

The status of soil ESS: what we know about potential and use

- For provisioning services, production and abstraction is well documented.
- What causes the increase or decrease and what is the role played by soil (quality)?
- Indications for unsustainable use of agricultural production
- Regulating services: the role of soil is hidden in integrative indicators
- For some regulating services required level of spatial detail is a challenge

Conclusions

The economic impact of changes in ESS

- The estimation of the economic value of soil ESS can inform decision-making on soils
- Economic valuation of soil ecosystem services is still a nascent area of research where research gaps abound.
- Particularly, there are very few economic valuation studies of soil ESS conducted in Europe.
- Virtually all economic valuation studies of soil ecosystem services focus on agricultural contexts.
- The available studies use very diverse, qualitatively divergent methods and approaches, which makes their results hardly comparable.
- The field mainly provides insights into the economic value of soil ESS in orders of magnitude.

Recommendations and future outlook

14:00 Workshop 2 Recommendations
16:15 Combined workshop 1&2 Ways forward

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EC DG Environment

Workshop set up

time	topic	name
2:00-2:15	Welcome intro of people Aim of the workshop	Linda
2:15-2:40	Presentation key recommendations and motivations	Bartosz
2:40-2:50	Time for questions	all
2:50-3:30	4 working groups	Linda Bartosz Bavo Nele
3:30-3:45	Wrap up: key outcomes / ways forward	Group leaders

Land- and soil management practices

Recommendations for practical soil management and policy making:

- Integrally consider the *potential* provision of ESS, *demand* for these services and *trade-offs* between ESS to determine whether the use of soil is sustainable.
- Analysis of potential supply and demand of ESS should be spatially and temporally specific.
- Stimulate practices that enhance multiple ESS

Which ecosystem services to include in a soil assessment?

Provisioning services	Biochemical and pharmaceuticals
	Food, wood and fibre
	Fresh water
	Carrying capacity for infrastructure, buildings and animals
Abiotic provisioning services	Raw materials
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Which ecosystem services to include in a soil assessment?

Recommendations for practical soil management and policy making:

- Structural analysis on the impact of their decisions on ecosystem services for well informed decisions.
- Start with a broad analysis

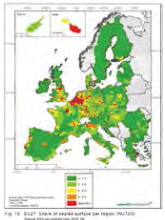
Recommendations for future research:

- For consistent use of cultural soil ESS, it would be helpful to refine the definition and to further assess the role of soil.

Information quantity of potential and use of soil ecosystem services

Recommendations for future research:

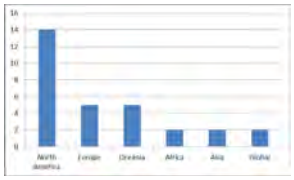
- Assess the relation between change in flows of provisioning services (harvest), the potential supply of provisioning services and the role of soil in potential supply.
- For regulation and maintenance services extract the role of soil
- Be aware of the required level of spatial detail
- When indicators for ESS potential are lacking, a combination of indirect indicators can provide insight in the potential. New maps in which these indicators are combined would be useful to be produced in the future.



Valuation studies soil ecosystem services

Recommendations for future research:

- Much effort in developing soil-specific approaches to economic valuation would be needed.
- More focus on non-agricultural contexts (e.g. urban soil ESS)
  and more research in Europe will improve the availability of information for decision makers in Europe.



TIME FOR QUESTIONS

Up to 2:50

Deltares CIHEAM IAM ZARAGOZA HELMHOLTZ CENTRE FOR ENVIRONMENTAL RESEARCH – UFZ IUNG Institute of Soil Science and Plant Cultivation State Research Institute CSIC Spanish Council of Research

DISCUSSION GROUPS

2:50-3:30

Group 1 which soil-related ESS - Bavo Peeters

Group 2 management of urban and agricultural soil systems to enhance ESS - Nele Bal

Group 3 Valuating ES - Bartosz Bartowski

Group 4 availability of information on ES capacity and use – Linda Maring

- Do you support recommendations?
- How to implement?
- Who can do what with it?
- Underpin your inputs with an example where possible