Water Watch

A newsletter for the Maquoketa River Watershed

Impact of soil erosion on soil productivity

by Gerald Miller, associate dean for extension programs, College of Agriculture, and Michael J. Tidman

Iowa's soils range in thickness from a few inches to several feet. Each soil has a unique combination of properties. Soil solids consist of mineral particles and organic matter. The pores are filled with air, water or both.

Soils are formed from parent material. A soil's parent material influences the soil texture, or the ratio of sand, silt and clay-sized particles occurring in the soil layers. Soil properties that directly affect productivity include topsoil thickness, texture distribution, rooting depth, density, soil fertility and slope.

Topsoil thickness. Preserving topsoil is important because deep surface layers generally translate into higher crop yields. Topsoil material is enriched with organic matter. Organic matter provides soil with large pores, thus reducing soil density and enhancing water infiltration. As the slope gradient increases, topsoil thickness usually decreases, especially where cultivation has occurred. Thin topsoils usually mean lower organic matter content and less rooting depth and plant-available water capacity. When topsoil is eroded, yield usually suffers.

Texture distribution. Soils with coarse textures (sand) throughout the profile tend to dry out fast because water drains away easily. Conversely, soils with fine textures tend to puddle or have standing water on or near the surface with frequent rain. Therefore, in areas where rainfall is moderate (26 to 35 inches in Iowa) soils with medium textures are preferred because they have a high percentage of silt and an adequate amount of sand and clay. Soils with loam, silt loam, silty clay loam and clay loam textures hold 10 to 11 inches of plant-available water in the first 60 inches of the soil profile. Most Iowa soils consist of medium-textured material within the soil profile.

Rooting depth. As crops approach maturity, roots extend through the topsoil layer into the subsoil to find available water. Subsoil properties, such as coarse sand and gravel, shallow depth to bedrock, high soil densities and clay content in excess of 42 percent can limit root elongation and development. Therefore, total rooting depth has a direct impact on yield. Most of Iowa's medium-textured soils have 72 or more inches of rooting depth.

Soil density. The ideal soil density for topsoil material is 1.25 grams per cubic centimeter or less. Erosion and reduced organic matter content increase topsoil density. Ideal soil density for subsoil material is 1.40 grams per cubic centimeter or less. Corn and soybean roots have difficulty penetrating densities in excess of 1.65 grams per cubic centimeter.

Soil fertility. Soil fertility is vital to a productive soil, but a fertile soil is not necessarily a productive soil. Steep slopes, poor drainage and other factors can limit productivity.

Slope and erosion. Erosion is directly affected by the steepness and length of the slope. Greater slopes increase the runoff velocity and the movement of sediment carried in runoff. Severe or prolonged erosion can cause changes in yield potential and soil productivity, depending on topsoil thickness and subsoil properties. In addition, nearly all organic matter is located in the topsoil, along with approximately 50 percent of plant-available phosphorus (P). A similar relationship exists for potassium (K). Losing topsoil to

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erosion, therefore, contributes to a loss of nitrogen, P and K, and a decline in potential crop yield.

The addition of animal manure and fertilizers can supply needed crop nutrients and help offset losses in soil fertility caused by erosion. But the productivity of eroded soils can only be restored by added inputs if favorable subsoil material is present (figure 1). Productivity lost by excessive soil erosion cannot be restored through additional nutrient inputs for soils with subsoil material that has unfavorable properties for plant root growth (figure 2). And in soils with fragile subsoils, limited rooting depth, coarse sand and gravel, or high densities, there is little or no ability to recover yield losses with increased inputs—the loss of potential yield can be devastating (figure 3).

Understanding the impact of erosion on soil productivity means knowing the characteristics of your soils and their profiles. Information about soil profile characteristics is available in each county soil survey report. Moreover, preserving topsoil means preserving inherent fertility and lowers the need for purchased fertilizer inputs, which means a better bottom line.

(This article first appeared in Iowa State University Extension's Integrated Crop Management newsletter, January 29, 2001.)

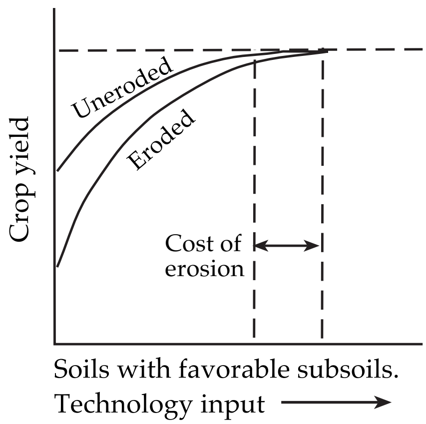

Figure 1. Impact of erosion on soils with favorable subsoils.

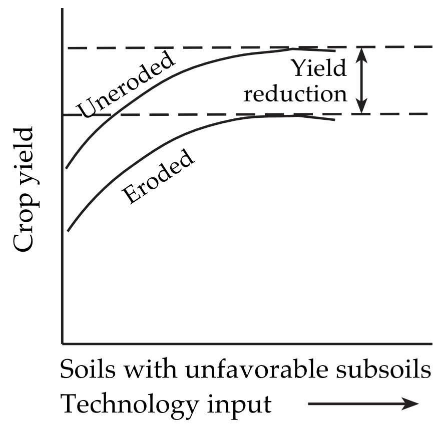

Figure 2. Impact of erosion on soils with unfavorable subsoils.

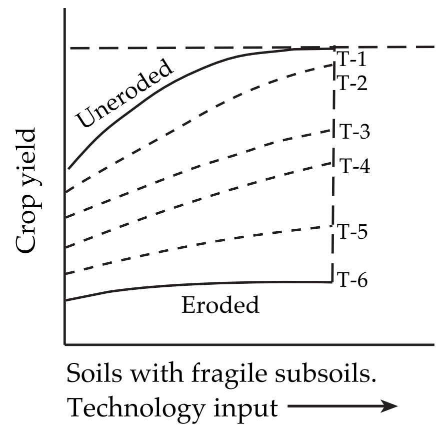

Figure 3. Impact of erosion on soils with fragile subsoils.

TMDLs, a whole watershed approach to water quality

by Charles Wittman, communication specialist, Maquoketa Watershed Project

Three-fourths of the land in this country (excluding Alaska) is privately owned and nearly all of that is working land, used for crop, livestock or timber production. Almost 90 percent of the precipitation that falls on the contiguous 48 states falls on privately-owned land before it enters lakes, streams, groundwater and estuaries. To those interested in water quality, the bottom line is: How privately owned land in this country is used and managed has everything to do with the environmental quality enjoyed by all.

Although Total Maximum Daily Loads (TMDLs) appear to have burst upon the water quality scene over the past few years, they are not a new concept.

The TMDL program was created by section 303 of the Clean Water Act of 1972 and was included in the Act as a safeguard against failure of the primary water quality improvement mechanism, the National Pollutant Discharge Elimination System (NPDES).

NPDES worked effectively with point source pollution, so TMDLs remained in the background. In the late 1980s and early '90s, it was becoming apparent that the NPDES program could not alone solve national water quality problems. A series of lawsuits compelled the Environmental Protection Agency and individual states to focus efforts on the TMDL program.

Section 303(d) requires states to identify waters that are and will remain polluted, assign priorities for action and establish TMDLs at levels necessary to meet applicable water quality standards.

TMDLs are now driving a watershed approach to water quality management and are aimed at managing all sources of pollution which affect beneficial uses of water.

How and where regulations can be imposed on nonpoint sources is

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TMDLs cont.

still unknown. Financial and human resources needed to tackle some of these issues are enormous, while resources are limited. And there is general agreement that data are scarce on many water bodies considered impaired.

TMDLs represent a significant shift in the manner of achieving water quality objectives. In simple terms, a TMDL is a calculation of the maximum amount of a pollutant that a waterbody can receive and still meet water quality standards. It must consider all contributing point and nonpoint pollution, as well as natural background sources, and include a safety margin as well as seasonal variations.

"In the very simplest terms, a TMDL is a blueprint of an impaired water that defines the problem, identifies where pollutants are coming from and outlines what pollution control methods can be put in place that will result in the water quality improving to where it once again meets its designated use," according to the Iowa Department of Natural Resources (IDNR) brochure, "Repairing the Impaired."

Iowa is beginning the TMDL process and hopes to have final TMDLs on 12 impaired lakes completed late this year and ready for public review, according to Bill Ehm, TMDL coordinator for the IDNR. IDNR held a series of public meetings this past winter to outline proposals addressing TMDL at 12 lakes and reservoirs on Iowa's list of impaired waters. The meeting for Silver Lake in Delaware County, one of the 12, was held Feb. 1 in Delhi. Silver Lake is within the Maquoketa River watershed and the only lake in northeast Iowa on the list.

At the Silver Lake meeting, Ehm explained IDNR's overall approach to protecting and preserving the state's natural resources, linking the soil resource and the water resource. "What happens on the land affects the water," he said. "The better we can do at identifying what is going on in the watershed, the more successful we will ultimately be in improving water quality."

Iowa has about 90,000 acres of lakes and about half the lakes have a designated use, he said. There are 157 water bodies, including wetlands and river and stream segments, on Iowa's list of impaired waters.

Ehm said that the state first decided on the designated use of water bodies, then decided on standards. If a water body is not meeting standards, he said, it is considered impaired.

Silver Lake was included on the list based on "best professional judgement," according to Ehm, since the state does not yet have sufficient data for all water bodies.

IOWATER's citizen-based water monitoring program

To help address Iowa's water quality concerns, a volunteer water monitoring program was established in 1998. Known as IOWATER, it provides Iowans with an opportunity to take an active role in protecting and restoring the state's water by monitoring the quality of streams across the state.

Why monitor? To get information needed to answer the most basic questions about Iowa's water resources: What is the condition of the state's surface water and groundwater resources? How has water quality changed through time? Is water quality improving, declining or remaining the same?

Level 1 training workshops set for northeast Iowa

June 15-16: Central Park, Jones County. For more information, contact Michelle Olson, Jones County Conservation Board, phone (563) 487-3541 or e-mail jccb@netins.net for more information.

July 12-13: Lake Delhi, Delaware County. Contact Rick Lawrence, Maquoketa Alliance, phone (563) 652-5104 or e-mail rick.lawrence@ia.usda.gov. Following the level 1 workshop will be a four-hour training session on standing waters (lakes, wetlands, etc.) open to those who have completed the level 1 training.

July 25-26: Waukon, Allamakee County. Contact Lynn Ellefson, Allamakee Soil and Water Conservation District, phone (563) 568-2246 or e-mail lynn.ellefson@ia.usda.gov.

Most of Iowa's 72,000 miles of streams remain untested. IOWATER's trained volunteers will gather valuable information on the quality of the state's water resources.

IOWATER is a citizen-based program that allows local groups to design their own monitoring plans, such as selecting monitoring sites and frequency as well as parameters. It focuses on solutions and results.

IOWATER uses a watershed approach, combining land use, soils and drainage basins with water quality. The program will develop local working partnerships and sharing

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information and resources among state and federal agencies.

Last year, more than 500 people (including those from Mineral Creek and Maquoketa Headwaters watersheds) attended 18 workshops held to train volunteers. Workshops cost $25 per volunteer, but each receives all the equipment and training necessary to start monitoring. Volunteers learn to identify bottom-dwelling organisms (benthic macroinvertebrates), chemically test the water and evaluate the stream habitat, including taking stream measurements. When they complete the ten-hour workshop, each participant is certified as a level 1 IOWATER citizen monitor. (Level 2 and 3 training includes more specialized water testing methods.)

Among the first things volunteers do after selecting a monitoring site is become familiar with their surrounding watershed. Watershed land use has an impact on the stream's water quality, whether the land is rural or urban, wooded, pastured, under development or paved.

By collecting the various data, the volunteers begin the process of assessing the health of a stream. Monitoring over time reveals whether water quality is improving, declining or remaining unchanged.

Data collected by the volunteers are placed on the IOWATER web site (www.IOWATER.net) and available to the public, part of the program's goal of sharing information and resources.

(Adapted from "IOWATER" by Richard Leopold and Lynette Seigley, Geologic Survey Bureau, in Iowa Geology 2000)

Maquoketa River projects update

Conservation proposals submitted by twelve cooperators in the **Mineral Creek Watershed Project** were approved for $67,055 in cost-share funds from a total of $86,313 Iowa Water Protection Funds received this winter.

The **Lake Delhi** Recreation Association has applied for a $300,000 state grant, to be matched by the Lake Delhi Assocation. The project has set three goals: to identify and reduce soil erosion in the watershed; to conduct a lake diagnostic feasibility study on dredging and septic systems; and educate lake and farm residents on water quality issues in the watershed.

Organizational meetings were held March 22 for the proposed **Sand Creek Watershed** project near Manchester and March 1 for **Lower Deep Creek** near Preston.

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