Prairie Strips

Bringing biodiversity, improved water quality, and soil protection to agriculture

By Lisa Schulte Moore

The prairie strips conservation practice harnesses the productivity, stability, and benefits of prairie—the historically dominant ecosystem that once blanketed much of the Midwest—to help farms produce clean water, wildlife, and biological wonder in addition to food, feed, fiber, and fuel.

The motivation for expanding the basket of goods that Midwestern farms produce is strong. While our current agricultural system achieves record productivity in crops and livestock, it is also associated with serious environmental shortcomings, including declines in water quality and biodiversity, increased flooding and greenhouse gas emissions, and even degradation of the foundation of agricultural productivity: the soil.

Even tried and true conservation practices, like no-till, are recognized to be insufficient given the heavy rains the region is now commonly experiencing. Many farmers, farmland owners, and conservation professionals are recognizing that we need a better way. Prairie strips might just be that better way for some farms.

SARAH HIRSH

The Prairie Strips Practice

A prairie strip is an area within or at the downslope edge of a crop field that has been planted to and managed as native prairie vegetation. The prairie strips practice was developed and monitored in an experiment at central Iowa's Neal Smith National Wildlife Refuge. The STRIPS acronym stands for "Strategic Integration of Rowcrops with Prairie Strips."

Prairie strips may vary in width and length based on the characteristics of the field, including its topography, soil type, and size. Importantly, the strips are interlaced with crops and follow the topographic contour so they intercept water running over the soil surface. Also importantly, the strips are planted to a diverse mix of native prairie plants, including cool-season grasses, warm-season grasses, and forbs. This diverse mix of prairie plants, with their stiff, upright stems, deep roots, and biological activity over the course of the whole growing season, provide ecological functions that annual crop plants—which are designed to maximize grain or bean productivity—do not.

In 2007, the STRIPS team—including investigators from Iowa State University, the USDA Agricultural Research Service, the U.S. Fish and Wildlife Service, and the U.S. Forest Service—sowed the seeds of 35 native prairie plant species in 10- to 30-foot-wide strips (100- to 150-feet-wide at slope base) in experimental catchments farmed on a corn-bean rotation using no-till techniques. The experiment tested four different configurations:

- all row crop (no prairie)
- 90 percent row crops and 10 percent prairie placed all at the bottom of the catchment where runoff water flows out
- 90 percent row crops and 10 percent prairie placed in multiple strips running along the contour
- 80 percent row crops and 20 percent prairie placed in multiple strips running along the contour.

Slopes at our experiment range between 6 and 10 percent. We also installed many kinds of scientific monitoring equipment in these catchments so we could quantitatively understand how these areas were functioning agronomically and environmentally. Specifically, we measured crop yield, soil and water movement, plant cover and diversity, bird and insect diversity, greenhouse gas emissions, and socioeconomic characteristics.

ANNA MACDONALD

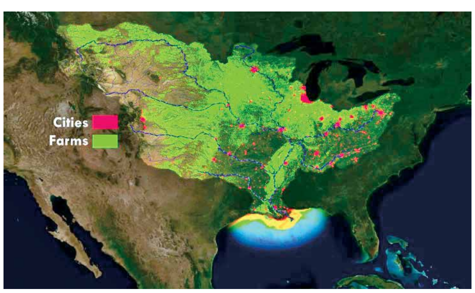
This prairie strip is part of the STRIPS experiment at Neal Smith National Wildlife Refuge, Prairie City, Iowa. The diverse native prairie plants with stiff stems and deep roots make this practice effective at providing multiple conservation benefits, including erosion control, clean water, and wildlife and pollinator habitat.

ANNA MACDONALD

A catchment is a topographically defined area of land that basically "catches" rainfall. Any rainfall, minus that which evaporates or is transpired by plants, should theoretically run toward and congregate at the lowest spot in the catchment. This experimental catchment, above, contains alternate strips of prairie and crops, in this case soybeans. An H-flume is located at the bottom of the catchment and allows collection of samples of water runoff. The poles protruding from the strips mark the location of ground water wells, for measuring ground water depth and chemistry, and suction cup lysimeters, for measuring soil water chemistry.

Here are some of our results:

- In terms of plant measures, we find that catchments that have at least 10 percent of their area in prairie have a 380 percent increase in native plants with 115 percent cover compared to entirely row-cropped catchments. This is impressive, but not surprising, given we planted most of this diversity.
- Important to farmers who might adopt prairie strips as a conservation practice, we've also found that the strips do not have a negative impact on yield of adjacent crops, and plants from them do not invade adjacent cropland. In other words, the prairie plants do not become a weed problem for farmers.
- Our data on water quality impacts are probably the most dramatic. We've recorded 60 percent less water leaving catchments with just 10 percent of their area in prairie strips, likely due to the combination of greater infiltration of water through the soil and transpiration of water to the atmosphere by the prairie plants. Associated with lower levels of runoff are 95 percent reductions in the amount of sediment moving out of the catchments, and nearly 90 percent reductions in the amount of phosphorus and nitrogen moving out of the catchments. These measures are important because while soil, phosphorus, and nitrogen are wonderful assets supporting plant growth in agriculture fields, they become serious pollutants if they reach our waterways. Sediment, phosphorus, and nitrate-nitrogen are three of the top four water pollutants in Iowa. In Missouri, bacteria is the most common water pollutant, followed by heavy metals.
- Soil is an invaluable farm resource. Our data show that, on sloping lands like at our experimental location, no-till soil management alone was not adequate for keeping soil loss below USDA Natural Resource Conservation Service's "tolerable soil loss" of 5 tons per acre per year. In one April 2009 storm alone, an average of 1 ton per acre of soil was lost from catchments without strips; loss from catchments with 10 percent in prairie strips was negligible. No-till needs to be considered a component of a conservation system that also include other conservation practices such as prairie strips, grassed waterways, and cover crops.
- In terms of beneficial insects, we've recorded the same diversity of insect pollinators as found in nearby patches of restored prairie. We've found 1.4 to 2 times the abundance of insects that serve as predators of crop pests in prairie strips than in adjacent cropland. While the strips appear to be providing habitat for these beneficial species, we have not yet detected a reduction in crop pests as a result.
- With regard to bird biodiversity, we've recorded 118 percent and 133 percent increases in native bird species richness and abundance, respectively, including species of regional and continental conservation concern, including the field sparrow, lark sparrow, and dickcissel. We next need to see if these increases in abundance translate into the increased fecundity of native birds.
- Prairie strips, if scaled up, could also have a meaningful impact on greenhouse gas emissions. Nitrous oxide is a serious greenhouse gas pollutant,



NOAA

Keeping Midwestern Soils Out of the Gulf

Hypoxia, or low oxygen, is an environmental phenomenon where the concentration of dissolved oxygen in the water is so low that it can no longer support living aquatic organisms. Hypoxic areas, or "Dead Zones," have increased in duration and frequency across our planet's oceans since first being noted in the 1970s.

The Gulf of Mexico is the largest hypoxic zone in the United States and the second largest worldwide. Gulf hypoxia is caused by the discharge of nutrients into the Mississippi River, which flows to the Gulf, which in turn encourages the growth of aquatic plants. When bacteria decompose this plant material, oxygen is depleted.

Row crop agriculture is responsible for tremendous losses of soil and fertilizers that, in a large part of the Midwest, run off the land into the watershed of the Mississippi River. Both Iowa and Missouri are top contributors of these nutrient losses—Iowa is a bigger contributor of nitrogen while Missouri is a bigger contributor of phosphorous. Iowa has recently committed to achieving 41 percent and 29 percent reductions in nitrogen and phosphorus, respectively, from reaching surface waters. Initial results from the STRIPS project suggest that prairie strips might be an effective, economical way to get Iowa much of the way there.

Members of the STRIPS team laying out prairie strips on Seth Watkin's commercial farm in Taylor County, Iowa. "My gut tells me that it's a good practice," Watkin said. "If other people are going to buy in, they're going to need some hard data."

The STRIPS experiment has yielded data on 1.2- to 8-acre experimental catchments, demonstrating the benefits of prairie strips to farmers and wildlife alike. The STRIPS team is beginning to consult with a growing group of farmers and farmland owners on "Phase 2" implementation of the experiment, which is on commercial farm fields.

with 300 times the global warming potential of carbon dioxide. Globally, most nitrous oxide emissions are associated with agriculture, emitted after fertilizers with naturally occurring and synthetic nitrogen are applied to row crops. We've found substantially reduced nitrous oxide flux associated with our prairie strips in comparison to cropped land. We've also found substantial accumulation of soil organic carbon at the base of catchments with strips.

- Finally, we've found that when baled, prairie strips produce about 3.2 tons per acre of dried plant material, which can be used for animal bedding or to produce bioenergy where markets exist. While this quantity isn't outstanding—it's similar to moderately managed switchgrass—it's an added benefit layered on top of a multitude of conservation assets, several of which help to sustain agriculture itself into the future.

We've run the numbers, and a farmer could get all of the benefits of prairie strips for $24 to $35 per treated acre per year, which could be further cut by 80 percent if the strips were enrolled in the federal Conservation Reserve Program. This is affordable: farmers continuously spend $3 to $35 an acre on inputs. For example, cover crops, which are experiencing a boom in adoption across the Corn Belt now cost about $40 per acre. An application of nitrogen fertilizer costs about $85 per acre.

If by now you're thinking that prairie strips make a whole lot of sense, you're not alone. Many others—including farmers, farmland owners, state and federal agencies, and commodity and environmental organizations—also think so and are getting on the bandwagon. The STRIPS team is beginning to consult with a growing group of farmers and farmland owners on "Phase 2" implementation of the experiment, which is on commercial farm fields.

In sum, prairie strips are a cost-effective way to blend production and conservation. They harness the productivity, stability, and benefits of the historically dominant ecosystem that once blanketed much of the Midwest and help build farming systems that produce clean water, wildlife, and wonder in addition to food, feed, fiber, and fuel. To learn more about the Prairie STRIPS program, visit www.prairiestrips.org.

Dr. Lisa Schulte Moore is Associate Professor of Natural Resource Ecology and Management at Iowa State University. She is one of the lead investigators on the STRIPS project, leading the bird biodiversity component and playing a major role in on-farm research and demonstration of the prairie strips practice.