Thinking beyond the border: Edge-of-field practices to improve the environment

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A spring view of constructed wetlands along the Embarras River in southern Champaign County, IL. Wetlands like these can help clean up tile drainage or field runoff water. Photo courtesy of the University of Illinois and originally submitted as part of a research article by

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Achieving better soil health, water quality, and biodiversity while saving water and decreasing greenhouse gas emissions from agriculture is a complex endeavor. In-field agronomic practices, like growing cover crops, reducing or eliminating tillage, installing reduced-flow irrigation, and following the principles of 4R nutrient stewardship are fundamental to reaching goals for better environmental outcomes. It is widely agreed upon that improving soil health in production fields is a win-win for farmer livelihoods and nature. But, limiting our attention to the area between field borders also limits the power of the agricultural community to fully realize our powerful potential to the big, quantifiable transformation needed to protect vital natural resources.

Expanding conservation practices beyond the field border can have big impacts on the quality of water leaving the field, conserving irrigation and supporting biodiversity. In areas that experience high rainfall or use flood irrigation, water leaving the field can carry soil and crop inputs with it as it enters streams and other bodies of water. On sloped sites, or flooded areas, water-induced soil erosion can cause gully erosion, which negatively affects productivity and is difficult and expensive to repair. Conservation practices that protect water quality can be designed in a way that supports local biodiversity.

Edge-of-Field Practices to Manage Runoff, Drainage Water, and Irrigation Tailwater

Vegetated Buffers

Vegetated buffers are areas planted in permanent vegetation that lie between crops and water bodies or on slopes to intercept water running off the field, trapping nutrients and sediment while providing forage and resting and nesting spots for wildlife, pollinators, and other beneficial organisms. There are different types of vegetated buffers that utilize various plant types and placement.

First-year prairie strip. Photo courtesy of the Soil and Water Conservation Society.

Grassed Waterways

Grassed waterways are designed to slow water movement and reduce gully erosion in and adjacent to fields. They transport the water to a stable outlet, such as a ditch or filter strip (USDA-NRCS, 2015). As the name implies, grassed waterways are generally planted in perennial grasses. Select native (when available), sod-forming species that have stiff, upright stems that can stand up to flowing water. Before seeding, the site is graded, smoothed, and firmed to promote quick germination and establishment before the rainy season when risk of forming new gullies or rills is high. Grassed waterways are best kept as wide and shallow as space permits to slow water moving downslope (USDA-NRCS, **2003**). Learn more about grassed waterways by visiting **https://bit.ly/2Wagw7x**.

Prairie Strips

Prairie strips are mixtures of at least two native prairie species planted in field or at edge-of-field swaths that are 30 to 120 ft wide. They are planted to reduce soil erosion, improve the quality of water leaving the field, and support biodiversity.

Seed mixtures for edge-of-field plantings may include a combination of perennial grasses or sedges and forbs (flowering herbaceous plants). Perennials will regrow each spring from underground structures and will not require re-seeding each year. When selecting seed for prairie strips, select a diversity of native species that are adapted to local conditions whenever possible. For prairies strips, mixes that are 50/50 grasses or sedges and forbs are best. The forbs can be a mixture of legumes and non-legumes. Native flowering plants are more likely to support native pollinators and will perform optimally in local soil and climatic conditions. Look for mixes with species that bloom over a long time and vary in height and rooting depth. Check seed mixes to ensure they do not contain known weeds in cropping systems, such as morning glory (*Ipomoea* spp. and *Convolvulus* spp.).

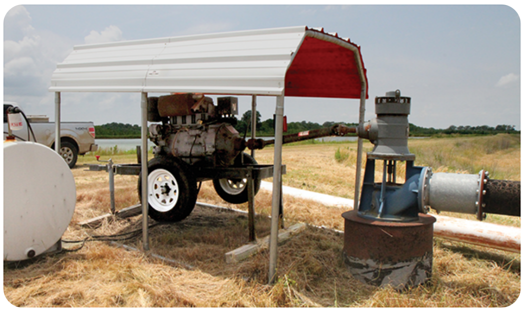
Managing weeds in prairie strips and the neighboring production fields is important. For the first year or two, annual weeds in the managed prairie strip need careful management. Regular mowing of prairie strips in the first few years can deplete the soil seed bank of annual weeds in favor of establishing perennials from the purchased seed mix. As the desirable perennials cover more of the soil surface, they will outcompete remaining annuals. Perennial weeds, like field bindweed or Canada thistle, can be challenging to manage in a perennial mix of native plants. Spot-treating such invaders with chemical or mechanical methods will minimize the risk of destroying desirable species in the strip. Regular, in-field weed management systems should be adequate for controlling rogue seedlings emerging from prairie strip or other seed mixes (Soil and Water Conservation Society, **2021**; Iowa State University, **2021**). The Iowa State University **STRIPS program** estimates the cost of converting one acre of land to prairie strip ranges from $280 to $390. The Farm Service Agency Conservation Reserve Program can help farmers reduce the cost of installing prairie strips by 75% (Iowa State University, **2021**). The Soil and Water Conservation Society has published useful resources about prairie strips at **https://bit.ly/3j4Ltmt**.

Saturated Buffers on Tile-Drained Fields

Tile drainage is an important practice for maintaining healthy crop roots in areas that experience flooding during the crop season. However, the water leaving tile drains is often laden with crop inputs, presenting a concern for water quality downstream. Saturated buffers are a type of vegetated buffer specifically designed to address this challenge. They are installed where underground tile drainage discharges water in order to reduce the amount of excess nutrients and chemicals before water is discharged to the stream. Water exiting the drain is distributed along lateral lines that empty into the saturated buffer. Perennial plants growing in the buffer intercept the discharge and utilize nutrients contained within the water. Recent research (Streeter & Schilling, **2021**) found that saturated buffers reduced nitrate nitrogen (NO_3–N) concentration in tile drainage from 15 g/L to less than 1.5 mg/L.

Saturated buffers work best in locations where the field is sloped less than 1%, there are no layers of sand or gravel, soil organic matter is at least 1% in the upper 30 inches of the soil profile, and the main drains at least 15 ac of land (The Ohio State University, **2021**). Research by the Agricultural Drainage Management Coalition and the USDA Farm Service Agency in Illinois, Iowa, and Minnesota calculated an average cost to install a saturated buffer at $3,884 (USDA-Farm Service Agency, **2021**). The USDA-ARS offers more information about determining feasibility and costs of installing a saturated buffer here: **https://bit.ly/3841WB7**.

Constructed Wetlands



Tailwater recovery systems collect excess irrigation water in reservoirs and return it to the top of the field for subsequent irrigation. Photo courtesy of USDA-NRCS.

Another way of cleaning up tile drainage or field runoff water is using constructed wetlands, which have the added benefit of also protecting against downstream flooding. Also used in the treatment of municipal wastewater, constructed wetlands hold water that is gradually released into soil, and excess nutrients are taken up by plants or denitrified by bacteria. This edge-of-field system mimics natural systems by supporting a diversity of plants, animals, and microbes. Well-suited for watershed-scale approaches to improving water quality and supporting local biodiversity, constructed wetlands work best in larger areas of land that are not in production. They are expensive to build, averaging around $10,000 per acre (Wilde, **2019**). Recently **published work** in the *Journal of Soil and Water Conservation* details the use of constructed wetlands to treat tile drainage water in Central Illinois.

Tailwater Recovery Systems

Tailwater recovery is a method to save water from each irrigation application for use in future applications, increasing efficiency and reducing overall water use. In recent years, many regions of the country have experienced drought or more intermittent rainfall than they have in the past, making such systems economically attractive as a means to conserve a scarce resource. As a result, in some regions, such as California, producers have been drawing more irrigation water from groundwater sources. Tailwater recovery works by capturing the excess water on the bottom of the slope of a field that can result from surface irrigation. That water must be conveyed away to prevent field flooding and oxygen depletion in the rhizosphere. Irrigation tailwater, like any runoff from farm fields, likely contains sediment, nutrients, and crop protectants that can enter and harm nearby water bodies. Tailwater recovery systems (TWS) collect this excess irrigation water in reservoirs and return it to the top of the field for subsequent irrigation. Therefore, TWS both conserves irrigation water and protects water quality by intercepting sediment and crop inputs as well as recycling runoff for a future irrigation, reducing the need to draw water from diminished surface or groundwater sources. Mississippi State University Cooperative Extension has a **comprehensive resource on tailwater recovery systems**.

Partnerships for Edge-of-Field Practices

Installing edge-of-field practices comes with a price that may be too high for a farmer to pay without financial support. The USDA Farm Service Agency's Conservation Reserve Program (CRP) offers such financial support to take "environmentally sensitive" lands out of production and implement practices mentioned in this article. In 2021, the USDA adjusted land rental rates and increased payments for water quality improvement practices to entice more landowners and operators to participate in the

CRP program. Find out more about connecting the growers you serve to this program at **https://bit.ly/2W7i95M**.

As consumer brand and retail companies increasingly turn their focus toward landscape-scale approaches to improving the sustainability of their supply chains, they are investing in projects that leverage public funding, such as the CRP program, to take conservation to scale. USA Rice and Ducks Unlimited have partnered, along with USDA-NRCS, Walmart.org, The Mosaic Company and the Mosaic Foundation, Nestlé Purina PetCare Company, RiceTec, BASF, Corteva Agriscience, and Riceland Foods, Inc., to deliver sustainable outcomes for the U.S. rice industry. Aptly named the Rice Stewardship Partnership, this collaboration brought $87 million to rice farmers from the six U.S. rice-producing states across 700,000 ac. Learn more about this partnership, which was recognized as Field to Market's **2019** Collaboration of the Year Award at **https://fieldtomarket.org/case-studies-series/2019-collaboration/**.

The Role of the Trusted Adviser

A recent publication by The Nature Conservancy, Meridian Institute, and the Soil and Water Conservation Society (**2021**) lays out a roadmap to advance edge-of-field practices in agriculture. One of the recommendations made in this roadmap directly points to the need to engage trusted advisers like CCAs, land grant university extension staff, district conservationists, and NRCS field staff: "Increase technical assistance by supporting the multiple sources of conservation expertise. Strengthen the capacity of conservation professionals to administer, advise on, and help producers implement these practices." The expertise of CCAs on the individual practices and systems mentioned above is needed. Another vital role for CCAs is helping their farmer-clientele navigate the cumbersome and sometimes confusing application process to access programs and cost-share opportunities available through the USDA Farm Service Agency and NRCS.

Protecting Water Quality and Promoting Biodiversity Go Together

Edge-of-field practices can have multiple ecosystem benefits when live plant material is incorporated into the design. Vegetated buffers utilize site-appropriate plants to slow water movement while trapping sediment and nutrients

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