AGRICULTURE

Erosion Study Finds High Price for Forgotten Menace

It was Scarlett O'Hara in *Gone With the Wind* who mused that land is "the only thing in the world that lasts." Scarlett O'Hara never read David Pimentel. On page 1117 of this issue, the Cornell University scientist and his colleagues present the most comprehensive effort yet to add up the costs of soil erosion by wind and water. Their bottom line is eye-popping: $44 billion every year in direct damage to agricultural lands and "indirect damage" to waterways, infrastructure, and health in the United States, and nearly $400 billion in damage worldwide. Not only does land not last, Pimentel finds, but its demise comes with a hefty price tag.

Pimentel's spectacular numbers are drawing mixed reviews from agricultural and economic researchers. "The magnitudes are out of alignment with what we have generally found to be the case," says John Stierna, an agricultural economist at the U.S. Department of Agriculture's (USDA's) Natural Resources Conservation Service. "Some of his numbers are a factor of 2 to 3 too high." But others say they are right on the mark. "I think some folks who are not familiar with the soil-erosion literature are going to be a little surprised," says Marty Bender, an agronomist at the Land Institute in Salina, Kansas, which studies innovative farming techniques. "But the data is there."

And the message could have some reverberations in Washington. The 1985 Food Security Act, which requires farmers to follow conservation guidelines such as contour farming and reduced tillage or risk losing federal subsidies, is now up for renewal, and sources close to the Senate Agriculture Committee predict intense pressure to roll back the law's environmental provisions. If the Cornell group's dire assessment of the costs of erosion is accepted, say these sources, it could be a powerful argument in favor of preserving the anti-erosion requirements.

It's easy to get complacent about erosion, notes Pimentel; the Dust Bowl, after all, is a fading memory, and modern farming techniques have greatly reduced the kind of erosion that corrugates a field with rills and gullies. But as early as 1929, just before the Dust Bowl, USDA soil scientist Hugh Hammond Bennett realized that the most devastating form of erosion is the least obvious: Wind and rain can strip away soil in extensive sheets, leaving little visible evidence of the damage.

Sheet erosion tends to be worse on large fields that have few windbreaks or natural buffers to prevent soil from washing off, says Pimentel, and some recent practices, like plowing up grassed strips at the edges of fields to accommodate larger machinery, may have increased it. In a night of heavy rain, the process can strip 5 or 6 tons of soil from an acre of cropland. "That's one millimeter of soil [lost], and if you walk out the next morning, you wouldn't know it," he says. "Erosion is one of those things that nickels and dimes you to death."

S.C. DELANEY/EPA

Down the drain. The most devastating forms of soil erosion are less obvious, however.

Pimentel's team totted up those nickels and dimes by drawing on dozens of individual studies published over the last several decades. Many of them estimate damage done far from the site of the erosion. Erosion by water leads to billions of dollars in costs when rivers, canals, lakes, and reservoirs become clogged with sediment or polluted with the fertilizers and pesticides that cling to the soil particles. Heavily sedimented rivers also increase the severity of floods—some researchers, for example, think silted river channels exacerbated the 1993 Midwest flooding. Wind erosion takes a toll on paints and mechanical equipment, buries roads and railways, and contributes to respiratory ailments.

Estimating the cost of on-site damage is "trickier," says Richard Harwood, a professor of sustainable agriculture at Michigan State University—and it's also the focus of most of the controversy. These costs are elusive, he says, because the loss of productive potential due to erosion can be masked for a time by increased inputs of fertilizer, irrigation, and higher yielding plant varieties. The price exacted by erosion is hidden in the cost of these inputs, and few researchers have tried to tease it out.

Pimentel and his colleagues worked around this problem by looking instead at the physical toll that erosion takes on croplands. Based on estimates of how much nutrient-rich soil organic matter is eroded each year, the team tried to estimate the market value of those lost nutrients—the cost of replacing them with fertilizers—and came up with a figure of $20 billion a year. They also took into account the loss of soil depth and soil biota such as insects and earthworms. Together with the loss of organic matter, these reduce the soil's ability to take in water, increasing the need for irrigation or reducing crop yields.

When the Cornell group added in these losses, the total on-site cost of erosion reached $27 billion a year in the United States. Perhaps more alarming, Pimentel's team found that the loss of nutrients and water retention drives a startling decline in productive potential. They found that moderate erosion, sustained for 20 years, can reduce the potential yield of good agricultural land by 20%.

Pimentel's accounting hasn't convinced everyone. "If there are two different values, he almost always goes with the big one," says Frederick Troeh, a soil scientist at Iowa State University. Other critics dispute the $20 billion figure for nutrient losses on the grounds that, in rich soils, crops consume only a fraction of the available nutrients each year, so the losses have little immediate effect. Pimentel replies that a loss is a loss, even if it comes out of long-term savings. "This stuff is gone down the Mississippi or the Missouri River," he says. "It's never going to be available—ever."

Erosion's toll might be higher still, says Rattan Lal, a soil scientist at Ohio State University in Columbus, if not for federal programs such as the soil-conservation provisions of the 1985 Food Security Act and the Conservation Reserve Program. But Pimentel and his colleagues say these steps fall short of what is needed. They calculate that an investment of 19 cents in new conservation measures for every dollar of damage would be required to bring soil erosion under control in the United States—a proposed annual outlay of $8.4 billion.

In the cost-cutting environment of Washington, that proposal has little chance of getting a hearing. But even those who disagree with Pimentel's numbers hope his broader message won't be ignored in the upcoming debate. "There are specific [numbers] to quibble about," says Troeh. "But the overall conclusion that erosion is a threat and is often ignored—I very much agree with that."

–James Glanz