



Soil science input in transdisciplinary projects in the Netherlands and Italy



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ABSTRACT

The UN-Sustainable Development Goals (SDGs) provide an attractive framework to demonstrate the essential contributions that soil science can make to transdisciplinary research. Contributions of soil science were systematically defined by considering relevant SDGs and the associated ecosystem services (ESs) for six transdisciplinary case studies in the Netherlands and Italy. Soil input consisted of available knowledge in terms of data and models in three case studies. This resulted in highly relevant research based on knowledge assembly, but is not helpful when soil scientists then demand funding for new research in order to expand the knowledge base. In three case studies not only available knowledge was used but also results from new research. An analysis of the six case studies resulted in recommendations for new soil research.

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1. Introduction

The world faces major challenges in the coming decades in terms of food security, fresh water scarcity, climate change, biodiversity loss and energy security. The widely publicised UN Sustainable Development Goals (SDGs) (Table 1) provide a fascinating perspective for soil science because major soil-related environmental issues are presented in a societal context. Substantial input of soil expertise will be needed to reach goals such as SDGs 2, 6, 12 and 13.

Food production is covered in SDG 2, water availability in SDGs 1 and 6, climate change in SDG 13, biodiversity loss in SDG 15, and energy in SDG 7. To increase the visibility of the soil science profession in the general scientific arena, a procedure has been proposed to link the seven soil functions (SFs) (Table 2) proposed by the EC (2006, 2012) directly to well known general Ecosystem Services (ESs) (e.g. De Groot et al.,

2002; Dominati et al., 2014; Robinson et al., 2014), which, in turn, can be related to the SDGs (Bouma, 2014). Relating SFs to ESs is justified because each soil function also expresses a general ecosystem service, except that defining general ecosystem services requires input from other disciplines as well. For example, “biomass production” (SF 1) also represents a general ecosystem service with the same name (ES 1) that can be defined by not only considering the role of soils, but also the roles of e.g., plant sciences, hydrology, climatology, ecology as well as socio-economics. Dominati et al. (2014) have defined a set of soil-related ecosystem services, subdivided into provisioning, regulating and cultural subgroups that largely correspond with or can be expressed by the EC soil functions, except for the important service of “provision of support for human infrastructures and animals” which is lacking in the EC functions (Table 3). Simple and direct expressions are desirable for communication with colleagues in other professions, stakeholders and policy makers so in this paper we will use seven ES, based on the seven EC soil functions, plus ES 8 on provision of support (Table 2).

The conceptual proposal linking soil functions with general ecosystem services and SDGs can, however, only become accepted and operational when illustrated with specific case studies that clearly demonstrate its relevance. Also, it would be wise to not follow the natural impulse of soil scientists to start with the soil functions but to, rather, consider first the SDGs to put considerations in a broad societal context and then move on to ecosystem services in which soils play a prominent role and discuss the soil functions that are relevant for the problem to be studied. The latter discussion should not only cover actual but also future environmental conditions.

Research focusing on SDGs has to be transdisciplinary because different scientific disciplines are involved and stakeholders have to be

Table 1
The UN “Sustainable Development Goals” for the period 2015–2030 (status July 2014). ((<http://sustainabledevelopment.un.org/focussdgs.html>)).

| | |
|---------|--|
| Goal 1 | End poverty in all its forms everywhere |
| Goal 2 | End hunger, achieve food security and improved nutrition and promote sustainable agriculture |
| Goal 3 | Ensure healthy lives and promote well-being for all at all ages |
| Goal 4 | Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all |
| Goal 5 | Achieve gender equality and empower all women and girls |
| Goal 6 | Ensure availability and sustainable management of water and sanitation for all |
| Goal 7 | Ensure access to affordable, reliable, sustainable and modern energy for all |
| Goal 8 | Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all |
| Goal 9 | Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation |
| Goal 10 | Reduce inequality within and among countries |
| Goal 11 | Make cities and human settlements inclusive, safe, resilient and sustainable |
| Goal 12 | Ensure sustainable consumption and production patterns |
| Goal 13 | Take urgent action to combat climate change and its impacts |
| Goal 14 | Conserve and sustainably use the oceans, seas and marine resources for sustainable development |
| Goal 15 | Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss |
| Goal 16 | Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels |
| Goal 17 | Strengthen the means of implementation and revitalize the global partnership for sustainable development |

Table 2
The eight ecosystem services (ESs) provided by the soil. The first seven services are based on the soil functions (SFs) defined by EC (2006) but to provide each service many other scientific disciplines are involved as well. ES 8 has been added from Dominati et al. (2014, see Table 3).

| | |
|------|---|
| ES 1 | Biomass production, including agriculture and forestry |
| ES 2 | Storing, filtering and transforming nutrients, substances and water |
| ES 3 | Biodiversity pool, such as habitats, species and genes |
| ES 4 | Physical and cultural environment for humans and human activities |
| ES 5 | Source of raw material |
| ES 6 | Acting as carbon pool |
| ES 7 | Archive of geological and archaeological heritage |
| ES 8 | Provision of support for human infrastructures and animals. |

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