SOIL SCIENCE

Searching for solutions to our soil woes

Could a controversial carbon storage plan help restore degraded lands?

By **Daniel D. Richter**

Poets, philosophers, farmers, and scholars have long recognized the mutual dependency of human beings and soils. We are utterly reliant on soil for food and fiber, water purification, carbon sequestration, infrastructure support, and even new drugs. That soil is dependent upon people may first have been asserted in *The Georgics* by Virgil, who framed soils and all of nature as being highly vulnerable to human action and in need of human care. Virgil celebrated the endless work required for sustaining soil and agriculture—work needed to stave off a degraded world where we might find ourselves shaking oak trees for acorns, "frantic for something to eat" (*1*).

A georgic ethos with the land resonates today, as the world's farmers work with soil to produce nearly 95% of the food supply for 8 billion human beings. To meet these times, microbial scientist Jo Handelsman, who served as a White House science adviser during the Obama administration, has written *A World Without Soil*, which presents a manifesto for improved soil conservation and management.

With more than half of the world's soils actively managed, Handelsman raises serious concerns about the many ways that soils are being degraded more rapidly than they can be formed. Her goal is to promote new soil policy that can help reverse the course of soil loss.

A World Without Soil is well written, even eloquently so. "Beneath the bustle of cities, towns, farms, forests, and highways lies the silent, dark ribbon of life, rock, and water that binds the past and future," reads one evocative passage. But it is the need for new soil management that drives the book, specifically the need to increase soil organic carbon and control soil erosion.

Handelsman's book adds to the literature warning of soil crises and urging reform, which includes the voices of G. P. Marsh, E. B. Balfour, H. H. Bennett, S. W. Trimble, and D. R. Montgomery (*2*–*6*). Like these authors, Handelsman emphasizes the precarious vulnerability of human-soil relations.

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What distinguishes Handelsman from her predecessors is her optimism about our ability to reverse the course of soil loss. While recognizing that soil degradation is a challenging problem long in the making, Handelsman considers it "one that can be remedied quickly" and "with relatively little short-term cost." Handelsman's positive outlook is based on her confidence that new policy can stimulate soil-carbon storage that will mitigate climate change and have co-benefits that improve soil health and fertility.

Nearly 10,000 years of agriculture have reduced soil carbon by more than 100 Pg (*7*), a loss that has compromised the functioning of many soils. Because this loss of soil carbon is equal to about a decade of current CO_2 emissions from fossil fuel combustion, if the world's soils could sequester a fraction of the carbon they have lost, Handelsman and others reason that this could provide more time for societies to reduce CO_2 emissions from combustion of fossil fuel. Handelsman thus sees improved soil management as "a powerful mitigative tool to address climate change" and strongly supports international efforts (*8*) to modify agricultural practices "to advance the world's climate mitigation and improve soil."

Many soil scientists, agronomists, and carbon scientists suggest that such massive initiatives are impractical and overly optimistic and lack a basis in the science of soil carbon dynamics (*9*–*11*). Handelsman acknowledges these criticisms but is not dissuaded.

Ultimately, Handelsman has crafted a book for a broad audience that will widen discussion and interest in soils and soil degradation. Perhaps the book can also spur broader science and policy discussion around whether soil policy should be used to manage the global carbon cycle. Handelsman's bold linkage of climate and soil will need much more robust examination in preparation for what may be some of the most important land-management policy decisions of our time. ■

A World Without Soil: The Past, Present, and Precarious Future of the Earth Beneath Our Feet
Jo Handelsman
Yale University Press, 2021. 272 pp.

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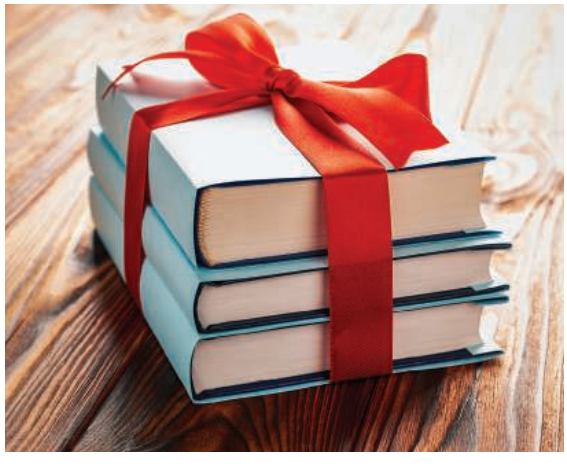

PODCAST

Best books of 2021

A playful immunology primer packed with vivid illustrations, a myth-busting reappraisal of early human history, a fact-filled romp through human-wildlife conflict, and a timely critique of the state of modern physics are among our favorite science books published in 2021. This week on the podcast, *Science*'s book review editor, Valerie Thompson, joins host Sarah Crespi to discuss the books we reviewed and loved this year. https://scim.ag/3CXXO2w

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