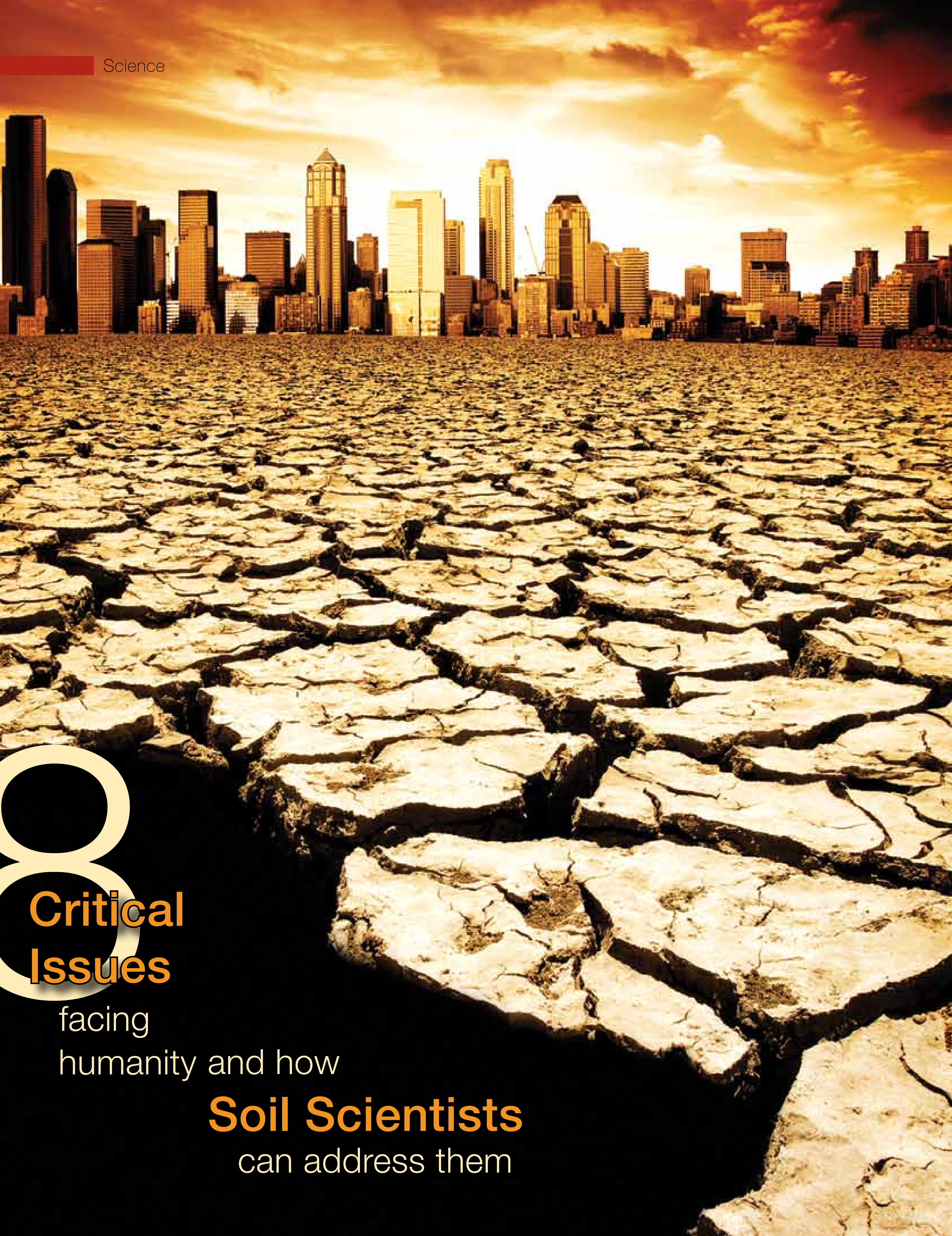

8 Critical Issues facing humanity and how Soil Scientists can address them

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The biosphere, our fragile and exquisite home, is changing abruptly and irrevocably, largely from human interference. Most or all of the coming stresses have links to the land, so finding hopeful outcomes depends on a wide and deep understanding of soils. In this article, we pose eight urgent issues confronting humanity in the coming decades: demands for food, water, nutrients, and energy; and challenges of climate change, biodiversity, "waste" reuse, and global equity. We then suggest some steps soil scientists might take to address these questions: a refocusing of research, a broadening of vision, a renewed enticement of emerging scientists, and more lucid telling of past successes and future prospects. The questions posed and responses posited are incomplete and not yet fully refined. But the conversations they elicit may help direct soil science toward greater relevance in preserving our fragile home on this changing planet.

The terrestrial landscape—our exquisite, fragile home on this planet—is facing upheavals perhaps as tumultuous as any in human history (Moore, 2002; Millennium Ecosystem Assessment, 2005). These rapid changes, discernible even in our own brief life spans, are mostly our own doing—the leavings of our burgeoning billions, squeezed ever tighter into a finite planet with dwindling resources.

Finding pleasant passage through the coming bottleneck (Wilson, 2002) will be a challenge of scale and gravity not seen before. And the place to start, we propose, is by knowing the soil. Although new technology may delay some stresses, the enduring answer will come from more humble aims: learning to live on the land. It is the land—founded on soil but interwoven with life and processes above and below it—that ultimately sustains us. Peoples in the past, now gone, did not learn that in time (Diamond, 2005). We, no less than they, are nourished in body and spirit by the ecosystems in which we are enmeshed, sometimes obliviously.

In this essay, we explore some urgent questions facing humanity in the coming decades and ponder how we, who study the land, might help resolve those challenges. We aim merely to ask the questions and proffer some initial musings in the hope of spurring conversation in soil science and affiliated communities.

Photo by Marco Dormino (United Nations)

1 Food: How Can We Feed Billions More without Harming Our Soils or the Broader Environment?

By 2050, global population may exceed 9 billion, an increase of more than 2 billion from today (United Nations, 2008). Daily per capita food consumption, now ~12 MJ, may reach ~13 MJ (~3,100 kcal) before leveling off (FAO, 2006). Furthermore, as incomes grow in developing countries, so do appetites for animal products, increasing the demand for feed. These factors and others have led some to project that global food requirements may increase by more than 50% by 2050 (Glenn et al., 2008; Godfray et al., 2010).

One fundamental question for soil scientists to ask is: Where should we aim to produce more? Where are potential increases the highest—in developing countries where needs are greatest? And where will such increases exert the least pressure on soils and other resources?

Soil scientists will also want to ask: How should we aim to produce more? Sometimes the best approach might be to intensify existing farming systems—with better genotypes; more advanced methods of fertilizing, tilling, and planting; and improved control of weeds and other pests. Elsewhere, pushing current systems harder may unduly damage the land, and we may need to explore fundamentally rearranging systems by asking venturesome questions. What is the place of "organic" farming systems or of genetically reconfigured crops? How can we exploit the innate advantage of ruminant livestock while reducing the environmental impact of some intensive feeding practices? Should we aim for more intensive production on smaller areas (land sparing) or more environmentally benign production on expanded areas (Balmford et al., 2005; Matson and Vitousek, 2006)? What are the prospects for urban farms (Drechsel and Dongus, 2010)?

It is not just a question of producing more food, but also of ensuring that we do not impinge on the capacity of others—notably our descendents—to derive from the soil their food and other services. The soil scientist, then, may step beyond merely measuring how current ways of producing food affect the soil to exploring new approaches that increase food yield and preserve other ecosystem functions.

2 Fresh Water: How Can We Manage Our Soils to Use Dwindling Pools More Wisely?

Our planet is bathed in water. But of all water on earth (~1.4 billion km^3), only ~3% is "fresh," and most of that is locked up in polar ice caps, glaciers, or underground reservoirs, leaving only a fraction available for humans and terrestrial ecosystems (Schlesinger, 1997; Oki and Kanae, 2006; Jury and Vauz, 2007).

For a long time, fresh water was seen as plentiful on earth—and squandered accordingly. But now, in the 21st century, fresh water is growing scarce as demands expand and the remaining pools are being drained or fouled. Already, some underground reservoirs are being quickly depleted, often to irrigate crops, and few major rivers are left to dam (Nilsson et al., 2005). With changing climate and continued population growth, these water shortages are likely to further intensify (Vörösmarty et al., 2004; Rosegrant et al., 2009).

How, then, do we manage water in the decades ahead to satisfy human and ecosystem needs on a warming planet? One way is to rely more on vertical fluxes of water ("green" water—precipitation and transpiration) and less on lateral fluxes ("blue" water—aquifers, lakes, and reservoirs) (Falkenmark and Rockström, 2006). Can we further improve water use efficiency on farms by managing soil disturbance, plant populations, and nutrient pools (Hatfield et al., 2001; Turner, 2004; Passioura and Angus, 2010)? Can improved understanding of the plant–soil system lead to cultivars with higher water use efficiency (Morison et al., 2008)? And can we reduce the polluting effects of agriculture, thereby keeping more water fresh?

Averting the threats of widespread water shortages is already an urgent global objective (Anonymous, 2008), and climate change may further exacerbate shortages (Chapin et al., 2008; Schimel, 2007). Much of the actively circulating fresh water on our planet percolates through the soil, at one point or another, and soil science is therefore needed not only to understand these flows but also to seek ways of managing dwindling reserves more efficiently.

Photo on the left originally submitted with a *Journal of Environmental Quality* article by Weston et al. (2008; 38:238-247). Photo on the right originally submitted with an *Agronomy Journal* article by Hanna et al. (2008; 100:1488–1492).

3 Nutrients: How Do We Preserve and Enhance the Fertility of Our Soils while Exporting Ever Bigger Harvests?

As yields increase, so do nutrient exports from soil. In the United States, for example, the harvest of major crops annually removes about 7.8 Tg of N (excluding N2–fixing crops—alfalfa, soybean, and peanut), 2.3 Tg of P, and 6.7 Tg of K, with removals increasing by roughly 1% per year (International Plant Nutrition Institute, 2010).

If reserves in soils are to be maintained, exported nutrients need to be replenished. One way to do that—an approach we rely on ever more as yield demands increase—is to apply commercial fertilizers. As much as 40 to 60% of food produced in the United States and United Kingdom is due to fertilizer use, with even higher proportions in the tropics (Stewart et al., 2005). Erisman et al. (2008) estimated that fertilizer N accounted for the food of 48% of the 2008 global population.

We can no longer do without synthetic fertilizers. But their supply depends on finite reserves of energy and ores (Jasinski, 2008; Ober, 2008; Cordell et al., 2009). They are also a major input cost for farmers, and if not used judiciously, they can contaminate air and water. Consequently, further efforts are still needed to improve their efficiency (Dobermann, 2007). For cereal crops, uptake in the year applied is typically <60% for N, P, and K, although such estimates may not include nutrients retained in the soil (Snyder and Bruulsema, 2007).

Another aim is to recycle more efficiently the nutrients already in ecosystems, notably those in manure. Globally, the N voided by animals rivals the amount added in fertilizer, but only about 40 to 50% of excreted N is recovered and only about half of that is recycled to cropland (Oenema and Tamminga, 2005). Nutrients in crop residues can also be used more efficiently, especially those in legume residues, which provide biologically fixed N_2 (Doran et al., 2007).

Nutrients, like soil, water, and biological resources, are limited and need to be stewarded. For all sources, imported or recycled, the basic strategy is simple in concept—ensuring that the nutrient supply is tightly tuned to plant needs, thereby affording adequate nutrition while minimizing leaks. But with the vicissitudes of nature—capricious weather and variable soils, for example—we have not yet been able to precisely synchronize nutrient availability with crop needs.

Stewardship of nutrients can often be improved by retuning existing practices: improved placement, timing, and forms of fertilizer, for example. But some inefficiencies arise from fundamental ecological disconnects—the surfeit of manure nutrients far from their source, for example. In such cases, systems with entirely reconfigured nutrient flows may be needed. Always, the best approaches can be found by following nutrients over the long term and through their life cycle, from initial entry to final fate.

4 Energy: How Can We Manage Our Lands to Accommodate Increasing Demands?

Plant-based biofuels have surged to prominence, as a way of mitigating climate change while seeking energy security. The dominant processed biofuel now is ethanol, mostly from grain corn or sugarcane. In the United States, for example, more than 20% of corn yield is used for ethanol (Tollefson, 2008). Producing grain-derived biofuels, however, is relatively inefficient and could increase CO_2 emissions from land use change (Fargione et al., 2008; Searchinger et al., 2008) or N_2O emissions from growing the crops (Crutzen et al., 2008). Cellulose-based ethanol could yield higher energy efficiency, but technologies are not yet mature.

The growing demand to furnish feedstocks for biofuel emphasizes the importance of carefully evaluating ecological tradeoffs. If more C is removed for biofuel, that leaves less for use as food, fuel, or soil C replenishment (Lal, 2009). Many other questions remain. How do biofuel crops or plantations affect water use (Tricker et al., 2009; Karp and Shield, 2008) or biodiversity (Wilcove and Koh, 2010)? Can the greenhouse gas emissions from growing these crops be reduced (Crutzen et al., 2008)? What are the long-term effects of energy crops on salinity (Bartle et al., 2007) and other soil properties? Can the byproducts of bioenergy (e.g., biochar) be applied to improve soil quality and productivity (Gaunt and Lehmann, 2008)?

The dwindling reserves of cheap and relatively clean energy sources will affect ecosystems worldwide, both by making energy more expensive and by expanding the harvest of biomass for energy use. Soil scientists will need to be alert and far-sighted to ensure that these changes do not compromise the long-term health of ecosystems and to see that gains in one facet of the environment (e.g., climate change mitigation) do not induce losses elsewhere (e.g., soil quality or biodiversity loss).

5 Climate Change: How Will It Affect the Productivity and Resilience of Our Soils?

Concentrations of greenhouse gases in the atmosphere are rising rapidly. Carbon dioxide concentration, once about 280 μL L^{-1}, now exceeds 380 μL L^{-1}, and is increasing by almost 2 μL L^{-1} yr^{-1}, mostly from fossil fuel combustion but also from land use change (Canadell et al., 2007). This abrupt increase is projected to have long-lived effects on the global climate and biogeochemistry, affecting ecosystems in many ways, both direct and indirect (Intergovernmental Panel on Climate Change, 2007). For example: higher CO_2 concentrations affect the photosynthetic rate; changes to local climates affect the adaptivity of plants, animals, and their pests; warming accelerates organic matter decay; altered precipitation patterns cause droughts or flooding; changes in weather intensity affect soil erosion; rising sea levels alter coastal ecosystems; thawing of northern soils may induce CH_4 bursts; and shifts in arable lands may pose new threats on newly cultivated soils as farming systems move or adapt. In short, projected changes will stress ecosystems worldwide, sometimes leading to dysfunction and even positive feedback on climate changes (Ojima and Corell, 2009).

Because many of the threats from climate change affect the land, soil scientists will need to be at the forefront of climate change research. First, we need to better predict, based on a deeper understanding, how coming changes will affect ecosystem functioning. What will happen to the massive reserves of C stored in soils, wetlands, and tundra (Davidson and Janssens, 2006; Schuur et al., 2009)? Or how will changing climates alter N mineralization for corn in Iowa, soil organic matter in German forests, soil sediment load in the Amazon estuary, and pest outbreaks in the Serengeti?

Because many of the threats from climate change affect the land, soil scientists will need to be at the forefront of climate change research.

A second aim is to help design systems on managed lands that mitigate the threat of climate change by sequestering C in fields and forests, by curtailing emissions of CH_4 and N_2O from farmlands, and by providing feedstocks for bioenergy. Soil scientists should ensure not only that these practices are effective in the short term, but also that they do not jeopardize long-term ecosystem performance.

Third, soil scientists will need to help prepare for change. Many impending changes already have enough inertia that some impact is inevitable. Perhaps the best way of bracing for change (sometimes even benefiting from it) is to bolster the resilience of ecosystems, especially those dominated by humans. This means identifying and protecting the most fragile systems and envisioning new ones that might withstand and flourish in decades ahead.

Image courtesy of the International Institute of Tropical Forestry

6 Biodiversity: How Can We Better Understand and Enhance the Biotic Communities within and on the Soil to Create More Resilient and Fructuous Ecosystems?

Life on earth occurs in a dazzling array, entwined by flows of nutrients and energy. Through the long eons, these myriad biota gradually evolve, some species being lost, others emerging. Recently, however, rates of extinction have accelerated (Scholes and Biggs, 2005) so that conserving biodiversity is now a priority (Cabrera et al., 2008).

Soils are the foundations for the ecosystems that house terrestrial biota, so preserving soils is often a first step in preserving biodiversity (Lal, 2007). Furthermore, soils themselves hold an astounding abundance and variety of organisms, many of which remain unidentified and unstudied (Giller, 1996; Wolfe, 2001; Barrios, 2007). Indeed, "soils are one of the last great frontiers for biodiversity research" (Fitter et al., 2005).

Why is preserving biodiversity so important? First, terrestrial biota drive many of the vital functions performed by ecosystems, from furnishing food to filtering water to delivering pharmaceuticals (Daily, 1997; Hooper et al., 2005; Fischer et al., 2006). The soils' microbial and faunal communities, although hidden and ill understood, quietly mediate countless essential processes (Coleman et al., 2004; Wardle et al., 2004). Indeed, our feeble grasp of their services may be the best reason for preserving them; without knowing exactly what they do, we cannot even be sure what we have lost when they vanish. Second, preserving biodiversity confers resilience and stability to ecosystems (Brussaard et al., 2007; Naeem et al., 2009). Although organisms perform overlapping functions, this redundancy provides stability and contingencies during disturbances and upheavals.

If maintaining biodiversity is imperative, how does it affect the research we do? A first aim, clearly, is to use new methods (e.g., Zhang and Xu, 2008) to measure diversity within and on the soil. Ideally, measurements should be conducted at a continuum of scales, from soil aggregate to the entire planet (Loreau et al., 2001; Brooks et al., 2006; Scholes et al., 2008), and also across time, from days to decades. Broader scales also allow us to probe questions about tradeoffs; for example, is more intensive cropland monoculture (sparse diversity) justified to spare uncultivated lands (rich diversity) elsewhere (Green et al., 2005)?

A second aim is to understand more clearly the links between diversity and ecosystem performance and resilience. We know enough to presume that biodiversity is critical but not enough to explain the mechanisms and complex interactions by which these benefits are conferred (Andrén and Balendreau, 1999; Wardle et al., 2004).

Third, we need to understand better how humans threaten (or enhance) biodiversity within and on the soil. Which farming practices enhance diversity; which ones destroy it? What will be the influence of proposed forestry practices on the long-term soil biology? And how will impending global changes affect the countless communities of organisms that furnish the ecosystem functions on which we will depend into the future (Araújo and Rahbek, 2006)?

Photo by Peggy Greb (USDA-ARS)

7 Recycling "Wastes": How Can We Better Use Soils as Biogeochemical Reactors, Thereby Avoiding Contamination and Maintaining Soil Productivity?

Wherever we go and whatever we do, we leave behind wastes—from households and cities, from family dinners and family farms. As our numbers grow and our consumption intensifies, the volume of our refuse increases, and wise use of wastes becomes a bigger challenge.

Many problems of "waste" arise from a linear view of industrial processes: raw materials enter at one end, and products and wastes emerge at the other. This linear sequence creates two problems: depleted raw resources at one end; excess wastes at the other. What is needed, then, is a regenerative cycle (Pearson, 2007), where the "waste" becomes input, a cycle that, mimicking nature, can continue without end.

Several examples may illustrate the opportunities. One is to find ways of reusing byproducts of industrial processes—the excreta of food and fiber factories, the debris of fisheries and forestry, for example. A second challenge is to use more wisely the growing stockpiles of animal manure (Russelle et al., 2007). And a third is to learn how to recycle also our own biological wastes, rerouting them back to the land from which they came.

> What is needed ... is a regenerative cycle, where the "waste" becomes input, a cycle that, mimicking nature, can continue without end.... Soils, the site of decay, are central to any regenerative system...

Soils, the site of decay, are central to any regenerative system, and soil scientists will need to address some critical questions. What is the capacity of various soils to process wastes without harm to themselves or the water or air they feed into? What is the fate in soils of toxins and biohazards that are applied with organic amendments (Alexander, 1994)? Can we design systems that emphasize local recycling of byproducts, even in cities, avoiding long-distance transport? In probing these and other questions, soil scientists may help redesign our farming, forestry, urban, and industrial systems to better convert "wastes" into "resources."

Soils are not only agents of recycling, they themselves benefit from the recycling. Decomposition in soil can improve the soil physical structure, supply the soil and plants with nutrients, and foster an energy- and substrate-rich environment to host a diversity of biota (Barrios, 2007; Abiven et al., 2009). In the long term, however, inputs of wastes need to be balanced by the soils' capacity to recycle them (Edmeades, 2003).

8 Global Perspective: How Can We Develop a Seamless Perspective that Still Allows Us to Optimize Management Practices for Local Places, Wherever They May Be?

Our earth is one cohesively connected entity, yet wounds are inflicted on the landscape locally: a farmer's field, a stand of forest, and a trickling stream. And healing of the earth also happens locally. The best way to manage the land varies from place to place, from year to year. Because of the many local factors—physical, social, and ecological—there are few universal "best management practices."

What is the way out of this dilemma—the need for a global perspective, while tuning practices to local peculiarities? The solution may lie in crafting a seamless understanding across scales of space from a soil aggregate to the planet. With careful weaving, such a continuum across scales allows insights and findings to be extrapolated upward, from the local to the global, and also downward, from the planet to the neighborhood. Soil scientists are uniquely endowed to forge such a continuum because the object of their study, soil, is itself an unbroken skin stretching across all terrestrial landscapes (and if we allow "soil" to include sediment, then, in fact, it wraps the entire surface of the planet).

This new way of looking at the world, in effect, allows a shifting of the boundaries of an ecosystem—from a handful of earth to the entire planet. A starting point may be to maintain and expand evolving global databases of soil, vegetation, and research findings (Hartemink, 2008), making them accessible to all potential users, from farmer-villagers to scientists. And to see changes in soils, we also need networks of long-term sites (Robertson, 2008; Richter et al., 2009)—numerous ecological sites, across biomes and land uses, sampled repeatedly to monitor how lands and their inhabitants change across decades. Although such networks are already underway, many gaps remain, notably in developing countries.

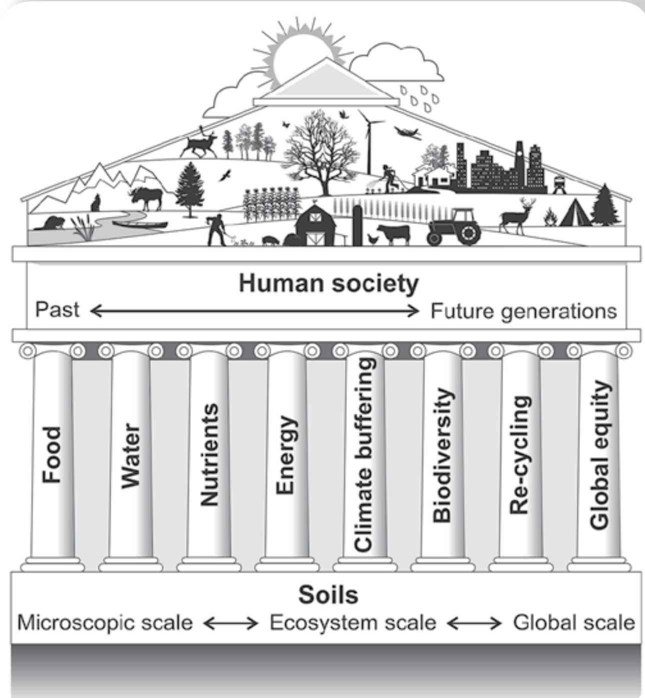

Fig. 1. Some ways in which soils support societal aims, now and into the future. The eight pillars correspond roughly to the issues addressed here.

Ways to ease the pressures awaiting human society, we claim, are founded in a better understanding of soils (Fig. 1). How then do we, who claim to know the soil best, expand and apply our expertise? We offer here some initial thoughts, as seeds to further fruitful conversations.

Refocus and Redouble Our Research Efforts on the Questions Identified

A first aim is to intensify our efforts to understand our biosphere, probing its functioning with the intent of building and preserving robust ecosystems, resilient enough to flourish in the coming tempests. In some areas, such as boreal forests and polar regions still relatively unscathed by direct human influence, that means learning how the systems behave in the hope of minimizing future stresses. In others—intensively managed farmlands, for example—it means looking for ways to reduce harm and imbue resilience while meeting the growing demands expected of them.

Such research should be directed, not from the vantage of today, but from that of our successors. If earth's systems are changing and much of our research will reach fruition only after long years, we might best design our experiments with an eye to how our landscapes will be when the find-

Photo courtesy of J. Kelley, http://SoilScience.info

ings emerge. This will demand all our foresight, to envision our earth as it will be and steer our work accordingly.

More than one civilization has fallen after failing to nurture soils and their functions (Hillel, 1991). Soil erosion likely hastened the decline of the Greek empire more than 2,000 years ago because people did not understand the irreversibility of soil loss. Similarly, limited understanding of soil–water relations left lands in the Tigris and Euphrates valleys saline and barren. More recently, huge amounts of N were lost from Great Plains soils before their native stocks had even been measured. Our task is to ensure that our own unfolding society, and that of our successors, does not falter for want of understanding its foundation—the soil.

Broaden Our Vision and Scope

To address the global issues confronting us, we will need to broaden our purview. First, we will want to look beyond soils to ecosystems, encompassing all living things and their physical environment and all the flows of energy and elements that connect them (Tansley, 1935). Second, we will need to look beyond deliberately managed lands to all biomes, emerging from the agricultural sector, our comfortable cocoon, to offer expertise to other scientific disciplines and to policymakers. Furthermore, soil scientists should look beyond well-funded regions to encompass especially poorly studied areas (Huntingford and Gash, 2005); for example, if future environmental stresses will weigh most heavily in developing countries (Millennium Ecosystem Assessment, 2005), can we apply more of our expertise there? Finally, we should see beyond the biophysical sciences to enfold also the humanities—economics, sociology, philosophy, political science—even the arts. The biophysical sciences alone will not resolve the awaiting stresses; if our behavior, in the end, is the most critical threat and hope for planetary health, then we may not make much headway in our science without also studying ourselves and reshaping our behavior (Lal, 2007; Jasanoff, 2007).

The real questions facing soil science—no less urgent than merely producing more—have to do with softening human impacts on the environment. Such efforts will demand new alliances, new synergies with diverse disciplines. But soil scientists have historical advantages here; the soils we study already connect societies across geography and across time. Have we exploited that integrative advantage enough?

Our ecosystems furnish for us countless services (Daily, 1997). Many are tangible and self-evident: food, fuel, and fiber; shelter for wildlife (and people); livelihood and places to play. But others happen quietly, in the background, and although they may be invisible, such services are as essential as the obvious ones. Can we, in the future, study also these other services by linking our work with that of other disciplines?

Entice New Scientists

For any species to survive and prosper, it must replenish itself. That applies also to soil scientists; and now, to our perplexity, the prospects for numerical renewal sometimes seem a little gloomy. Most soil scientists today are "mature" (Collins, 2008) and, in many places, student enrollment in soil science courses has fallen (Baveye et al., 2006; Hartemink, 2006; Hopmans, 2007). The mention of excitement of soil science to an undergraduate student may elicit a blank stare.

In short, where once we looked downward onto and into the soil, now we look upward and outward from the soil, pondering the biosphere from its foundation.

One way to advance a "renaissance" (Hartemink and McBratney, 2008) may be to redefine what a soil scientist is and does. Where once soil scientists probed the soil seeking to elucidate processes there, now they study soil's place in the broader biosphere. Where once we fretted about eroding soil quality, now we ponder bigger questions of ecosystem resilience. Where once we congregated mostly among ourselves, now we mingle with others in diverse forums, disciplines, and issues (Bouma, 2009). In short, where once we looked downward onto and into the soil, now we look upward and outward from the soil, pondering the biosphere from its foundation.

Another way to attract more students may be to illuminate and articulate, with greater passion, the grandeur of our questions. When listing the challenges with which we wrestle, we might ourselves be surprised at their magnitude, their urgency, the wild sense of curiosity they engender. The greatest enticement to emerging scientists may be the chance to explore questions of our natural world, intensely fascinating, deeply relevant, and critical to society's future. Young students of chemistry and microbiology might be surprised to find that the most enticing research topics reside, not in the pure and tidy tubes and cultures of the laboratory, but in messy, mysterious soils.

Communicate Better

Soil science has an image problem, in part perhaps because few outside our discipline appreciate the essential place of soil and the way it is enmeshed in the past and future of society. Few link the abundance of vegetables in their local grocery to healthy soils in California. Few stop to ponder that what they choose to eat might affect soil in a distant landscape. And fewer still see that maintaining soils is not just a question of food but also of broader societal aims: security, justice, and peace (Lal, 2008).

Can we talk to others about soil science with more passion and clarity? We might start by celebrating more vigorously our past achievements. We have already made substantive gains in many of the questions enumerated above. For example, global land productivity has more than doubled in the past half century (Alston et al., 2009), in part through better management of soils. Although poverty and hunger persist, more people are now better fed than ever before. Freed from scrabbling daily for food, most people across the planet can enjoy social, emotional, intellectual, and economic pursuits that are the hallmarks of a civilized world. Another example: we have learned ways of conserving soils in the face of winds and water that once eroded the lands; one such practice—no-till—is now used effectively on farms worldwide (Hobbs et al., 2008). How many know of these achievements?

We are a lucky lot, we who scratch about in the earth, trying to uncover its mysteries, searching for new hope in the face of ominous threats. Our good fortune and our simmering excitement, sadly, may not always erupt spontaneously from the papers we write and the text we flash on screens. Our highest aim, then, may be to let our audiences in on the joys of our exploring. Our noblest task, and the most rewarding, may be to find better ways of expressing our delight and wonder in the secrets we are slowly unearthing, and of how our renewed acquaintance with the land can offer hope for coming generations.

Acknowledgments

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Soil Science Society of America Celebrates 75th Anniversary

The Soil Science Society of America (SSSA) is celebrating its 75th Anniversary in 2011, and also the 75th anniversary of its peer-reviewed journal, the *Soil Science Society of America Journal* (SSSAJ).

Founded in 1936, SSSA supports peer-reviewed publications, an Annual Meeting, science policy activities, and the Certified Professional Soil Scientist Program. Today, SSSA continues to help its members advance the field of soil science through outreach to teachers, undergraduate and graduate students, and members around the world.

"During our 75-year history, the Soil Science Society of America has had many accomplishments. From our peer-reviewed journals, Annual Meeting, and educational outreach, we have much to celebrate," says SSSA President Charles W. Rice, Kansas State University. "We look forward to the next 75 years in SSSA history, as the importance of the soil ecosystem moves to the forefront of discussions about climate change, food security, water quantity and quality, contamination, and human health."

SSSA recently completed its assessment of the grand challenges facing the soil science discipline, identifying the most critical future research needs in soil science: climate change; food and energy security; waste treatment and water quality; and human and ecosystem health. For more information on the grand challenges in soil science, including the full list of short-, medium-, and long-term research goals, visit: www.soils.org/about-society/grand-challenges.

SSSA is planning several anniversary activities throughout 2011. A national outreach plan is being launched to increase awareness of the importance of soils and the soil science profession and will continue throughout 2011. A renewed and expanded effort to educate K-12 students about soil science is also being launched in 2011. Anniversary celebrations will culminate at the 2011 Annual Meetings, 16–19 Oct. 2011 in San Antonio, TX. For more information on the Annual Meetings, visit www.acsmeetings.org. To celebrate its anniversary, SSSAJ will publish historical perspectives throughout 2011. For more information on the journal, visit www.soils.org/publications/sssaj.

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