Reconnecting soils and agriculture

Agriculture is one of the most successful of human endeavours. The future of agriculture has sparked wide discussions focusing on food production, hunger alleviation, environmental issues and global land use, economic policies, bio-energy and public trust – to name a few. Here we discuss a key component of agriculture that has been somewhat ignored in several debates: the soil and how it connects to the agricultural endeavour. Before we shed some light on ideas for the future and how we can reconnect soils to agriculture, we analyse briefly how agriculture has changed and the role of soil science in that change.

In our view, three broad developments have taken place since about 1945. The first period was after the Second World War, when a considerable increase in agricultural production was needed to alleviate hunger and to feed the post-war baby boom. Most agricultural research was directed towards agricultural production, which increased dramatically thanks to technological developments and major investments in agricultural infrastructure. Soil science played a crucial role in the increase in agricultural productivity by assessing land suitability for different uses, by improving water and nutrient use efficiency and, more generally, by increasing understanding of the role of interacting physical, chemical and biological soil processes when producing crops. In several parts of the world, however, the indiscriminate application of soil research results led to an excessive use of agrochemicals, followed by soil, water and air pollution, and to the destruction of natural habitats for animals and plants.

In response, land-related environmental research was strongly promoted in the second period – after, say, 1970 – when agriculture was regarded as a major cause of environmental problems. Suggestions were made and implemented, therefore, to de-emphasize agricultural research, the more so because large food surpluses were being produced and economists stressed that hunger was due to institutional and distribution problems and not to a lack of food. Agriculture became the victim of its own success. As soil science was closely linked to agriculture, it suffered a setback in funding and research attention. Global funding agencies decreased their agricultural agenda as well, favouring infrastructure, health and education rather than agricultural development.

From the early 1990s, the third period, society became increasingly individualized, while the influence of governments and political parties diminished. Changing coalitions of citizens and their interest groups, politicians and scientists started to address issues, and non-governmental organizations became important. Agriculture was increasingly seen not as an enemy of the environment, but as a crucial partner in developing sustainable and multifunctional forms of land use, and this changed perspective provided new impulses to soil and land research. Industrial
pollution of soil and water greatly decreased due to effective legislation, leaving non-point water pollution from agricultural lands as a major source of environmental concern. Agricultural research was quite effective in this third period, as many new technologies were developed, demonstrating that what is good for the environment is not necessarily bad for business. One example is precision agriculture, in which the right amount of water, nutrients and biocides is applied to crops at the right time, taking into account soil variability and weather conditions: thus natural resources are saved and the adverse environmental side effects of agricultural practices are much reduced. Soils play a key role in precision agriculture, but soil research has not taken a lead in developing practical systems, partly because of a lack of integration of soil subdisciplines, such as pedology, soil physics, chemistry, biology and technology.

The third period was strengthened after 2008 following the financial, but particularly the agricultural, crises. Suddenly citizens realized that sufficient food was not a certainty, and this realization has fundamentally changed the debate.

In recent years, both agriculture and soil science have received increased attention. Nevertheless, we believe that soil science is playing a diminishing role in shaping the agriculture of the future. Possible reasons include:

(1) There may be an impression that we already know all there is to know about the role of soils when producing crops and livestock in a most efficient manner, and that attention to genetic modification of crops has more potential for the future.

(2) Soil scientists – members of a relatively small community – are now increasingly linked to other scientific disciplines (environment, earth and geosciences, hydrology) and less to the agriculture discipline per se. Compared with earlier times, fewer soil scientists have an agricultural background, which provided a natural bond between soils and agriculture.

(3) Practitioners and policy makers may think that soil science may not be able to provide answers to today’s agricultural questions, perhaps because soil scientists – like many scientists – are focused primarily on enthusiastically communicating their results rather than listening to third parties.

(4) Soil scientists may not be able to communicate their findings and insights into a readily transferable format that fits the rapidly changing information society of the twenty-first century.

In our view, the natural resource questions that confront agriculture can be roughly grouped around the themes of food production, water quality, biodiversity loss, bio-energy generation, climate change and human health. Soils play a key role in each of these themes, whether it is through crop production, water purification, forming a gene pool or sink, or being a source of greenhouse gases. The management of our soils affects all of that, but we still have insufficient data and understanding of many of the highly complicated soil processes and cycles involved. The lack of sufficient data and understanding decreases our ability to make informed decisions about sustainable management practices in terms of balancing ecological, economic and social considerations. However, data and understanding are only one part – successful future interactions between soil and agricultural science require a clear reconnection not only with scientific colleagues in other disciplines, but also with a wide range of stakeholders and members of the policy arena.

Continuing the discussion of the four possible problem areas defined above, we suggest that soil scientists should become more involved in
studying at least the six key environmental questions mentioned above that challenge agriculture and society at large. Second, soil science should follow a more intradisciplinary approach whereby, for example, soil microbiologists, biogeochemists, digital soil mappers and soil physicists all work together. In addition, interdisciplinary work with hydrologists, climatologists, ecologists, economists and sociologists needs to be strengthened, while transdisciplinarity, working with stakeholders and policy makers, is crucial for the successful implementation of projects. Finally, communication practices should be improved in line with modern opportunities offered by the information revolution. These suggestions present major challenges that are worthy of pursuit.

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