Cropland Degradation

by Matt Hagny

PERSPECTIVE

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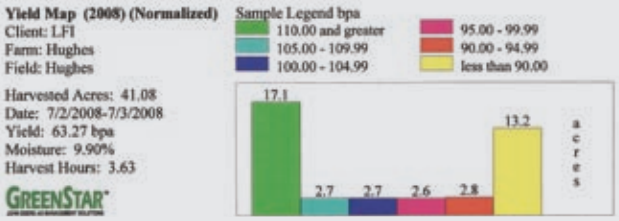
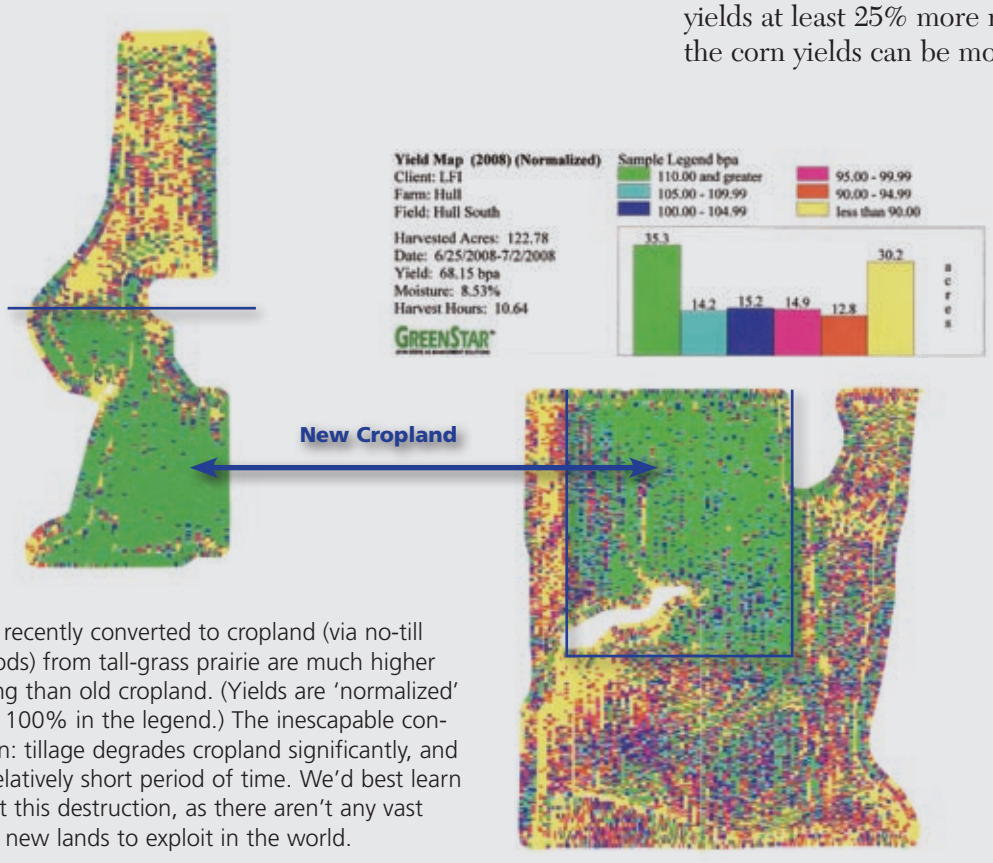
Some people would like to argue about exactly how much soil is being lost by erosion, or the consequences to the cropland, or haphazardly use the term 'sustainable' (the long-term ability to feed ourselves is indeed in question). But every now and again, there's a stark reminder: These two yield maps contain areas of both 'new' and 'old' cropland. Care to guess which is which?

In both cases, the new cropland was in native grass until converted to cropland with no-till methods about 3 years ago (2008 is the only year for which we have yield maps). The old cropland had been farmed since at least the 1950s, and probably since the 1880s, with the tracts being located in north-central Kansas near Clay Center.





Areas recently converted to cropland (via no-till methods) from tall-grass prairie are much higher yielding than old cropland. (Yields are 'normalized' to +/- 100% in the legend.) The inescapable conclusion: tillage degrades cropland significantly, and in a relatively short period of time. We'd best learn to halt this destruction, as there aren't any vast fertile new lands to exploit in the world.

The yield advantage to the new cropland was 29% on Hughes (70.1 vs. 54.5 bu/a) and 18% on Hull (75.6 vs. 64.2). Note that both of these were wheat, and 2008 was a year of abundant moisture for wheat production in this region. Josh Lloyd, who farms the tracts, makes this observation: "I was surprised. I usually don't see the big yield variability [on new cropland versus old] with wheat as I do with beans and milo. In other words, I expect the advantage to the new cropland to be even greater in beans and milo on these fields."

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I have several clients (central KS) who have similar fields with portions that are newer to cropping. In many cases, being degraded with tillage for only 25 years instead of a century makes a huge difference: The newer land often yields at least 25% more milo, and in a droughty season, the corn yields can be more than double on the newer land (~50 versus 100 bu/a). And I should point out that the added bushels are pure profit—no extra expense, other than hauling the extra grain away. So profitability per acre might be ten-fold higher on the newer parts compared to the rest of the field.

Much of the loss is due to water erosion. There are many cases of fields with different histories on subparts, where the terraces have to make a jog when crossing the line onto the new cropland—surveying often reveals 8 – 10 inches higher elevation in the new cropland, and this extends far out into the new cropland,

well beyond any effect of blow-dirt in old fence-rows or hedgerows.[1] David Lobb's "tillage erosion"—the tillage implements physically dragging the soil down the hill—no doubt contributed on fields with slope.

In more arid regions (or in droughts), wind erosion does play a major role in land degradation, and an inch or more of topsoil can be removed in a single episode of severe wind erosion, often being deposited in adjacent ditches, fencelines, etc., but sometimes carried many miles away (I can think of quite a few fencerows that are elevated 5 feet or more from the surrounding terrain).

Carbon losses and breakdown of soil structure are also at work. But whatever the exact contribution of each of these mechanisms, a great many yield maps are clear and convincing evidence of the degradation caused by tillage. Anyone concerned with the long-term productivity of the land should take careful note.

A recent book, *The Worst Hard Time* by Timothy Egan, describes in graphic detail the horrors of the Dustbowl Era, along with the causal mechanisms. Drought was involved, certainly, but there have been worse droughts since then that have been far less destructive. The 1930s were unique in just how much sod had been broken and farmed haphazardly to monoculture wheat, mostly due to U.S. government policies. Yes, that's right, this fury of nature was largely unleashed by the follies of central planning.

Photo by Dirceu Gassen.

The force of a raindrop's impact on bare soil can break small particles loose, which creates a sealing of soil pores, resulting in runoff and erosion. Adequate mulch cover eliminates 99% of soil erosion by water.

Photos by Steve Groff.

Epic rains (13 inches in 2 days) occurred in late June of '06 in southeastern Pennsylvania. Tilled land suffered devastating erosion (left photo), while right across the fence, Steve Groff's long-term no-till with cover crops had negligible erosion. The gullies in the tilled land were 4 feet deep, as Steve's son demonstrates. If anyone seriously thinks that cropping with tillage is sustainable, we have a bridge in Brooklyn to sell you.

Destruction of agricultural land has a very long history, as documented by W.C. Lowdermilk in his 1948 summary of his global fact-finding expeditions, *Conquest of the Land Through Seven Thousand Years*.[2] The deserts of Iraq were once lush and fertile. The same for Lebanon and Syria, inland China, and countless other lands. The scope and degree of destruction are astonishing, and in most cases the civilizations apparently had no concept of what was happening. Only by 'discovering' new continents with fertile lands (and then by killing off—with warfare or disease—the indigenous peoples) has human society been able to avoid outright starvation and depopulation, the epitome of a Malthusian existence.

Despite the apparent sophistication of many modern farming techniques, the degradation of the land continues in all too many cases. Tillage is still the norm on most of the world's cropland. And even today, many agriculturalists (including some scientists) do not comprehend the destructive aspect of tillage. Not to mention that the popular fad of 'organic' farming necessi-

[1] Part of the elevation rise when crossing the boundary onto less degraded land (native sod) is due to better structure, i.e., the soil solids arranged to create more pore space, which therefore takes up more spatial volume (i.e., taller), but this only accounts for a couple inches of the height difference. Interestingly, due to this effect, we shouldn't say that tillage "fluffs up" a soil; it's more accurate to say tillage fluffs *down* the soil by destroying structure.

[2] Available (free) at http://www.nrcs.usda.gov/news/pub/pdf/conquest.pdf.

Photo by David Pabst.

Dust storm near Colby, KS, in May '04. Growing more stubble and keeping it standing would eliminate this problem, too. For truly sustainable agriculture, tillage is not an option.

tates tillage for weed control and mining of nutrients from the soil.[3] I'm not too sure this story has a happy ending.

For the first time in 7,000 years of agricultural history, we have the ability to use cropland in a way that doesn't degrade it, and in many well-documented cases is actually reversing some of the degradation. No-till farming, particularly low-disturbance no-till farming with adequate cropping intensity, is a true revolution in farming technology.

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Actually, no-till has a fairly long history, but *mechanized* no-till is relatively new. Even so, mechanized no-till was first used in the early 1960s. No-till farming gets easier with each passing year because of improvements in seeding equipment, better herbicides, transgenic crops, farmer innovations, and so forth. The economics of no-till are very good; the erosion control well-documented; and the flourishing of soil biology and other favorable soil developments adequately proven. No-tillage truly deserves to be the new paradigm of agriculture.

However, the word about this exciting technology has traveled slowly in the ag world, and essentially not at all amongst the general public. You'd think something this important would be shouted from the rooftops: "We don't have to destroy the land to feed ourselves!" It's time that no-till gets the recognition (and widespread adoption) it deserves, or perhaps we shouldn't be called *Homo sapiens* [wise man] after all.

Further reading: Rolf Derpsch, History of Crop Production With & Without Tillage, Leading Edge, *March '04; Derpsch, Understanding Infiltration, Dec. '03. Also, Kirk Gadzia's keynote closing address to the '09 No-till on the Plains Winter Conference (CDs of the audio from that presentation are available from the organization, contact details on p. 502).*

[3] Continuous long-term 'organic' no-till has never been attained, as is openly admitted even by its proponents and researchers. Weeds soon overrun the fields or plots. Annual weeds might be controlled by hand removal (extremely costly), or someday by robots, but invasive perennial plants aren't controllable without something to kill the deep root system. Essentially the only herbicides currently allowed by 'organic' rules are citric acid and vinegar, with desiccant-type actions (with little translocation to roots). Crop nutrition also becomes a huge obstacle, since no effective N or P fertilizers are allowed except as animal manure, and there simply isn't enough of that to make much headway in crop nutrition needs globally. To supply the demand for 'organic,' manure is now frequently being hauled hundreds of miles—so much for local and sustainable production. Without adequate crop nutrition, and without the benefits of effective pest control, the yields of 'organic' production fall dramatically, which necessitates still more land being brought into production. All things considered, 'organic' has a rather heavy environmental footprint, and certainly isn't sustainable whenever soil erosion is permitted. (This isn't to say that none of the concerns of the 'organic' movement have merit. For instance, less reliance on pesticides and more emphasis on nutritious, safe foods are worthy goals, even if science has found little empirical evidence to substantiate the directions the 'organic' movement is going.)