LAND STEWARDSHIP PROJECT

Land Stewardship Project Fact Sheet #9

Updated: April 2008

1 Storm — 2 Outcomes

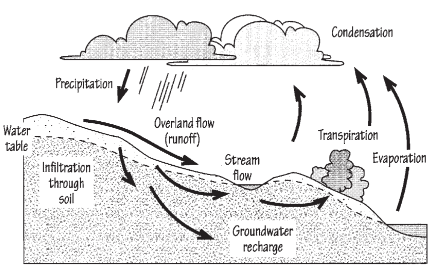
Why did one field lose a truckload of soil during a heavy rain storm, while just up the road another lost only a bucket's worth?

Bucket versus dump truck

During a few wet hours on June 26, 1998, more than four inches of intense rain fell on the Sand Creek watershed, an area south of Minnesota's Twin Cities dominated by crop and livestock farms. It was a widespread storm that saturated the entire area.

So why did each acre of a farm near the town of New Prague lose enough soil to fill a small dump truck, while just a few miles up the road near Jordan a particular farm's per-acre soil loss was measured in terms of a five-gallon bucket?

The answer to that gets at the heart of some wider questions about how various farming systems can have drastically different impacts on the same land under similar conditions. But it also brings up another issue: Do farmers manage their soil to protect it against the wear and tear of day-to-day erosion, or to mitigate the damage caused by major, sometimes rare, storm events?



The two fields

We know about the two results that came out of that one storm because two different farm field runoff research projects were in full swing in the Sand Creek watershed on June 26.[1] In one study, soil scientists Neil Hansen and John Moncrief had split a five-acre corn field into two parts near the town of New Prague. On one half, the farmer tilled the soil using moldboard plowing, a traditional tillage method that flips the soil over, exposing the bare dirt to the elements. The other half of the field was chisel plowed, a technique that disturbs the soil less and leaves more residue on top. For the five-year study, the scientists then set up remote monitoring stations that could measure what (and how much) left the field during runoff events—rains heavy enough to send water, and whatever is along for the ride, racing off a field.

A few miles away near the community of Jordan, another team of soil scientists—Christopher Iremonger, Prasanna Gowda, David Mulla, and Deborah Allan—had set up a similar type of remote monitoring station at the bottom of a 25-acre field that was being farmed using a mix of small grains, alfalfa hay and pasture.

During the storm, each acre of the study field that was moldboard plowed ***lost 8.5 tons of soil*** during that two and a half hour storm. Another two tons was lost when it rained the next day, making for a total per-acre soil loss of well ***over 10 tons on that one field*** (that's more than double the national average soil erosion rate for one year). The part of the plot that was chisel plowed lost about half that amount.

Up the road...

At the research site where small grains, alfalfa hay and pasture were growing, only ***53 pounds of soil*** per acre was lost during the June 26 storm event. That low erosion rate is particularly impressive when one considers how steep that field is: it has a 12 percent slope in some spots and as much as 30 percent in others. In fact, the hillside is so steep that it is farmed using contours—a system where long, curving linear fields are tilled across the face of the hillside. Each contour is about 80 feet wide. The New Prague and Jordan farms have similar soil types.

In 1998, the Jordan farm had oats with an underseeding of alfalfa planted on two of the contours. Established alfalfa was growing in the other two. At the bottom of the field were paddocks for rotationally grazing a 50-cow dairy herd. In other words, by June 26 the field was covered with thick vegetation from top to bottom.

The field that Hansen and Moncrief were monitoring, in contrast, was growing corn. At the time of the storm, the plants would have been perhaps a foot high. But the canopy was not fully developed (that doesn't usually occur in that part of Minnesota until around July 1 or after), leaving plenty of open space where rain drops could hit bare ground. In the chisel plowed plot, dead plant material left on top helped considerably in keeping soil in place. But as the research from the Jordan farm indicates, there's no substitute for growing, green vegetation when it comes to soil protection. That's why, even though the corn field was actually not on as steep a slope—about 6 percent to 8 percent—as the small grains/hay/grass field, it lost many times more soil.

It's the big things that count

Besides supporting the argument for good vegetative

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ground cover, what does this storm tell us about soil erosion? For one thing, it reinforces a belief that soil scientists and farmers have long held: big storms cause the bulk of sediment loss.

"Runoff for this single event was greater than cumulative runoff from the three previous study years," Hansen says of the June 26 storm.

Iremonger found the same thing on the Riesgraf farm. That one event loosened more soil on that field than was measured in his entire three-year study combined.

That's not surprising. Various studies have shown that major storm events cause the majority of our farm field erosion. In a landmark paper published in the March-April 1997 issue of the *Journal of Soil and Water Conservation*, soil scientists W.E. Larson, M.J. Lindstrom and T.E. Schumacher pointed out that in fact such storm events are the major cause of soil erosion. The authors of the paper went on to argue that land management systems must be adjusted to deal with such erosion events. That doesn't mean that a significant amount of soil isn't lost on a routine basis. But big storm events can accelerate things considerably, particularly if they come at just the wrong time—when crops are short and provide very little ground cover, for example.

According to climatology odds makers, the kind of rain that hit Sand Creek on June 26, 1998, has a chance of happening about every 25 years or so. But it's misleading to think the timing of these storms can be predicted with any great precision—Sand Creek isn't safe from a major erosion-causing storm until June 26, 2023. These storms can come at just about any time, making it particularly difficult to manage for them.

The rich, lightweight organic matter present in soil is the first to erode. So far, farmers have been able to use phosphorus and nitrogen fertilizers to cover up for that lost fertility. But that extra fertilizer often finds its way into our ecosystem, where it causes pollution problems (Hansen and Moncrief found that about 70 percent of the total phosphorus that ran off the moldboarded corn field in 1998 came during the June 26 event). It's only a matter of time before even chemical inputs can't cover for the lost organic matter.

But what if a system of agriculture could be established that helps build soil between major events, and gives maximum protection when gully washers do come? Using the three years of runoff monitoring figures as a base, Iremonger set up a computer model showing what could happen to the Jordan plot during the next two decades under different production systems. Such modeling takes into account, among other things, soil type, drainage, weather, wind speed and crop management techniques. In this case, the modeling found that if the hillside were planted to corn, erosion rates would climb dramatically, particularly during large rainstorm events. Under the grass system, sediment loss was next to nothing. This leads Iremonger to believe that there is a way to make a farm so resilient on a daily basis that it can take major storm events in stride.

"If you have a management system that's robust enough to have almost no sediment loss during normal events, and is pretty resistant to these big events that come every 10 years or so, in the intervening time you have been creating soil on your farm," he says.

A little of this, a little of that

So is the main message to take away from the June 26 storm that the entire Sand Creek watershed should be planted to grass and small grains? No. Row crops such as corn and soybeans play an important role in the farm economy. Also, not every farmer has the desire, resources or market access to profitably produce livestock on grass.

"Even with financial assistance, a farmer will not adopt a technology if he or she is unfamiliar with it," concluded researchers with the Natural Resources Conservation Service in a 1999 report.

The best approach may be a variety of systems, according to a modeling study conducted by scientists on the entire Sand Creek watershed. Over 60 percent of the watershed is planted to row crops—about a quarter of that is under some sort of conservation tillage system, and around 40 percent is under conventional tillage such as moldboard plowing. What the researchers—Brent Dalzell, Dave Mulla and Prasanna Gowda—found was that if 100 percent of the watershed's agricultural land was put under conservation tillage, the average monthly sediment load decreased by 32.9 percent. In another modeling scenario, the scientists converted 32 percent of the watershed from conventional to conservation tillage and 13 percent from crops with conventional tillage to rotationally grazed pastures. The last scenario reduced sediment loss by 33.4 percent. In other words, a mix of systems on fewer acres provided more bang for the buck as far as runoff control is concerned—it's not an all or none situation. Such a mix allows for different land forms, economic factors and the willingness and ability of farmers to adopt various techniques.

Sources for this fact sheet

✔ "Same Storm-Different Outcomes," by Brian DeVore, *Land Stewardship Letter*, April/May/June 2001, page 1. www.landstewardshipproject.org/lsl/lspv19n2.html#coverstory

✔ *The Multiple Benefits of Agriculture: An Economic and Social Analysis*. November 2001, Multiple Benefits of Agriculture Project Team. www.landstewardshipproject.org/programs_mba.html

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This fact sheet is brought to you by the members and staff of the Land Stewardship Project, a private, nonprofit organization devoted to fostering an ethic of stewardship for farmland and to seeing more successful farmers on the land raising crops and livestock. For more information, call 651-653-0618 or visit www.landstewardshipproject.org.