Practices to Improve Water Quality

Leopold Center for Sustainable Agriculture

LEOPOLD CENTER

There are many on-the-ground practices that farmers and landowners can use to improve Iowa's water quality. The Leopold Center for Sustainable Agriculture supports research to learn more about these practices.

Prairie Strips

Remove pollutants from subsurface and overland flow. Research that started in 2007 at the Neal Smith National Wildlife Refuge demonstrates the benefits of strategically placed native prairie buffer and filter strips in row-cropped fields. Sediment loss has been reduced by as much as 90 percent where 10–20 percent of the watershed is planted in prairie strips. Nitrate and phosphorus movement also have been substantially reduced in watersheds with prairie strips, both in runoff and in subsurface flow.

Learn more: **www.priairestrips.org**

Riparian Buffers

Remove pollutants from subsurface and overland flow. Long-term research at Bear Creek has shown that diverse plantings of trees, shrubs and grasses, 60–80 feet wide along streams can reduce sediment in surface runoff by 90 percent and cut nitrogen and phosphorus in surface runoff by 80 percent. Nitrates in shallow groundwater also can be reduced by as much as 90 percent depending on site geology. Atrazine concentrations were found to be 70 percent lower in the rooting zone below the buffer.

Learn more: **www.leopold.iastate.edu/agroecology-research-team**

Saturated Buffers

Remove pollutants from tile drainage. Saturated buffers, unlike ordinary riparian buffers, capture and treat water from tile drainage. A shallow lateral line redirects flow from a main tile line into the buffer, where it percolates into the soil or gets taken up by vegetation.

A 1,000-foot saturated buffer at Bear Creek removed 100 percent of the nitrate from 60 percent of the tile flow during its first year of operation. No data has been collected yet for phosphorus or pesticide removal. The demonstration buffer has an estimated lifespan of 20 years and treats water draining from 50 acres.

Learn more: **lib.dr.iastate.edu/leopold_grantreports/450/** and **lib.dr.iastate.edu/leopold_grantreports/463/**

Woodchip Bioreactors

Remove nitrate from tile drainage. A bioreactor works by rerouting tile drainage through a buried trench filled with woodchips, where naturally occurring denitrifying bacteria will convert nitrate to harmless nitrogen gas. Most bioreactors remove 15–80 percent of the nitrate load annually. They have an estimated lifespan of 15–20 years and treat water draining from 30–80 acres.

Learn more: **lib.dr.iastate.edu/leopold_grantreports/412/**

Cover Crops

Remove nitrates from subsurface and overland flow. Cover crops like rye, oats, wheat and red clover accumulate nitrate and recycle it into the soil. Rye is the most studied in Iowa. It significantly reduces nitrogen losses at widely variable rates depending on field conditions, fertilization rates, weather conditions and when the cover crop was planted. Legumes such as red clover make atmospheric nitrogen available for subsequent crops, reducing the need to apply synthetic nitrogen fertilizer.

Learn more: **www.leopold.iastate.edu/iowa-cover-crops-working-group**

September 2016

Forest Understories

Remove pollutants from subsurface and overland flow. This research looks at how forest understories capture nutrients and slow soil erosion to protect small headwater streams. The restoration or preservation of key spring-growing species has the potential to improve nutrient capture. Ongoing work investigates any differences between intact, healthy forest ecosystems and degraded ones.
Learn more: **lib.dr.iastate.edu/leopold_grantreports/419/**

Wetlands

Remove pollutants from subsurface and overland flow and/or tile drainage. Wetlands are a proven and long-lasting practice for improving water quality. Research at Iowa State University has shown that wetlands can remove 40–90 percent of nitrates and over 70 percent of herbicides. Nitrate removal is variable depending on the volume of inflow and watershed size. Wetlands treat drainage from watersheds that are 500–4,000 acres and can be designed to treat drainage from tile flow.
Learn more: **lib.dr.iastate.edu/leopold_grantreports/126/**

Rain Gardens

Remove pollutants from urban runoff. Rain gardens, shallow depressions filled with native plants, capture and filter pollutants from runoff by increasing soil filtration. Properly designed rain gardens can effectively trap and retain up to 99 percent of the common pollutants found in urban storm runoff. A special Leopold Center project installed two demonstration gardens in Ames and developed an outreach program to educate landowners about native landscaping.
Learn more: **http://www.rainscapingiowa.org/en/rainscapes/rain_gardens/**

Diverse Crop Rotations

Reduce inputs and transport of pollutants; reduce nitrate loss.

1. Diverse crop rotations allow farmers to apply less synthetic fertilizer, herbicides and pesticides. A project at Iowa State University's Marsden Farm compares the conventional corn-soybean system with a three-year rotation (corn-soybean-small grain/red clover) and a four-year rotation (corn-soybean-small grain/alfalfa-alfalfa). The diverse rotations, which received composted cattle manure and clover and alfalfa residues, required 80 and 86 percent less synthetic nitrogen, respectively. After nine years, herbicide inputs were 7–10 times lower and herbicide-related freshwater toxicity 200 times lower. On average, corn yields were 4 percent greater, soybean yields 9 percent greater, and net returns similar, compared to the conventional system.
Learn more: **www.leopold.iastate.edu/grants/e2010-02**

2. Another option is to add a "third" annual crop to the conventional corn-soybean rotation. A research project evaluated spring and winter varieties of canola as a potential third crop for Iowa. The canola is double-cropped with spring or winter varieties of wheat and interseeded with red clover. Because canola actively takes up nutrients and water during times of year when corn and soybean aren't growing, the three-year rotation has a smaller risk for runoff. Winter crops also interrupt the life cycles of summer annual weeds.
Learn more: **lib.dr.iastate.edu/leopold_grantreports/483/**

3. An on-farm project in western Iowa looked specifically at reducing nitrate leaching into shallow groundwater with perennial crops and cover crops. The project tested five different rotations, including continuous corn, continuous grass, and various combinations of corn, soybean, oats, alfalfa and winter wheat. The cover crops used were red clover, oats and winter rye. Initial results showed that perennial crops like alfalfa, with living root systems in the ground all year long, are the most effective way to reduce nitrate loss.
Learn more: **lib.dr.iastate.edu/leopold_grantreports/496/**

Photo credits: 4 - Laura Christianson, 6 - Iowa DNR, 7 - Scott Bauer/USDA, 8 - Anna MacDonald, 10 - Stefan Gailans