



A NEW FUTURE FOR FARMING, FOOD, AND HEALTH

David R. Montgomery

The first time I stood in a Kansas cornfield, I felt completely out of place.

You see, I'm a geologist accustomed to reading how mountains and rivers shape landscapes. Here there were no hills to break the horizon. Aside from all the corn and herbicide-resistant weeds there was hardly any life. No birds or insects broke the silence. This farm was a biological desert. Standing in that flat, eerie field on a hot summer day, all I had to do to know agriculture was in serious trouble was keep my ears open and look down at the ground.

The bare, rotting heart of conventional farming lay exposed between rows of corn marching across the field. Hardly any cover shaded the dusty ground. This anemic khaki dirt resembled California beach sand more than the dark fertile earth of pioneer lore. What little topsoil remained on the field had lost its organic matter to decades of conventional tillage and a steady diet of agrochemicals. The land was sick.

We don't tend to think of the soil as a living thing. We walk on it, after all. But an abundance of life makes for healthy fertile soil. Communities of bacteria, fungi, and larger organisms like worms and dung beetles spin the wheel of life, extracting mineral elements from rocks and recycling dead things—organic matter—back into the raw materials for new life. Just as our gut has a microbiome that affects our health, the soil has its own microbiome that influences crop health. Overuse of antibiotics can wreak havoc on gut microbes. Likewise, farmers can harm the soil microbiome through routine tillage and conventional agrochemical use.

Gazing across a sea of corn and bare earth, I knew that virtually everything on this typical American farm, from tractors and other machinery to the process for making fertilizers, ran on or was made with fossil fuels we can't afford to keep burning. Modern farming will change over the course of this century—the question is how. Will we double down on conventional practices that degrade the soil or transition to regenerative ones that restore fertility to the land? Whether you believe peak oil is already upon us or lurking off in a haze of distant tomorrows, there is no question we are long past peak soil.

Even so, arguments about the future of farming tend to overlook something remarkably fundamental—the state of the land. Soil degradation remains the most critical underappreciated and yet eminently solvable environmental problem humanity faces. Restoring agricultural soils would help address our warming climate and the parallel crises of biodiversity loss and water pollution. Rural communities and economies would also benefit, as would public health. But a century of entrenched thinking and interests stands in the way, resisting changes to a system that degrades the land, squeezes farmers economically, and seduces consumers with diets of empty calories. Contemporary debates tend to focus on the most polarizing issues—animal versus plant-based foods and genetic engineering. Unfortunately, this focus overshadows how the conventional wisdom that we need industrialized agrochemical farming to feed the world neglects what underpins it all, the health of the land—soil health.

I didn't set out to rock the boat in a field outside my own. I never aspired to write about soil, let alone how agriculture can heal or destroy farmland, undermine or sustain civilizations, and enhance or compromise human health. As a geologist trained to read the forces that sculpt landscapes and to interpret evidence of vanished worlds, I initially saw soil as annoying stuff that covered up rocks and obscured earth history.

My perspective started to shift as I specialized in geomorphology, or how erosion shapes the land—the here and now of geology. If geology is about how rocks are put together, geomorphology is about how they fall apart and get shaped into terrain. Over time, I came to see that soils around the world told stories about people and societies that degraded their land and passed the bill on to impoverished descendants.

The more I looked, the more apparent it became that the way we think about the soil in this century will profoundly shape the world for generations to come. How farmers treat their fields today affects the health of the land and what gets into what we eat, and thus us—for better or worse. We are at the point today where conventional agriculture erodes soil far faster than it forms, needlessly shortchanges our health, and degrades soil organic matter and soil life, stalling out nature's grand engine of fertility. That can't go on forever, and we shouldn't let it for much longer. We can only degrade land for so long before shortsightedness bites our descendants in the backside.

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Looking into long suspected but often discounted or overlooked connections, I began to see how farming practices link to soil health, biodiversity, climate, and human health. To be sure, I didn't connect the dots all at once in some inspired moment, or all by myself for that matter. I learned from historians, farmers, fellow researchers, and biologist Anne Biklé, my wife and coauthor, whose soil-building gardening adventures spurred us both to dig deeper into regenerative practices.

My journey, together with emerging science, convinced me an updated soil-building philosophy could reform agriculture enough to feed everyone well into the future—and keep us from repeating mistakes that plagued past societies. Global food security is within our grasp if we look at soil differently—as an invaluable intergenerational inheritance rather than a cheap industrial commodity.

When I first started thinking about soil erosion and agriculture, I did not imagine that I'd be writing about the connection years later. But the more I looked into the issues around how farmers treat their land, the more I realized how important solving the problem at the heart of land degradation will prove to our collective future. Along the way I changed, from a pessimist sure we would repeat stories past civilizations wrote in their soil to seeing ways to reform conventional farming and harvest benefits beyond feeding the world.

It all began with *Dirt: The Erosion of Civilizations* (2007), the story of how societies that don't take care of their land don't last. Writing it, I started to wrestle with the question of how humanity might reverse the historical pattern of soil degradation that undermined one civilization after another.

I found inspiration and education in an unanticipated place—the garden in my own backyard. When Anne and I bought a house in North Seattle in the late 1990s, the yard came with a large lawn of stickery dandelions, a dead cherry tree, and a big old clump of invasive Japanese knotweed. Only when we pulled off this green veneer to start planting the garden she lusted after did we realize we had crap soil. Not a single worm wriggled out of that dead dirt.

Through intensive mulching and organic matter applications, Anne brought our soil back to life. Seeing how fast her efforts rebuilt incredibly fertile soil motivated us to write *The Hidden Half of Nature* (2016), an exploration of microbial life and its influence on soil health—and human health. Impressed with how Anne’s regenerative gardening restored our soil, we wanted to know whether similar practices can heal farmland. So I set off to visit farmers around the world who had done to their soil what Anne did to our yard. *Growing a Revolution* (2017) tells their stories and investigates how farming practices based on soil-building principles can rapidly heal the land.

Could we afford to farm this way and still feed everyone?

Left with questions about how farming practices affect the nutritional quality of the human diet, Anne and I explored what rebuilding healthy soils could mean for human health in our most recent book, *What Your Food Ate* (2022). My latest book, *ReGen*, synthesizes what I’ve learned along the way into a regenerative vision for the future of farming, food, and health rooted in reforming how we see and treat the world beneath our feet.

The overarching question around the future of farming is not conventional versus organic, plowing versus no-till, or plant-based versus animal products in our diet—the major disputes that trigger passionate debates today. Cutting across them all is whether farming practices are degenerative or regenerative, whether farming degrades or enhances soil health, mines or builds and maintains fertility. Now, after a century pursuing chemical solutions to the inherently biological problems of soil fertility and pest control, we’re discovering that we shortchanged naturally effective solutions that can benefit farmers, society, and the environment.

In contrast, regenerative farmers seek to build and support soil health through minimizing or avoiding physical and chemical disturbance. They greatly reduce if not eliminate tillage, synthetic fertilizers, and pesticides. Regenerative organic farming takes soil building a step further, eliminating chemical disturbance and minimizing physical disturbance (through low or no-till practices). This combination is particularly beneficial to soil life, and thus soil health.

The U.S. Department of Agriculture defines soil health as the continued capacity of soil to function as an ecosystem that sustains and promotes the health of plants, animals, and people. That’s kind of a mouthful. Another way soil health has been defined is as the capacity to sustain plant and animal productivity through the natural fertility of the soil. Health also conveys a sense of resilience, the ability to resist or counter the effects of physical stress and disease. What this all means is that soil health reflects the physical, chemical, and biological properties of the soil. Researchers argue over how to define and measure soil health and will no doubt continue to do so well into the future. But assessing whether farming practices work to build or degrade soil health is fairly straightforward.

Consider how we commonly use a few indicators like blood pressure and body temperature to assess human health. Yet we all know there's more to understanding health than just a couple of indicators can convey. That's why doctors ask about a patient's health background and family medical history.

Likewise, a few initial factors are particularly helpful in assessing soil health, like soil organic matter levels. Interpreting and diagnosing additional qualities including microbial communities and soil structure also come into play. Moreover, the importance and implications of all these factors vary with geography. Consider that there are several hundred thousand different types of named soils in the world, reflecting a wide variety of parent materials (rocks), climates, and topographic position, as well as organisms living on and in them. In addition, practices that work best to build healthy soils can vary from farm to farm, region to region, and among farming systems. Despite all this complexity, when interpreted in their geographic context, soil organic matter levels and microbial activity are essential aspects of soil health. Moreover, they are tightly linked—more organic matter tends to support greater populations of more diverse and beneficial communities of soil life.

The need to adopt practices that build rather than degrade soil health extends across all styles of farming. After all, long before mechanization and agrochemicals, tillage-heavy organic farming undermined soil fertility in ancient societies. The issue isn't large versus small farms; I've seen regenerative farming work on tiny subsistence farms and several-acre vegetable farms as well as vast row-cropping operations and sprawling ranches. Indeed, a few general principles for building soil health appear to be universal, even if specific practices need to be tailored to the soil, climate, crops, and technologies available to farmers in different regions.

Of course, for soil-building farming to catch on it needs to be both feasible and profitable for farmers. I started to become optimistic about the potential for widespread adoption of regenerative practices when I visited farms around the world that had rapidly and profitably restored the productivity of seriously degraded land. Having seen it done across a range of settings, I'm confident it can be done again and again—and faster than I'd imagined.

Indeed, a surge of recent paradigm-shifting botanical, microbial, and agronomic science piling up in academic journals provides a solid foundation for broad adoption of soil-building farming. This new knowledge and understanding about ways to build and maintain healthy soil is far from fully deployed in agriculture. Biological solutions remain a hard sell to conventional farmers and crop advisers accustomed to treating fertility as an applied chemistry problem. Yet barking up the agrochemical tree for a century left us with a daunting series of problems rooted in soil degradation and disruption of soil life. Although our global agricultural enterprise rests on a foundation of twentieth-century agrochemistry, twenty-first-century science points to the transformative potential of a soil health-oriented approach.

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I recall how at one of the first regenerative farms I visited in the American Corn Belt, the spongy soil underfoot seemed to spring back with each step across the fields. This Ohio farm grew the same crops that neighboring conventional farms did—the farmer just did it really differently. Walking across his fields, the ground beneath my feet testified to the power of a new style of farming to heal the soil and restore life to the land.

I was so used to the hard-packed, crusty, or dusty soils on conventional farms like I'd first encountered in Kansas that this felt like a stroll across fluffy cushions. When I slipped my hand into the crumbly black earth, a knot of worms wriggled away as myriad crawly things scattered. This soil was alive and full of bugs while the fields buzzed with birds hanging out eating them. Crops looked vibrant and healthy. The promise of a regenerative future for farming lay exposed all around me, yet a critical question loomed. Could we afford to farm this way and still feed everyone?

Now, after years of looking into how farming influences the soil on which it depends, I'm convinced it is not only feasible but imperative. For it will take merging ancient wisdom rooted in aspects of traditional practices with the benefits of modern science and technology to solve humanity's oldest problem and rewrite the stories we inscribe upon the land. 🌱



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David R. Montgomery is a professor of Earth and Space Sciences at the University of Washington. He studies the evolution of topography and the influence of geomorphological processes on ecological systems and human societies. He received a BS from Stanford University (1984, geology) and a PhD from UC Berkeley (1991, geomorphology). His field studies have included projects in the Philippines, eastern Tibet, South America, California, and the Pacific Northwest of North America. He is an elected Fellow of the American Geophysical Union and has received many awards throughout his career, including a MacArthur Fellowship and the Vega Medal. His books *Dirt*, *King of Fish* and *The Rocks Don't Lie* have all won the Washington State Book Award in General Nonfiction. *Growing a Revolution* was a finalist for the PEN/E. O. Wilson Award for Literary Science Writing. He also coauthored with Anne Biklé *The Hidden Half of Nature* and, most recently, *What Your Food Ate*. His books have been translated into ten languages. He is also a coauthor of the new textbook *Essentials of Physical Geography* with W. W. Norton.



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