

GUEST EDITORIAL

Soils are back on the global agenda

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Abstract

In the 1990s and early 2000s, there was widespread pessimism on the status of soil science in most parts of the world. This was mainly due to dwindling research budgets, reduced number of students and the overall perception that soil science and pedology were dead and buried. Renewed interest in agriculture for food, feed and fuel has brought soils back onto the global research agenda. Soil erosion, nutrient depletion and pollution are key issues brought up in many recent reports by UN and other international organizations. The need for up-to-date and fine resolution soil information and the revival of soil research is highlighted and prioritized in several studies. There is increased interest in soils in the popular press and media, and soils have entered the policy arena. For the global soil science community, there are challenges ahead and there is a direct need to educate a new generation of soil scientists.

Keywords: Soil research, food production, environmental soil science, soil science impact

Introduction

Soil science has made large contributions to the increase in agricultural production and a sound understanding of soils has been essential for tackling research questions on climate change, environmental regulation and ecosystem services. In the 1960s and 1970s, the impact of soil science was large (Hartemink, 2002) but reduced funding that started in the mid-1980s affected soil science and this followed reduced interest in agriculture and widespread governmental budget cuts (Mermut & Eswaran, 1997). In many parts of the world student numbers decreased during the 1990s (Hartemink *et al.*, 2008). Many new questions asked by environmental and other regulatory authorities could not be quantitatively answered by the soil science community. As a result the influence of soil research declined despite a re-focus on topical subjects such as sustainability and climate change.

Currently, there is increasing attention on both soils and soil research following the global renewed interest in agriculture (Hartemink & McBratney, 2008). In order to understand the current upsurge in concern for soils it is helpful to reflect on how soil science has responded to some of the big global issues in the past. This editorial overviews some of the big themes in soil science through reference to selected recent reports from UN and other international organizations. The aim is to dispute some of the pessimism that soil science and pedology are dead and buried (e.g. White, 1997; Baveye *et al.*, 2006).

The big themes in soil science – some pedobarometry

Prior to World War II, inequalities in food supplies for different countries were accepted as part of the natural order of things (Russell, 1954). That thinking changed after World War II when international organizations such as the United Nations Food and Agricultural Organization (FAO) were established and many countries were aiming at independence. The provision of sufficient food for growing populations became an important area of research. Increasing food production was also a concern in western Europe because of the devastation after the war and population increase. In the 1950s and 1960s, many Europeans and their overseas descendants had a growing feeling that they should do something to mitigate the hunger that oppressed so many in the undeveloped countries (Pendleton, 1954; Bradfield, 1960).

There was great optimism and positivism in the 1950s and agricultural research rapidly expanded. The motto for the Seventh International Congress of Soil Science in 1960 in Madison was 'Alleviate Hunger, Promote Peace through Soil Science'. In his presidential address R. Bradfield mentioned that he can think of no single group of scientists who have more to contribute to feed the world than soil scientists (Bradfield, 1960). He also mentioned that agriculturists including soil scientists had more experience and in general more success in increasing food production than population experts had in population control. Most agricultural research after the World War II was directed towards agricultural production, and there were major investments in agricultural infrastructure. As a result, food production in Europe dramatically increased and resulted in massive surpluses of

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primary agricultural commodities. There is no doubt that the results of soil research played an important role in the increase of agricultural productivity (Bouma & Hartemink, 2002).

In the 1970s, soil science became linked to wider environmental aspects. Research shifted to a whole range of new subjects including, for example, soil pollution, eutrophication and ground water contamination (Tinker, 1985). There was also a decline in inorganic fertilizer use that started in the 1980s when environmental concerns about inorganic fertilizers were rising such as the nitrate content of drinking water and ozone destruction (Addiscott *et al.*, 1991; Bouwman, 1998).

After the Bruntland report of 1987 on 'Our Common Future' and the 'Earth Summit' in Rio de Janeiro in 1992, there has been a wide debate on the issue of sustainability, particularly in relation to soils, land and agriculture. When the history of soil science of the 20th century is written, the 1980s and 1990s will be remembered as decades in which the term 'sustainability' was overwhelmingly present in the soil science literature. With the increased perception and quantification of soil degradation in the tropics, came the call for the design and study of sustainable land management systems. The reports on 'Our common future' (Bruntland, 1987) and Agenda 21 of the Rio declaration on sustainability (Eswaran, 1994) were politically influential, but had no major impact on soil science funding and research capacity.

Climate change and soils came on to the global agenda in the 1990s (Scharpenseel *et al.*, 1990) and especially after the Kyoto protocol from 1997. Much research has been geared towards carbon stocks (Eswaran *et al.*, 2000; Smith, 2004) and the relation between climate change and food production (Sanchez, 2000).

Currently, there is new concern about feeding the world (UN Millennium Project, 2005) and the land needed for energy (biofuels), food (hunger alleviation, increased

demand) and feed (increased animal production). The cultivation of biofuel crops is competing with food crops in some parts of the world and is driving up commodity prices (UNEP, 2007). The environmental and soil impact of the shift towards growing crops for energy or increased food production is not known, but it is widely realized that global soil information is not accurate or digitally available, and, certainly not up to date. Other important themes that are currently on the agenda include biodiversity, water scarcity and carbon accounting.

Figure 1 schematically illustrates the impact of soil science since World War II and also indicates links to the big themes.

Soils on the agenda

There are countless reports from UN and other international organizations (e.g. IPCC and various conventions) in which the need for studying soils and the provision of adequate soil information is emphasized. It is instructive to provide a brief summary of a few of the recent reports.

In September 2000, world leaders adopted the United Nations Millennium Declaration which set out the Millennium Development Goals (MDGs). In the MDG reports, a range of recommendations on soil health are made and the links between poverty, unhealthy people, unhealthy soils and poor soil management are reinforced (UN Millennium Project, 2005).

Since 1990, UNDP has published an annual Human Development Report to measure and analyse developmental progress. There was no mention of soil until the 2000 Human Development Report but in 2003 soils were referred to in several parts of the report, mostly in relation to nutrient depletion and soil degradation. In successive reports, issues like land rights (2004) and indigenous soil knowledge (2006) were brought up. The most recent report focuses on climate change and soils are referred to in terms of acting as sinks and sources of greenhouse gases (UNDP, 2007). There is also mention of soil erosion and soil fertility decline and its impact on food production. The inclusion of soil issues in these reports is important because they are widely used by decision and policy makers.

The FAO had its first ever external evaluation in 2006 and 2007 (FAO, 2007). One of the conclusions of the report is that FAO is in crisis and has very few areas left in which it has technical leadership including land and soils. Yet, an area of comparative priority is the provision of basic global natural resource data and statistics including land and soils. The review gives land and soils the highest priority for resource allocation.

UNEP has produced four Global Environment Outlook (GEO) reports that provide scientific assessments of the interactions between environment and society. The third assessment (GEO3) was in 2002 and included a section on

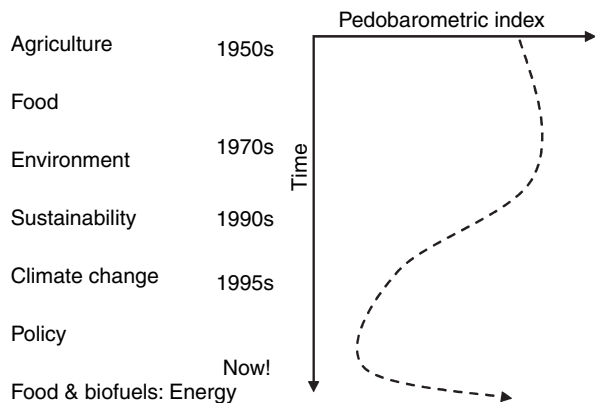


Figure 1 Approximate topical themes and foci in soil science post-World War II and the overall activity and impact of soil science (pedobarometric index).

soil degradation. GEO4 contains a full chapter devoted to land and includes sections on water, forests, land degradation including chemical contamination and pollution, soil erosion, nutrient depletion, salinity and disturbances in biological cycles. The use, management and threats to soils are included throughout the GEO4 report that also recognizes the need for much better soil spatial information at regional and local scales (UNEP, 2007).

Soils have also entered the policy arena and in several countries and continents soil legislation is being developed. The largest effort to effectively bring tools for soil legislation has been in the EU through its Soil Thematic Strategy, and more recently in the USA through the adoption of a Resolution in the US Senate. Environmental policies in Europe started in the 1970s (European Commission, 2006). These strategies included air quality, marine environment, sustainable use of resources, waste prevention and cycling, pesticides, the urban environment and soil quality. The thematic strategy on the protection of soil was started in 2002 and adopted by the European Commission in September 2006. The strategy is aiming to give soil the same importance as air and water; it sets out a roadmap to address soil degradation by preserving and restoring soil and its functions.

In June 2008, the US Congress adopted a soil Resolution in the Senate. This resolution enforces the role of soils and emphasizes the lack of legislation on soils in the USA in contrast to, for example climate change and water quality. The Senate recognized it as being necessary to improve knowledge, exchange information and develop and implement best practices for soil management, soil restoration, carbon sequestration and long-term use of the Nation's soil resources. It also highlighted the important role of soil scientists and soil professionals, who are well equipped to address the issues of the Nation's soil resources.

Discussion

Soil scientists have been effective in communicating the problem of soil degradation (e.g. soil erosion, nutrient depletion and soil pollution) and of all their activities, research on soil degradation with often its 'gloom and doom preaching' has had a considerable impact. It continues to do so in both the popular press (e.g. the September 2008 issue of the *National Geographic*), in legislation (the threats to soil in the EU soil thematic strategy) and also in the scientific press (e.g. the 'Soil and Trouble' issue of *Science* in June 2004). It can be argued that the preaching of gloom is fruitless unless it is underpinned with science, and is harmful as it encourages fatalism instead of much needed determinism. Like any important subject, the discussion should be based on the collection and careful interpretation of facts and figures in which research plays a major role. Science can provide much needed answers and guide the future focus of the political and research agenda (Greenland *et al.*, 1997). As agricultural

production is largely dependent on soil's productive capacity, soil science should be upfront in providing the much needed data on soil resources and scenario studies on how soil and land-use change affects food production.

The current attention and upsurge in soil science could lead to a fruitful and highly productive new era. The link with real-world issues (climate change, food production and hunger alleviation, environmental degradation) is essential as is the development of fundamental research (Bouma, 2001). Much emphasis has been on practical applications, but there is a real need to challenge some of the old paradigms and come up with truly novel approaches (McBratney, 2006). Adoption and spread of new methodologies and techniques have a relatively low priority and require a new type of soil scientist equipped with different tools and views. Some other disciplines, for example, geologists, have already taken on board part of the soil science task.

Now the importance of soils is recognized, action is needed and is already being taken on some fronts, such as a range of new soil projects across the globe (e.g. various new soil projects in the EU 7th Framework Programme, such as i-Soil, DigiSoil, and e-SOTER) and *GlobalSoilMap.net* (Hartemink & McBratney, 2008). These projects will combine the demand for new data with new ways on how such data should be collected. There are many novel techniques and methods available for soil scientists and there is a range of software and hardware that needs exploring and further development, including digital soil mapping. Such techniques have exceptional promise when combined with the demand for accurate and up-to-date soil information (McBratney *et al.*, 2006). It is not only in Europe, North America and Australia that these techniques are being applied, they are also being used and developed in Sub-Saharan Africa (Awiti *et al.*, 2008). Another sign of the current vigour of soil science is its steady increase in publications with increased impact (Minasny *et al.*, 2007) and the relatively large number of job vacancies, a consequence both of a retiring generation of soil scientists and various new projects.

Conclusions

Soils are back on the global agenda and there is an increasing demand for soil information and, at the same time, a technological revolution to address the questions raised by other scientific disciplines, policy makers and society at large. The global soil science community should act promptly and deliver; at the same time the community should continue to develop new thinking about the ways we study soils and how they should be managed.

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