[A CASE FOR NO-TILL]

PAY DIRT

The slow pace at which soil rebuilds makes its conservation essential **By David R. Montgomery**

A fundamental drawback of conventional farming is that it fosters topsoil erosion, especially on sloping land. Tillage leaves the ground surface bare and vulnerable to runoff, and each pass of the plow pushes soil downhill. As a result, the soil thins over time. How long this process takes depends not only on how fast plowing pushes soil downhill—and wind or runoff carries it away—but also on how fast the underlying rocks break down to form new soil.

In the 1950s, when the Soil Conservation Service (now known as the Natural Resources Conservation Service) began defining tolerable rates of soil erosion from agricultural land, hardly any data on rates of soil production were available. The agency thus determined the so-called soil loss tolerance values, or T values, on the basis of what farmers could do to reduce erosion without "undue economic impact" using conventional farming equipment. These T values correspond to as much as an inch of erosion in 25 years. But recent research has shown that erosion rate to be far faster than the rate at which soil rebuilds.

WIND EROSION in the Southern Plains of the U.S. during the Dust Bowl era revealed the perils of plow-based farming.

Over the past several decades, scientists have determined that measuring the soil concentrations of certain isotopes that form at a known rate permits direct quantification of soil production rates. Applying this technique to soils in temperate regions in coastal California and southeastern Australia, geologist Arjun Heimsath of Arizona State University and his colleagues found soil production rates ranging from 0.001181 to 0.003149 inch a year. As such, it takes 300 to 850 years to form an inch of soil in these places. My own recent global compilation of data from soil production studies, published last year in the *Proceedings of the National Academy of Sciences USA,* revealed an average rate of 0.00069 to 0.001417 inch a year—equivalent to 700 to 1,500 years to form an inch of soil.

The soil on undisturbed hillsides in temperate and tropical latitudes is generally one to three feet thick. With natural soil production rates of centuries to millennia per inch and soil erosion rates of inches per century under plow-based agriculture, it would take just several hundred to a couple of thousand years to plow through the soil in these regions. This simple estimate predicts remarkably well the life span of major agricultural civilizations around the world. With the exception of the fertile river valleys along which agriculture began, civilizations generally lasted 800 to 2,000 years, and geoarchaeological studies have now shown a connection between soil erosion and the decline of many ancient cultures.

Clearly, then, if we are to conserve resources for future generations, we need alternatives to conventional farming practices. No-till systems simultaneously reduce the erosive force of runoff and increase the ability of the ground to hold onto soil, making these methods remarkably effective at curbing erosion. In a study published in 1993, researchers at the University of Kentucky found no-till tobacco farming reduced soil erosion by more than 90 percent over conventional tobacco cultivation. More recently, investigators at the University of Tennessee reported that no-till methods decreased soil erosion by a whopping 98 percent. Although the effect of no-till on erosion rates depends on a number of local factors, such as the type of soil and the crop, it can bring soil erosion rates down close to soil production rates.

In the mid-1990s Cornell University researchers estimated that undoing damage caused by soil erosion would cost the U.S. $44 billion a year, and that it would take an annual investment of about $6 billion to bring erosion rates on U.S. cropland in line with soil production. They also estimated that each dollar invested in soil conservation would save society more than $5. Because it is prohibitively expensive to put soil back on the fields once it leaves, the best, most cost-effective strategy for society at large is to keep it on the fields in the first place.

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