

LETTER TO THE EDITOR

PERSPECTIVE: THE SOIL-SPHERE, SAVE IT OR LOSE IT

Why soils?

Being first and foremost a plant geneticist specializing in maize, I must admit that when it came to the soil, my most immediate responsibility was to make sure pre-planting amendments were incorporated as recommended. Once those seedlings were up, my focus was almost exclusively on the green plants. But more recently, I taught *The Living Soil*, a course held at The Woodend Sanctuary and Mansion, owned and operated by the Audubon Naturalist Society of the Central Atlantic States. It was while teaching that I came to see soil more distinctly, as a natural resource with its own taxonomy and individual qualities. It brought back days spent studying soil science and revisiting the relationships among the twelve soil orders as pictured in Dr. Nyle Brady's textbook [1]. As I considered the time needed to renew these soils and the paucity of highly arable soils globally, I began to see this resource quite differently.

The soil of the world, especially the most productive, needs protection. That is what I came to understand, and that is why I have written to the Editor with two supportive points in mind. First, while there may be new technologies to shorten crop breeding cycles, there is no shortcut for "engineering" soil. Second, our track record for protecting the natural world can be described as a "Johnny come lately" response that puts off timely actions until on the verge of a species going extinct or seeing that its habitat will be changed forever.

Let me present one example. In 1913, William Hornaday completed the first scientific and exhaustive study of the loss of wildlife, not in Africa or the rain forest, but right here, in the USA. These losses during his lifetime were so extensive that he felt the need to document them in his book, *Our Vanishing Wildlife—Its Extermination and Preservation* [2]. Despite the drastic loss of life, species decline continued. A new understanding of the importance of these other species was emerging over time [3]. However, 58 more years passed until President Nixon authorized the *Endangered Species Act* in 1973. The act includes enforcement measures and consequences for those who continued to hunt or capture species considered endangered.



Let's face it

New concerns regarding the well-being of the world's soil were awakened after reading a study by Becker-Reshef and Mitkish [4] explaining what occurs when soil is caught in harm's way. Their work focused on conflict-related damage emanating following the Russian invasion of Ukraine. The authors detailed the resultant damage to Ukraine's soils, especially those that form Ukraine's "breadbasket," one long recognized as its nation's most productive cereal-growing region. In the case of this particular region, Ukraine not only grows food for itself and Russia, but also for many countries around the world.

Soils have their own nomenclature, with over 18,000 distinct types, with each one belonging to one of twelve orders. The productivity of Ukraine's breadbasket depends on its soil type, which is chernozem – a Russian word meaning "black earth." Based on the composition of these soils, being humus-rich grasslands, one is also globally important as this soil order is also found throughout the grasslands of the Canadian prairies [5]. Such benefits as described above are further extended to human health and the planet by other authors [6, 7, 8].

Are such natural resources something we can afford to lose? Such loss of soil is not exclusive to the battlefield. Attrition can come in other, equally devastating ways, which are remarkably consistent across the globe. The causes attributed to such damage or loss include the Big Five below. They are listed for emphasis, even though some are well known they seem forgotten or ignored given the current pace of human population growth.

The Big Five

1. **Urban development.** Sprawling developments devour farmland, allowing developers to keep excavated high-quality topsoil to re-sell, rather than incorporate it into green areas. Farmland is desirable because it is flat, making it easier and less costly to place complex housing and commercial developments. It is estimated that, as noted in another article's headline, "U.S. Losing Farmland at Alarming Rate," eleven million acres were lost or paved over from 2001 to 2016 [9]. From that base, it is estimated that from 2016 to 2040, some 18.4 million acres could be lost.
2. **Erosion.** Losses due to erosion [10] can be gradual and almost unrecognized, or sudden, as follows a natural disaster. While erosion can occur quickly and unnoticed, it is worth noting in contrast the time taken to rebuild topsoil. Here, it is generally agreed that it requires from 200 to 1000 years to form an added inch in depth. Topsoil is thus disappearing faster than it can be replenished.



Topsoil is thus disappearing faster than it can be replenished. Losses from such erosion can also be seen in the U.S. Corn Belt [11].

3. **Salinization and desertification.** These are warnings of what can happen when soil management and conservation practices are not in place, often resulting from a combination of factors over an extensive time horizon.
4. **Loss of soil biodiversity and other means of depletion.** Poor management of natural resources combined with poor farmland soil practices has led to soil degradation and loss of much subterranean biodiversity [12]. This loss comes just as a fuller understanding of soil-borne organisms is emerging [13]. In addition, as mentioned by the authors [4], “severe climate-related events and armed conflicts are expected to increase.” And while mentioning that management of such food disruptions is key to food security, forward-looking policies and enforcements to protect the planet’s base foundation for agriculture would seem to be an important part of food security planning [10].
5. **Nomenclature: introducing the soil-sphere.** Clearly, there are factors at work that cause significant harm to the foundation of life on earth, especially if left unabated. But while preparing to write this note, an unexpected problem arose, warranting attention. The issue occurred while wanting to simplify the nomenclature attached to soils and their conservation. Having too many terms and conditionalities to describe soils complicates one’s meaning regarding a solution for a soil in crisis.

Take, for example, just the following nine terms: the Lithosphere (crust + mantle); the rhizosphere; the A horizon; B and C horizons; topsoil; soil profile; subsoil, and bedrock – just to name a few. Each one signifies something different from the others yet can be so close in meaning as to cause confusion.

As an alternative, the use of the term *soil-sphere* it can serve the same purpose as to avoid confusion and misunderstandings arising from the reference words listed for such reporting when solutions are needed that are all-encompassing. To reach the public and those dwelling in urban centers, the word *soil-sphere* avoids the trap of terminology, which can hide or put off readers from seeing the urgency of instigating best practices. Such a change in words can be the center of communication, as noted, “...unless we make it easy for people to remember how, when, and what to do, it is unlikely that a program will be successful,” [14].



Recent global developments - is endangered too strong a word?

We are used to using the term “endangered” for organisms in a living ecosystem. Here, endangered means a species in danger of extinction, to put it concisely. Consequently, when one looks at a given ecosystem, it has its abiotic and biotic inputs, and we see extinction in the biotic, or living, elements of a particular location. However, where does this cast “soil?” While soil may not seem to be living itself, in many cases, what the soil holds and provides for is an abundance of life underground – a soil’s biodiversity [13] - where it becomes part of a soil’s profile.

Previous documents from the Convention on Biological Diversity and/or the Global Biodiversity Framework (GBF) contained supportive documentation on soil-related issues and actions, as seen in one FAO report [15]. However, in the most recent such undertaking, the Kunming-Montreal Framework, soil is not mentioned, nor is soil present in subsequent analysis of that framework [16].

While soil may be absent from conventions, one international network taking the “save our soils” perspective is *Conscious Planet Save Soil*, <https://consciousplanet.org/en/save-soil>. In addition, to help conserve and protect farmland, valuable soil textures and horizons can now be readily identified. Subsequent actions could be rapidly adopted if spoils in peril could be given an official classification as “endangered.” Taking a more holistic view of soil has included three levels of beauty: sensory, functional and meaningful [17]. When taken together, the importance of the *soil-sphere* is clearly seen.

While the loss of cultivated acreage in Ukraine due to invasion can be clearly shown, to fully capture the story would require equivalent projections for agricultural land lost to urbanization, erosion, or any other of the previously mentioned factors. This would paint a fuller picture as to how one vital resource, the soil-sphere, is faring during a time of farmland reduction, greater expectations for productivity, and a counter-balance to the absence of the *soil-sphere* in the recent GEF report.

Joel I. Cohen
Visiting Scholar
Nicholas School of the Environment
Duke University, Durham
Joel.cohen@duke.edu



REFERENCES

1. **Brady NC and RR Weil** The Nature and Property of Soils. Upper Saddle River, NJ: Prentice Hall.
2. **Hornaday W** Our Vanishing Wildlife - It's Extermination and Preservation. New York Zoological Society. 1913. 410 pages.
3. **Cohen JI and S Altman** An historical analysis of United States experiences using stamp-based revenues for wildlife conservation and habitat protection. *Discover Sustainability*. 2021.
<http://en.sustainablevalueinvestors.com/2020/09/28/2020-global-biodiversity-outlook-places-humanity-at-a-crossroads/>
4. **Becker-Reshef I and Mitkish** When farmland becomes the front line, satellite data and analysis can fight hunger. *Issues*, Winter. 2024.
5. **Canadian Society of Soil Science (CSSS)**. Chernozemic Order, in Soils of Canada. 2020. (Online). <https://soilsofcanada.ca/imagery-collection/chernozem.php#BrownChernozem>
6. **Kopittkea PM, Minasny B, Pendall E, Rumpel C and BA McKenna** Healthy soil for healthy humans and a healthy planet. 2020.
7. **Brevik EC, Slaughter L, Singh BR, Collier D, Barnhart P, Pereria P and JJ Steffan** Soil and Human Health: Current Status and Future Needs. 2020. <https://doi.org/10.1177/1178622120934441>
8. **Brevik EC and LX Burgess** The Influence of Soils on Human Health. *Nature Education Knowledge*. 2014; **5(12)**: 1.
9. **Schafer S** Surface pressure: losing farmland at an alarming rate. *AG Web, Farm Journal*. 2022.
<https://www.agweb.com/news/business/farmland/surface-pressure-us-losing-farmland-alarming-rate#>
10. **Meyer A** Save the topsoil. Soil Solutions LLC. 2024.
[https://soilsolutions.net/save-the-topsoil/William_Hornaday_\(1913\)_in_his_book,_Our_Vanishing_Wildlife_-_It's_Extermination_and_Preservation.](https://soilsolutions.net/save-the-topsoil/William_Hornaday_(1913)_in_his_book,_Our_Vanishing_Wildlife_-_It's_Extermination_and_Preservation.)
11. **Thaler EA, Larsen IJ and Q Yu** The extent of soil loss across the US Corn Belt. *PNAS*, 2021; **118(8)**.



12. **Chrispeels MJ and DE Sadava** Plant nutrition and crop improvement in adverse soil conditions. Chapter 11 in, *Plants, Genes and Crop Biotechnology*. Jones and Bartlett Publishers. 2003.
13. **Anthony MA, SF Bender and MGA van der Heijden** Enumerating soil biodiversity. *PNAS*, 2023; **120(33)**: e2304663120.
14. **McKenzie-Mohr D** *Fostering Sustainable Behavior Third Edition*. New Society Publishers, Canada. 2019.
15. **FAO, ITPS, GSBI, SCBD and EC**. State of knowledge of soil biodiversity - Status, challenges and potentialities, Report 2020. Rome, FAO.
<https://doi.org/10.4060/cb1928en>
16. **Hughes AC and RE Grumbine** Perspective, The Kunming-Montreal Global Biodiversity Framework: what it does and does not do, and how to improve it. *Frontiers in Environmental Science*. 2023; **11**: 2296-665X.
<https://www.frontiersin.org/articles/10.3389/fenvs.2023.1281536>
17. **Thompson M** SSSA President's Message: Soils are awesome-and beautiful! *CSA News and Perspectives*. 2024; **69(2)**: 20-23.
<https://doi.org/10.1002/csan.21226>

