Success Stories in Sustainable Agriculture:

Saturated Buffers

In Hamilton and Story County, researchers are working with landowners to establish and test saturated buffers to treat farm runoff.

The Story

Research supported by the Leopold Center is finding ways to improve Iowa's water quality, specifically in streams near agricultural land. Initial research showed planting buffer strips comprised of native perennial plants along the edge of streams could essentially remove sediment, nitrogen, phosphorus and atrazine contained in water flowing off agricultural land. New research is studying the effects of redirecting the water flowing through field tile lines into those same buffers, thus treating a larger proportion of water flowing from agricultural land.

The Opportunity

Water quality in Iowa and downstream is of great concern. Studies indicate that nutrient and pesticide loss from agricultural land, yards and other landscapes can enter waterways through runoff, erosion and tile drainage lines. The excessive nitrate and phosphorus in water creates an imbalance in natural systems and poses risks to human and animal health.

Connection to the Leopold Center

Riparian buffers are areas of perennial grasses, shrubs or trees planted along the edge of waterways. Research in Iowa began on riparian buffers in 1990 when the Leopold Center assembled a research team from ISU and the Iowa Department of Natural Resources. There are now at least 10 miles of buffers along Bear Creek involving 10 landowners in Hamilton and Story counties.

The research showed several benefits of riparian buffers, including reduction in surface runoff, reduction of nitrogen and phosphorus in runoff, and reduction of stream bank erosion. As a result of this research and similar research conducted throughout the United States, more than 200,000 acres of streamside buffers have been established in Iowa alone.

Iowa farmer adoption continues. Leah Maass added a buffer of switchgrass along a creek running through her farm in Hamilton County. "We got enrolled in [the buffer program] and have 120 foot wide buffers on both sides of the creek […] Later we put in some bird land buffers."

However, researchers and farmers are aware that riparian buffers are only able to purify the water that flows through it. "It became

"We know that nitrogen that goes into the buffer disappears."

—Dan Jaynes, who is researching a new type of buffer treatment that redirects tile water before it empties into a stream

A new line redirects tile water into the nearby riparian buffer along Bear Creek on the Hansen farm. Credit: Kent Heikens

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obvious that in riparian buffers in tile-drained landscapes much of the water moves […] through tiles, and is disconnected from the riparian buffer," says Dan Jaynes, a research soil scientist at the USDA Agricultural Research Service who joined the research team in 2010. Says Maass, "With all the tile we have, whatever comes off the land would more than likely run through the tile rather than […] as runoff" through the buffer.

The Strategy

In 2010, the riparian buffer research team received a Leopold Center grant to study the impact on nitrate removal in a riparian buffer in which part of the tile drainage water is redirected to flow through the buffer. They called this a saturated buffer, and the practice is intended to make further use of the buffer's ability to improve water quality. They created a saturated buffer at an existing Bear Creek buffer. A second saturated buffer also was installed on Maass' land. The three-year study produced surprising results.

Making a Difference

First, the saturated buffer was more efficient at removing nitrogen than expected. "From the water we were able to infiltrate into the buffer... there was 100% efficiency of nitrogen removal," says Jaynes. Second, the buffer was able to treat more water than expected. Jaynes explains why a saturated buffer can only treat a portion of the water flowing through tiles lines. "Water has to infiltrate into the soil, so it's limited by the infiltration capacity of the soil. We're draining 15- to 20-acre fields and can't expect a 1,000-foot-long buffer to absorb all that water." However, "The other surprise was that the buffer could take a substantial amount of tile flow—about 50 percent of tile flow in 2011 and 2012. We didn't think the permeability of the soil would allow that much."

Using those results, the team was able to successfully apply for a USDA Agriculture and Food Research Initiative (AFRI) grant to continue their research. Tom Isenhart, associate professor in Natural Resource Ecology and Management at ISU who has worked on the project since the 1990s, says "Once again, initial support by the [Leopold Center] to establish the demonstration site within Bear Creek and collect preliminary data was essential in our success in receiving the grant." They will

This is where tile water is redistributed. Data is uploaded remotely, powered by solar cells. Credit: Kent Heikens

receive $489,191 over three years to study how the saturated buffer removes nitrogen from water and where the nitrogen goes. "We know that nitrogen that goes into the buffer disappears," says Jaynes. "We think most is being denitrified into nitrogen gas and going into the atmosphere, but have no evidence of that. The AFRI grant will help us answer where the nitrogen is going and help identify […] properties of the buffer that drive denitrification so we can improve the design and improve where to locate buffers."

Contact

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Case study by Arlene Enderton, Winter 2013

Leopold Center competitive grants:

E2013-13, Reconnecting riparian buffers with tile drainage: An emerging technology to reduce nitrate loss from croplands

E2010-01, Reconnecting Iowa riparian buffers with tile drainage.