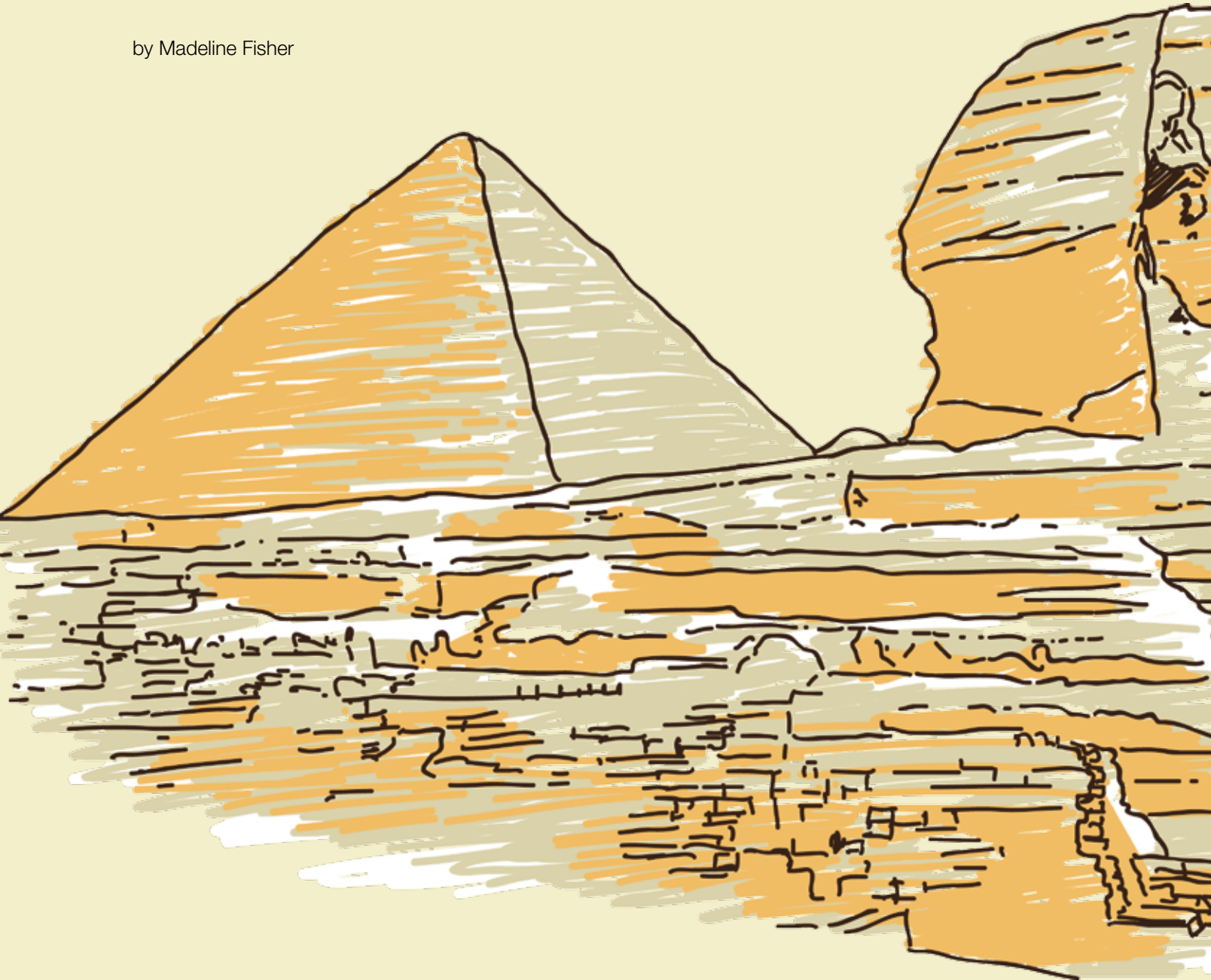


# Sustainability

Learning the lessons  
of past civilizations

by Madeline Fisher



## When a group of Polynesians arrived some 1,000 years ago on an isolated South Pacific isle known as Easter Island, they encountered a lush, forested landscape.

That quickly began to change, however, as the settlers chopped down trees to stoke cooking fires, make dug-out canoes, and erect the giant stone statues the island is known for. Historians and anthropologists estimate the last tree was axed 700 years later, leaving the islanders with no new wood for canoes, no means to fish the sea—and no way to escape. Chaos ensued, and the society collapsed in a frenzy of civil war and cannibalism.

Haunting tales like this about past civilizations never fail to fascinate us.

But in telling the Easter Islanders' story last fall at the ASA, CSSA, and SSSA Annual Meetings in Long Beach, CA, speaker Jared Diamond had more in mind than simply spinning a romantic yarn. The fates of failed societies carry a modern day warning, said the UCLA geographer and Pulitzer Prize-winning author: We

pursue unsustainable environmental practices and ignore environmental problems at our peril.

"The metaphor is so obvious. Easter Island is isolated in the Pacific Ocean; once the Easter Islanders got into trouble, there was nowhere that they could flee," he said. "Just as if, today, we on planet Earth mess up our island planet, there is no other galaxy that we're going to be able to float off to."

Forget quaint notions of sustainability, then, centered on cheerful things like local foods and compact fluorescent bulbs. If we don't solve our most pressing environmental challenges, including soil erosion, climate change, peak oil, and increasing consumption of global resources from a growing population, history suggests we won't survive. Yet, in bringing this bleak message to the Annual Meetings, Diamond also offered some hope. Of the 12 most important classes of environmental problems that plagued past societies and threaten us now, at least 10 are also central to agronomy, crop science, and soil science. Agricultural sustainability, in other words, is the heart of global sustainability—making the work of agricultural and soil scientists central to the solutions to these problems.

University of Washington geomorphologist David Montgomery, the SSSA plenary speaker at the meetings, echoed Diamond's thoughts. In fact, he argued even more strongly that agricultural sustainability—particularly the conservation of soils—could be a key to our long-term survival.

"If we rethink the way we treat the land, if we rethink the way we treat soils," he said, "we can use soils as a foundation for addressing some of the fundamental challenges that face humanity this century."



UCLA geographer and Pulitzer Prize-winning author Jared Diamond (**top**) and University of Washington geomorphologist David Montgomery (**bottom**) speaking at the ASA, CSSA, and SSSA Annual Meetings in Long Beach, CA in November.

## Choosing to Fail or Succeed

Acknowledging the importance of sustainability is one thing, however; mustering the will to follow sustainable practices is quite another. That's why Diamond has spent the last 15 years examining the consequences

All that said, how societies exploit natural resources often isn't the only factor in whether they succeed or fail, he added. Four other factors usually contribute, as well: climate change, the presence of enemies, the support of friends, and the existence of economic, social, and cultural institutions

social and political structure insulated them from the consequences of the destruction—until the moment, that is, when the malnourished commoners finally “rose up and burned down their palaces.”

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of failing to do so—research that is summarized in his 2005 book, *Collapse: How Societies Choose to Fail or Succeed*. The ancient Maya, for example, were the most advanced Native American society in the New World before Columbus. Yet, like the Easter Islanders, they helped fuel their own demise by decimating their forests and soils. Much more recently, an exploding population in the 1980s in Rwanda forced the nation to carve its cropland into such tiny parcels that they could no longer nourish families who farmed them.

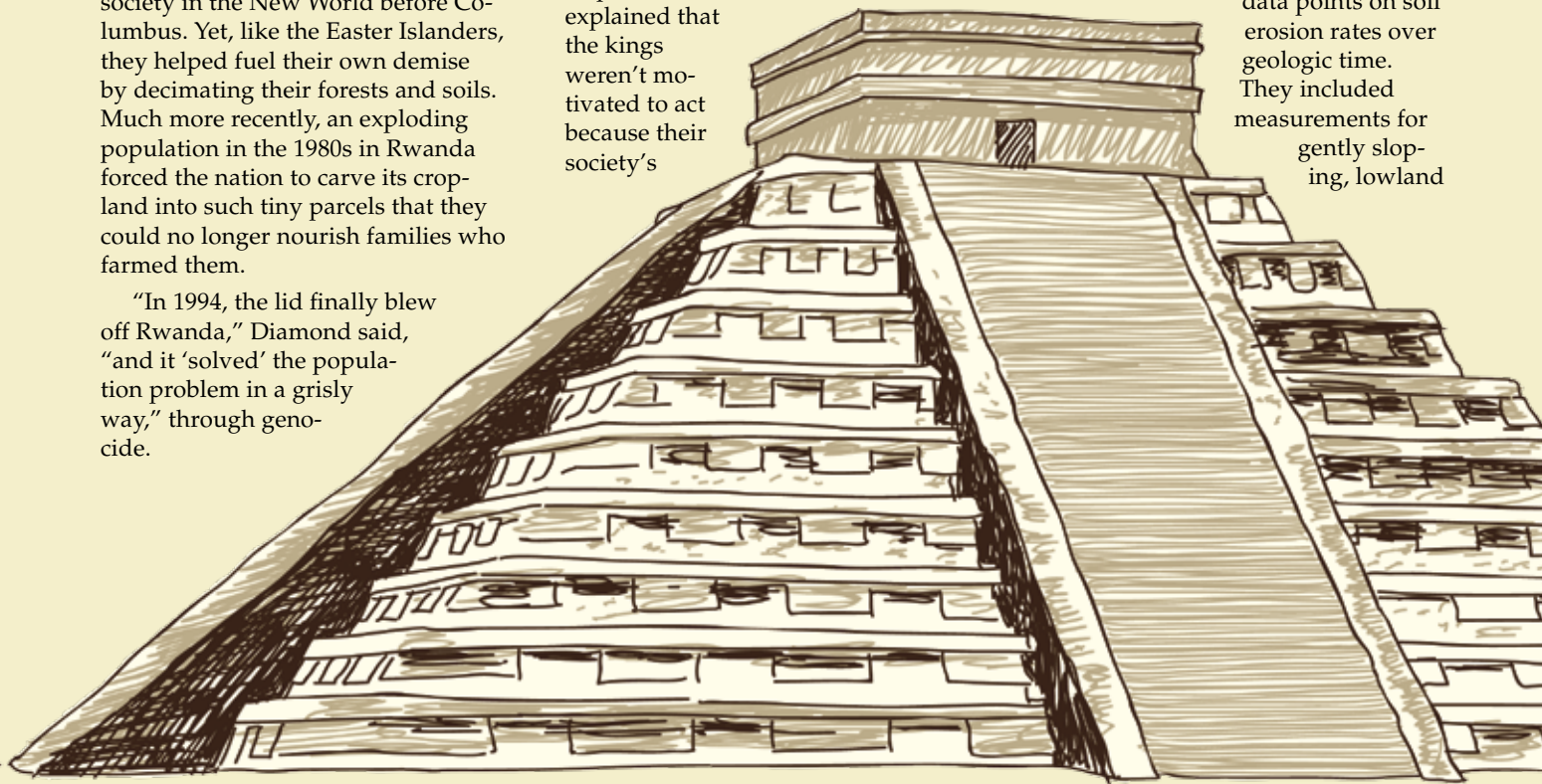
“In 1994, the lid finally blew off Rwanda,” Diamond said, “and it ‘solved’ the population problem in a grisly way,” through genocide.

that lead people to perceive and solve environmental crises—or not. For example, when the Mayan people were degrading their forests, soils, and water, why didn't the Mayan kings stop them? Diamond explained that the kings weren't motivated to act because their society's

## The Erosion of Civilizations

Montgomery, on the other hand, fingered a much more specific cause for the collapse of many of these same societies. While past researchers have often speculated that soil erosion through deforestation is to blame, “Could agriculture have been the culprit involved in the soil erosion that plagued ancient civilizations?” he mused. “Could it have been the plow and not the axe?”

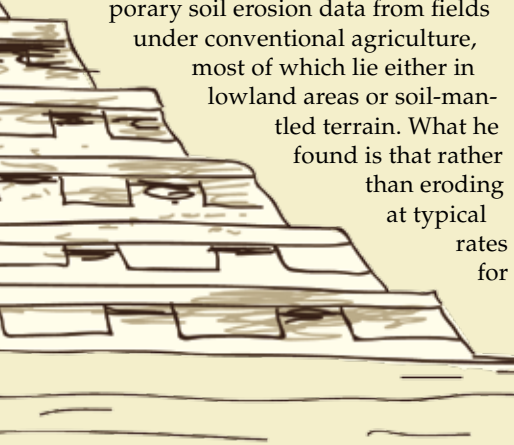
Montgomery proceeded to describe an analysis he performed to help test this hypothesis. From past studies conducted around the world, he compiled nearly 1,000 data points on soil erosion rates over geologic time. They included measurements for gently sloping, lowland





areas of continents, such as the American Midwest (i.e., craton regions); moderately sloping, soil-mantled terrain; and steep, tectonically active, alpine topography. Not surprisingly, soil erosion rates in the cratons were lowest, at  $10^{-4}$  to 0.01 mm per year; soil-mantled terrain experienced rates of up to 1 mm per year; while steep alpine areas showed the highest geological erosion rates, at greater than 1 mm per year.

Montgomery then added contemporary soil erosion data from fields under conventional agriculture, most of which lie either in lowland areas or soil-mantled terrain. What he found is that rather than eroding at typical rates for



these areas, farm soils were lost much faster. In fact, with mean and median erosion rates of greater than 1 mm per year, these soils appear to wear away as quickly as those in alpine areas. "It's actually quite a trick, on average, to get places that tend to erode at very slow rates to erode like very high, mountainous environments," said Montgomery, who first presented these data in a 2007 issue of the *Proceedings of the National Academy of Sciences* (PNAS).

Moreover, modern day agricultural soil erosion seems to be substantially outpacing global soil production rates, which Montgomery's PNAS study put at less than 0.1 mm per year on average. That this spells trouble is nothing new, but a look back in time suggests just how much trouble we might be in for. A net loss of approximately 1 mm per year suggests a farmed hillside soil would completely erode in about 5 to 10 centuries, Montgomery said. "And if you look back at the archeological record, that's approximately the lifespan of many major civilizations outside of major river floodplains, which of course, are fertil-

ized by erosion of the surrounding uplands."

Indeed, in his 2007 book, *Dirt: The Erosion of Civilizations*, Montgomery documented the same unfortunate pattern time after time, beginning with the first farmers in the Tigris and Euphrates river basin and ending with today's industrial farming operations. In each case, farming of good land led to increased food production and a growing population, which the society then tried to support by expanding agriculture to steeper, more marginal lands. This, in turn, led to increased erosion, eventually hastening the society's demise.

While others may argue this is mere coincidence, Montgomery thinks dismissing the pattern completely is a mistake.

"It's very hard to avoid the conclusion that if we maintain practices for long enough, if we erode soils at paces faster than they form, then eventually the bill will come due," he said.

Like Diamond, however, Montgomery also offered some hope. "The good news is that we know how

to farm in ways that could actually reduce soil erosion rates. The data demonstrate it," he said. But the bad news, he added, "is that it's not conventional."

He was speaking of no-till agriculture. Many studies have now shown that no-till farming dramatically reduces soil erosion compared with traditional tillage practices. And despite its label as "alternative," no-till appears to be growing. Approximately 36% of U.S. cropland (88 million acres) had no-tillage operations in 2009, according to a November 2010 report from the USDA's Economic Research Service (ERS). Moreover, the practice increased for corn, cotton, soybeans, and rice at a median rate of roughly 1.5 percentage points per year from 2000 to 2007, USDA-ERS reports.

Reducing subsidies for conventional, erosive farming and boosting incentives for soil conservation could help fuel this trend, Montgomery said. In addition, practices that return organic matter to the soil could be widely adopted to help rebuild soils even as people use them to produce food, he added.

## Peak Oil, Climate Change

Food security isn't the only problem that conserving and restoring the soil could help address. Another is the looming crisis of peak oil. In particular, supplies of cheap, petroleum-

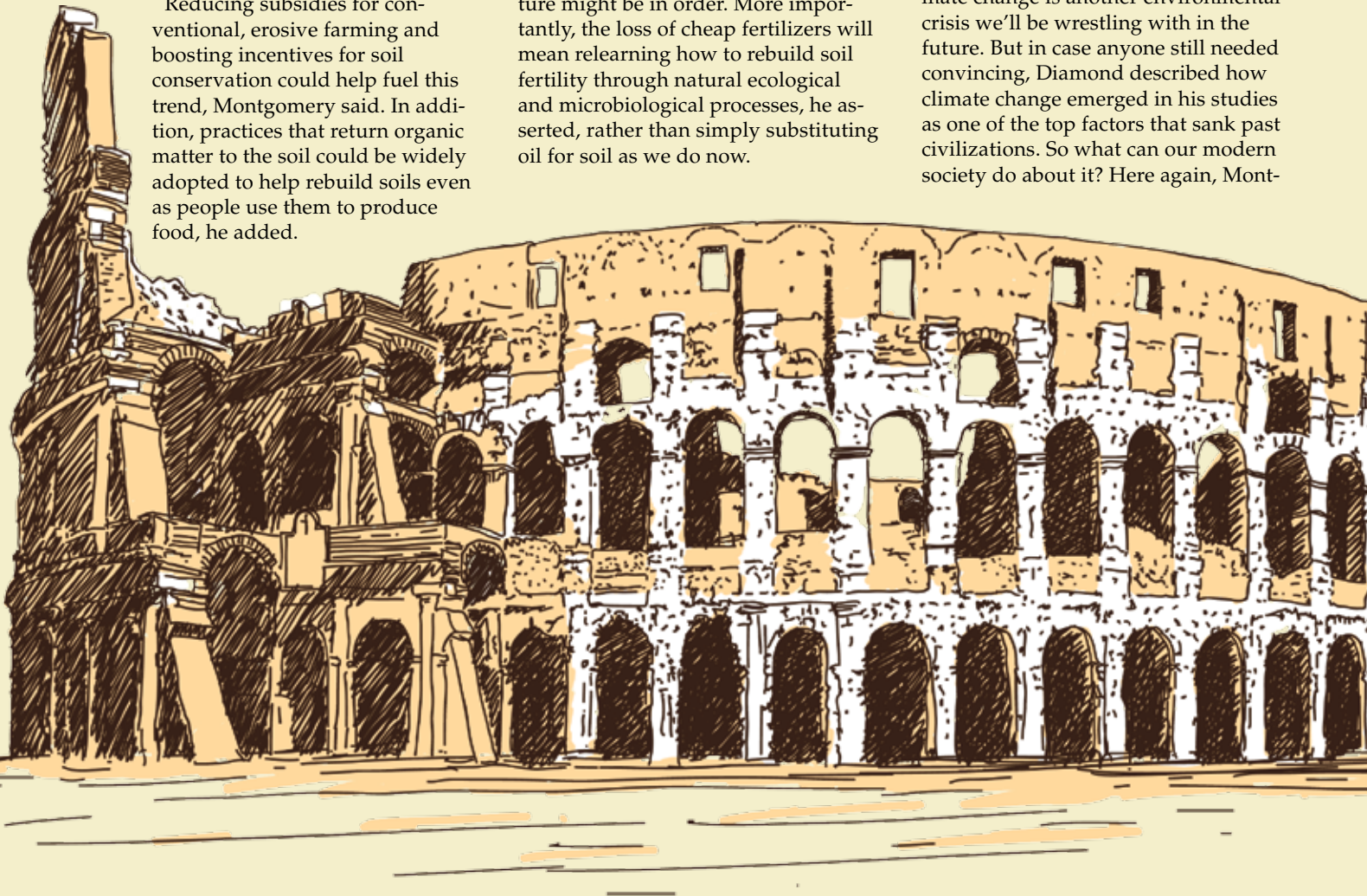
Of course, whether we'll be able to match current levels of agricultural productivity by employing these "alternative" practices is an open question. But, Montgomery said, "Unless somebody invents that cheap, clean

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based fertilizers will likely become squeezed in the future, suggesting to Montgomery that a "greener revolution" of widespread organic agriculture might be in order. More importantly, the loss of cheap fertilizers will mean relearning how to rebuild soil fertility through natural ecological and microbiological processes, he asserted, rather than simply substituting oil for soil as we do now.

source of energy that we'd all love to see, we're going to have to wrestle with this."

It seems obvious to state that climate change is another environmental crisis we'll be wrestling with in the future. But in case anyone still needed convincing, Diamond described how climate change emerged in his studies as one of the top factors that sank past civilizations. So what can our modern society do about it? Here again, Mont-





gomery saw promise in soil and agricultural science. He pointed, for example, to a 2004 *Science* paper in which Rattan Lal, ASA and SSSA member and Ohio State University professor, estimated that changes in agricultural practices could offset 5 to 15% of global fossil fuel emissions every year. Montgomery then cited work by Ron Amundson at the University of California–Berkeley, who estimated that deforestation and cultivation release 4 Gt of carbon into the atmosphere each year—an amount equivalent to more than 50% of today’s global fossil fuel emissions.

Thus, Montgomery concluded toward the end of his talk that restoring soil and rethinking our land use practices could be important pieces in the puzzle that is global sustainability. But, he added, the only way people will choose to do these things is if they also learn to rethink soil itself. Right now, soil is

treated mainly as an agricultural commodity—and the cheapest ingredient in agricultural production at that. A simple input, in other words, in the making of a product: food.

But soils are, of course, much more than this. They are complex, fertility-sustaining ecosystems that need first to be fully understood, and then harnessed, not consumed. “To be put to use by humanity,” Montgomery said, “not to be used up by humanity.”

### Putting Our Technological Advantages to Use

Near the conclusion of his remarks, Diamond returned to the Easter Islanders, who chopped down their last tree around the year 1680. He’d already made clear the parallels between their society and our own, but in the end, he also described the differences. Without the benefit of television or the internet, for example, the Easter Islanders had no way of knowing that their contemporaries in Japan, after starting down the same path of extreme deforestation, had learned to practice forestry sustainably. Similarly, with no scientific

literature to consult, the islanders couldn’t learn about past “experiments” with chopping down trees that had been tried by New Guineans and the ancient Maya.

We, on the other hand, are the first people in world history with the chance to learn from societies remote from us both in space and time. “We have agronomists and soil scientists and crop scientists—namely you,” Diamond said. “You know what agricultural practices were like in the past, and you know how they worked out—some well and some not so well. And you’ve used that knowledge base to improve our agricultural practices today.”

In other words, Diamond concluded, we enjoy “a huge advantage, a unique advantage” over the likes of the Easter Islanders when it comes to solving our environmental problems and meeting the challenges of sustainability. Now it’s a matter of putting that advantage to use.

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