

# Saving our soils

Although the US healthcare system is among the best in the world at treating disease, it is frequently criticized for not doing enough to prevent disease. Similarly, soil management, while effectively addressing acute problems, is less successful at preventing chronic degradation. This analogy becomes clear when we consider how important the world's soils are to human civilization. Within the next several decades, about 9–10 billion people will increasingly require food, timber, fiber, and bioenergy, as well as related ecosystem services such as maintenance of clean water and mitigation of greenhouse gases – all of which depend on healthy soil systems. Human health is fundamentally tied to the well-being of the Earth's soil. However, it is scientifically uncertain how maintaining proper “soil health” – a term used by researchers and land managers to characterize the integrated functions of soils – will affect these vital tasks in the future.

Global economic, political, and climatic conditions create great challenges for soils. Agricultural producers, motivated by short-term finances, increase inputs of fertilizers and pesticides to maximize yields, frequently with adverse environmental impacts. Subsistence farmers coax decreasing crop yields from soils that can no longer be managed sustainably. The problems associated with these management regimes will be greatly exacerbated by global climate change, which is predicted to have profound effects on agricultural production. The world's soils are already showing signs of strain, and masking these symptoms with short-term treatments may result in catastrophic outcomes.

The long-term consequences of soil management extend to surrounding waterways and the atmosphere. Soils are responsible for more than half of the biosphere's emissions of nitrous oxide, an extremely potent greenhouse gas, with emissions strongly enhanced by nitrogen-based fertilizer use. Mismanagement of such fertilizers has also led directly to the creation and persistence of hypoxic “dead zones” in many coastal areas, including the Gulf of Mexico. Here, excess nutrients in agricultural soil runoff have reduced the value of that region's renowned commercial and recreational fisheries over thousands of square kilometers. Soil organic matter – which sustains soil biodiversity, provides nutrients for plants, helps mitigate erosion, and ensures improved water quality – has been diminished in topsoils around the world by up to 50%, as a result of intensive land use. These losses contribute to elevated atmospheric concentrations of CO<sub>2</sub> and threaten the long-term productivity of agricultural soils.

How will our relationship with soil develop in the future? Will we continue to seek short-term solutions to acute problems or, instead, begin to establish practices that encourage long-term soil health? Farmers, foresters, and other land managers have always appreciated healthy soil and our dependence on it; now, we are seeing encouraging signs of a renewed awareness of that dependence among other groups as well (eg the international interest in urban farming, in rural farmland managed by people who grew up in cities, and the proliferation of bestselling books on agriculture and food supply). This reawakening raises hope that we are entering a period in which humanity will better appreciate the importance of caring for soils in a more sustainable way.

We need to engage the world's population in a broad discussion about soil degradation. This will not be an easy conversation; soil-management issues are characterized by difficult questions of short- versus long-term priorities, and the rights of individual landowners versus those of the community. However, recent examples demonstrate that public and private sectors can unite behind a common cause. The reductions of sulfur emissions and acid precipitation have been achieved far more rapidly and with much less investment than predicted – international agreements helped protect the ozone layer so critical to our planet's health, and likely saved our society from serious harm. Lead in gasoline has been removed in developed nations and is finally being reduced in developing nations as well.

We need to use such examples as models to develop new initiatives that promote stewardship of our soil resources, without asking the immediate stewards of soil health – the farmers, foresters, and other land managers – to shoulder too much of a burden that should be shared amongst us all. We also need to stimulate technological advances, improve our understanding of how soil responds to ever more extensive and intensive human activities, and revitalize educational curricula in soil science. If we expect Earth's soils to satisfy our burgeoning agricultural needs and simultaneously provide ecosystem services, then they deserve nothing less than our very best stewardship in the challenging decades ahead.



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