Leveraging Conservation Dollars

Agricultural Practices that Deliver Water Quality, Wildlife Habitat, and Soil Health

DEFENDERS OF SOIL, AIR, WOODS, WATERS AND WILDLIFE
THE IZAAK WALTON LEAGUE OF AMERICA, INC.

The Izaak Walton League of America

The Izaak Walton League of America is one of America's oldest conservation organizations. Chartered in 1922 by 54 anglers, the League has worked to conserve our nation's rivers, lakes, and wetlands for nearly a Century. Today the League has 230 local chapters and more than 43,000 members across the country.

The League has been at the forefront of successful efforts to protect critical areas, from the Upper Mississippi River Wildlife and Fish Refuge, Boundary Waters Canoe Area, and Jackson Hole National Monument, to Everglades National Park.

The League was instrumental in passage of the Migratory Bird Conservation Act, Pittman-Robertson Act, Federal Water Pollution Control Act, and Wild and Scenic Rivers Act. The League's 'Walton Soil Plan' presaged the 1956 Soil Bank Act, and the 1985 Conservation Reserve Program.

Today the League's Agriculture Program is focused on efforts to reduce the impact of crop and livestock production on America's waters, especially in signature watersheds like the Upper Mississippi and Missouri rivers, Great Lakes, Chesapeake Bay, and Florida Everglades. That includes advocating for conservation programs and funding in the federal Farm Bill, and supporting state-level efforts to stem pollution from agricultural sources.

We educate policy-makers and others on the value of healthy soils for reducing soil erosion and polluted runoff, improving water quality, storing carbon in the soil, boosting farm profitability, and preserving rural communities. To learn more about the Izaak Walton League of America, visit us at www.iwla.org.

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Facing page, L to R: Lynn Betts, NRCS; Lynn Betts, NRCS; Lynn Betts, NRCS; US FWS; Keith Weller, USDA ARS.

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The federal Farm Bill provides over $5 billion per year in financial and technical assistance for farmers, livestock producers, and woodlot owners to adopt conservation practices and systems that conserve soil, improve water quality, reduce inefficient water use, boost soil health, and restore and protect wildlife habitat.

That $5 billion is our nation's largest source of funding for farm and ranch conservation, but every year it falls far short of meeting the demand from farmers and ranchers for conservation assistance. Many states also provide funding for conservation efforts on farms and ranches, but that too falls far short of the need.

With demand for conservation funding that far exceeds the dollars available, scarce conservation funds need to be invested to achieve the maximum conservation benefits for each dollar spent. Fortunately, many farming practices and systems deliver multiple natural resource benefits, and recent research is highlighting where those synergies are the strongest. Not all practices are alike in delivering benefits for multiple natural resources.

> **The purpose of this report is to highlight five conservation systems in growing use on America's farms and ranches that deliver significant benefits for water quality, fish and wildlife habitat, and soil health.**

While some advocates choose to argue about whether conservation funding should support water quality, wildlife, *or* soil health goals, we would argue for targeting funds to conservation systems and practices that support *all three* important goals. In short:

►Congress, which enacts the Farm Bill, and the U.S. Department of Agriculture, which administers Farm Bill conservation programs, can boost the conservation benefits delivered by designing programs and prioritizing practices and systems like these that deliver benefits for multiple natural resources.

►State and local governments can also provide funding and direction to promote more widespread adoption of conservation systems like these that solve multiple natural resource problems.

Five Conservation Systems that Deliver Multiple Benefits

- **No Till**
- **Buffer Strips**
- **Cover Crops**
- **Integrated Pest Management**
- **Rotational Grazing**

Lynn Betts, NRCS

No Till

Zero tillage and other conservation tillage systems reduce erosion and polluted runoff by leaving in place all (no till) or most (other conservation tillage) of the plant residue remaining after a crop is harvested. Rather than disk or plow in the fall after harvest, or in the spring before planting, the system leaves some or all of the crop residue on the land to protect the soil through the winter and into the growing season. In a no till system, a seed drill plants the seeds through the residue, leaving residue in place to continue to protect the soil. Other conservation tillage systems, like ridge-till, strip-till, and mulch-till, leave a portion of the plant residue in place at planting.

Roots remaining in place help hold the soil, and residue on the surface protects the soil by deflecting rainfall and reducing the erosive force of runoff. No till farming can reduce soil erosion by half or more[1], and in some cases as much as 90% to 98%[2]. Reduction in phosphorus runoff is tied to the reduced soil erosion, and can likewise approach 90%[3].

No till can also reduce nitrogen runoff[4], although recent research suggests that no till needs to be combined with other practices like cover crops to most effectively reduce nitrate runoff[5]. Long-term, no till practices boost soil health, increasing the infiltration rate of precipitation and further reducing runoff of sediment and nutrients. Its effectiveness has made no till one of the bedrock water quality measures recommended by the U.S. Department of Agriculture (USDA) on cropland.

USDA provided funding for over 521,000 acres of no till, strip till or mulch till through the Environmental Quality Incentives Program in 2017[6]. The Conservation Stewardship Program supported over 96,000 acres of no till or reduced tillage practices, plus another 107,800 acres of intensive no-till (such as organic no till) in 2016[7].

Kelly VanBeek

No Till Produces Ducks

In Canada, the prairie-parkland region provides breeding habitat for over half of North America's continental mallard population. At least 80% of the region is under intensive cultivation, and the region has seen substantial wetland loss as well. With a shortage of wetlands and native prairie available for nesting habitat, waterfowl must often nest in cultivated fields.

Researchers in 1982 found that total duck production was several times higher in crop fields with zero tillage than in conventionally tilled croplands, although farmer actions to avoid crushing nests and to cover nests during seeding operations, and equipment types and timing also have impacts[11].

Erwin & Peggy Bauer, US FWS

For Fish and Wildlife…

No till provides substantial benefits for fish and wildlife by leaving residue on fields that provides food and cover. Research at the University of Illinois Urbana-Champaign documented significantly greater density of birds, a greater density of nests, and a greater diversity of bird species nesting in no-till soybean fields than in conventional tilled soybean fields[8]. The conservation value of the bird

community in no till soybean fields was also greater[9]. Research at Southern Illinois University at Carbondale showed that invertebrates, birds, and small mammals are more abundant in a no-till corn field than a conventionally tilled corn field[10].

Avian usage of crop fields has been shown to increase as residue cover increases, as happens in no till systems[12]. In another study, quail chicks needed to spend about six hours a day foraging in a no till field to meet their nutritional needs, one-third of the 20 hours of foraging needed in a conventional tilled field[13].

Research in no till corn fields in southwest Iowa showed that small mammal populations were no more abundant in no till fields compared to tilled fields, but the diversity of species was greater in no till fields[14].

After harvest, no till wheat fields in the Great Plains provide cover and habitat for migrating ducks, geese and other waterfowl, as well as habitat for the insects those waterfowl can feed on[15]. Waste grain left on the surface can feed deer, small mammals, migrating waterfowl, and upland game birds like turkey, quail and pheasant. Wildlife can, in turn, return benefits to the farmer: Research at Iowa State showed that field mice will eat a large share of the weed seeds in a no till field, reducing the need for herbicides[16]. Research in Indiana showed that field mice help farmers by consuming weed seeds and waste grains over the winter[17].

Fish and other aquatic life see benefits from no till in reduced runoff of sediment and phosphorus into streams, wetlands and lakes. Many studies have documented the impact excess sediment can have on aquatic species, especially trout and salmonids[18]. Excess phosphorus can feed algae, causing it to grow and multiply faster than the ecosystem can handle. These algal blooms then die, and the bacteria that breaks down the decaying algae can use up the oxygen in the water, causing kills of fish and other aquatic species.

According to the U.S. Geological Survey, many but not all fish kills are caused by low levels of dissolved oxygen, which can occur naturally or can be the result of excess nutrients[19].

For Soil Health…

Mycorrhizal fungi colonize the root zone of plants, helping the plants be more efficient at obtaining water and nutrients, especially phosphorus and nitrogen[20]. Tillage disrupts and can destroy mycorrhizal fungi. Fungi also produce proteins that help bind soil particles together, creating soil aggregates that provide habitat for bacteria. Soil aggregates create spaces that enable better infiltration of water. Eliminating or sharply reducing tillage of croplands helps protect the fungi that are part of healthy soil and provide benefits to plants.

Tillage also impacts the makeup of the bacterial community in the soil[21]. The diversity of bacteria in the soil under a no-till field is higher than under a conventionally tilled field[22].

While tillage disrupts mycorrhizal fungi and causes a loss of soil health, pesticides are also an important disruptor of soil health by poisoning some of the bacteria and fungi that perform important soil functions (see below). In the U.S. and other countries, the spread of no till and conservation tillage practices has been enabled and accompanied by the growing use of glyphosate-resistant crop varieties, which allow for chemical control of weeds previously managed with cultivation. This highlights the importance of developing and testing organic and low-chemical systems of no till and conservation tillage to maximize soil health.

Erwin & Peggy Bauer, US FWS

Lynn Betts, NRCS

Buffer Strips

Lynn Betts, NRCS

Buffer strips along streams and wetlands catch and hold nutrients, soil, pesticides, manure, and other runoff from farm fields. Grassed waterways are broad channels in fields planted in grassland species that direct and slow water moving down-slope to reduce soil erosion. Conservation buffers (which include buffer strips, grassed waterways, windbreaks, contour grass strips, field borders, and similar practices) can reduce the runoff of nutrients and pesticides by 50% or more into nearby streams or wetlands, and can reduce the runoff of soil by 75% or more[23]. Grass filter strips in the southeast reduced herbicide runoff by 66% to 95%[24].

The effectiveness of conservation buffers has made them one of the basic water quality measures promoted by the USDA. However, buffers are most effective when designed in the context of the farm's other conservation systems. For example, buffer strips along streams have limited effectiveness where drainage tiles carry nitrogen and other runoff from a field through a pipe under the buffer strip and directly to a stream. Contour buffers and grassed waterways used on land without adequate erosion control measures can fill up quickly with sediment[25].

USDA's Conservation Reserve Program provides support for over 1.5 million acres of conservation buffers, and almost 2.3 million acres of restored wetlands and wetland buffers[26]. The Conservation Stewardship Program provided support to widen or install buffers on almost 394,000 acres of land in 2016, and the Environmental Quality Incentives Program supported grassed waterways, windbreaks, field borders and other conservation buffers on 137,012 acres in 2017.

Gary Kramer, NRCS

For Fish and Wildlife …

A wide variety of wildlife will use buffer strips as habitat, depending on the vegetation planted and the region of the country. In Texas, white-tailed deer, wild turkey, cardinals, woodpeckers, owls, turtles, frogs, and insects will use riparian forest buffers[27]. In the southeast, researchers found two to three times as many bobwhite quail on farms with field borders compared to similar farms lacking field borders, and those field borders improve nesting and brood-rearing habitat[28].

A study of breeding season bird densities in crop fields with and without native grass buffers in 14 states showed higher densities of 5 of 6 targeted bird species near fields with native grass buffers in most regions, with the relative effect greatest for Northern bobwhite, dickcissel, and field sparrow[29]. While buffer areas do not provide ideal habitat for grassland birds that prefer large blocks of habitat (e.g., lesser prairie chickens), the smaller patches typical of buffer strips delivered bird abundance similar to larger patches for a suite of shrub-land birds that includes Bell's vireo, Northern bobwhite, yellow-billed cuckoo, field sparrow and willow flycatcher[30].

During winter, conservation buffers can provide critical bird habitat in an area, even where they involve a relatively small change in the primary land use (e.g., 7% of the landscape)[31]. Field margins with a naturally diverse flora provide habitat for a relatively high abundance and diversity of above-ground arthropods, and those areas can provide important habitat for pollinators and other beneficial insects[32]. Beneficial insect abundance was shown to be greater in fields with field borders[33], and the benefits of conservation buffers for pollinators can be increased with the addition of forbs and flowering shrubs[34].

Fish and other aquatic species benefit from the reduction in sediment, phosphorus, pesticides, and sometimes nitrate runoff into streams, lakes and wetlands. The impacts of sediment on fish species have been well documented, as noted above. Pesticides are another factor contributing to the decline of aquatic species, and they have been responsible for fish kills, as well as harming frogs, turtles, mussels, water birds, and other wildlife[35]. According to the Environmental Protection Agency, in some farm states like Illinois (89%), Kansas (81%), and Nebraska (76%), a large share of the lakes and reservoirs that were assessed failed to meet water quality standards because of nutrient-related impairment[36]. Reducing polluted runoff should benefit fish and other aquatic species locally as well as downstream.

For hunters, buffer strips can provide other benefits. Trees and shrubs planted in buffer areas along highways or busy roads can shield deer, turkey and other wildlife in fields or food plots from the disturbance of traffic, improving the hunter's chances that their prey will visit and stay in the area[37].

For Soil Health …

One of the best ways to restore organic matter to degraded cropland soil is to plant a diverse mix of perennial grassland plants. Research in Missouri comparing soil under a grazed pasture, un-grazed grass buffer, and tree and grass buffer, showed all had significantly higher soil organic carbon content and total soil nitrogen than the same type soil under row crop production, and the difference for both organic carbon and total nitrogen was roughly 50% greater. The same study showed that the percentage of water stable aggregates (a measure of soil structure) was more than three times as high in the three perennial vegetation treatments (grazed pasture, grass buffer, tree and grass buffer) than in row crop treatment, which helps explain why when it rains well managed perennial vegetation has higher infiltration rates, and less runoff, than a crop field[38].

Even years after they are established, the health of soil planted in grassed buffer strips continues to improve. Research in Iowa showed that buffer strips planted in land that had been in row crops and heavily grazed pastures showed "far better developed soil food webs than they (i.e. the very same plots) did 13 years earlier." When first sampled, the buffers along Bear Creek in Iowa were zero to 11 years old, and the follow-up sampling was done when they were 13-24 years old. After 13 more years, the switchgrass-dominated plots showed total soil bacteria biomass was 14 times greater, total fungal biomass was five times greater, and total protozoan densities were 18 times greater, in 2014 versus the first sampling in 2001[39]. All three are indicators of the additional life in the soil.

Conservation buffers are not a substitute for healthy soil in the adjoining fields. They work best where cropland infiltration rates for precipitation are highest, and resulting runoff the lowest, due to healthy soil with high soil organic matter content and strong soil structure. Where infiltration rates are low, buffers can be overwhelmed by runoff and fail to capture some of the nutrients, pesticides, sediment, and manure[40].

USDA

Conservation Reserve Enhancement Program projects fund buffer strips that deliver water quality, wildlife, and soil health benefits.

Cover Crops

Jeremy Singer, USDA ARS

Cover crops are planted before, during or after harvest to keep living plants growing on cropland between harvest and planting time. A cover crop can be a single species like cereal (winter) rye or clover, or a mix of cover crops such as forage radish, crimson clover, and annual ryegrass planted together to provides multiple benefits. The cover crop is typically not harvested, although it can be grazed by livestock where appropriate.

Plants grown as cover crops can provide water quality benefits by scavenging leftover nutrients in the soil, holding soil in place, slowing erosion, and reducing polluted runoff. Studies of different cover crop treatments show reductions in polluted runoff by 40% to 80%, and they reduced sediment loss from 40% to 96%[41].

The Iowa Nutrient Reduction Strategy estimates that planting rye or oats as a cover crop could reduce nitrogen loss from crop fields by around 30%[42], and winter rye could reduce phosphorus loss by around 29%. Cover crops also reduce the risk of wind erosion in dryer regions like the west and Great Plains.

Cover crop strategies that include legumes, which fix nitrogen from the air into the soil, reduce the amount of nitrogen fertilizer needed to be added for crop production. That can reduce nitrogen loss even more[43].

USDA's Natural Resources Conservation Service (NRCS) reports that it provided support for the planting of 1.26 million acres of cover crops in 2017 through the Environmental Quality Incentives Program[44], and at least 0.44 million acres of cover crop mixes, intensive cover crops and similar systems through the Conservation Stewardship Program (CSP) in 2016. The CSP also provided support for the use of non-chemical methods to terminate cover crops on nearly 200,000 acres in 2016[45].

For Fish and Wildlife …

Fields with cover crops provide shelter and forage for birds and other wildlife, which can be especially helpful in providing winter cover for species that don't migrate. Research in eastern Illinois documented substantially higher numbers of migratory and resident birds in the spring in corn and soybean fields with cover crops than in fields without cover crops[46]. That research also showed a higher diversity of species in fields with cover crops, and the fields with cover crops hosted birds of higher conservation concern,

Ryan Stockwell, NWF

like the Eastern meadowlark.

Research at the University of Missouri has documented the habitat provided by cover crops for quail, and the increased potential for quail nest survival in cover crops compared to fields with no cover crops. While that increase in nest survival was not particularly large, it could be significant when multiplied by the large expanse of cropland acres that could be planted to cover crops[47]. That research also documented the use of cover crops as winter forage by rabbits, deer, turkey, and other wildlife.

Cover crops also provide habitat for pollinators, other insects, and small mammals. Pollinators benefit crops like fruit, vegetables, and alfalfa, and other beneficial insects can kill insects that eat crops. Insects in turn provide food for birds and small mammals.

Scott Bauer, USDA ARS

Fish benefit from cover crops in the same way they benefit from reductions in nitrogen, phosphorus, and soil sediment due to the use of no-till and buffer strips. Fewer excess nutrients in the water means fewer algal blooms, and less potential for the crashes in dissolved oxygen that can result. Less sediment runoff means fewer problems with high turbidity and fine sediment in streams.

For Soil Health …

Cover crops boost soil health by providing exudates that feed soil microbes, adding carbon to the soil, and improving aggregate stability. Plants use photosynthesis to convert water and carbon dioxide in the atmosphere to carbon in the form of sugars (carbohydrates), some of which feed the plant's growth and some of which are exuded through the roots into the soil. Those exuded carbohydrates feed bacteria and impact the beneficial fungi in the soil. By providing living cover (and the accompanying plant exudates) for much more of the year than annual crops, cover crops boost the abundance of soil bacteria and fungi[48].

Cover crops have been shown to significantly increase the amount of organic matter in the soil, and to also increase levels of total carbon, nitrogen, and potassium[49].

Cover crops can rapidly improve soil aggregation (when soil particles clump together, improving soil structure). Higher aggregate stability can enhance water, nutrient, and carbon storage, improve porosity, allow better root growth, and reduce the soil's erodibility[50]. Increased porosity and water infiltration means healthy soils can hold far more precipitation, soaking up rainfall like a sponge and reducing runoff that carries sediment, nutrients, and pathogens into nearby streams or wetlands.

Jeff Liebert, USDA

A roller-crimper kills off a cover crop without using chemicals on an organic farm.

Integrated Pest Management

Conventional row crop production involves prophylactic use of broad spectrum pesticides over whole fields. In contrast, Integrated Pest Management (IPM) focuses on long-term prevention of pest damage through techniques like biological control, habitat management, and diverse crop rotations. IPM doesn't necessarily eliminate the use of all chemical pesticides, but chemicals are used only as needed, applied selectively in targeted areas, to combat specific pests that have been identified through scouting, and using more benign chemicals when available.

Tim McCabe, NRCS

By using this systems approach, farmers and ranchers can reduce their use of chemical herbicides, insecticides, and fungicides. That should reduce the potential for those chemicals to drift to neighboring land or water, or to run off into nearby streams or wetlands. Integrated Pest Management can maintain and often increase yields, and increase profits, while substantially reducing the use of chemical pesticides[51].

A 2013 study of 100 small streams in the Midwest detected a median of 62 pesticide compounds per site, indicating the prevalence of pesticides in our waters[52]. Earlier sampling had detected at least one pesticide in about 95 percent of surface water samples in the USA, and in about 90% of fish tissue samples from streams[53]. Pesticides are ubiquitous in our waters, and they are often found at levels that have been shown to have clear impacts: In California, almost 25 percent of the state's surface waters fail to meet water quality standards because of the level of pesticides in the water[54].

USDA's Natural Resources Conservation Service reports that the Conservation Stewardship Program provided funding for high level Integrated Pest Management on 1.25 million acres of land, and supported related practices like GPS sprayers, drift reducing nozzles on sprayers, and non-chemical cover crop termination practices on another 4.7 million acres. NRCS also provided cost-share to put Integrated Pest Management in place on 138,315 acres of land through the Environmental Quality Incentives Program in 2017.

For Fish and Wildlife…

Integrated Pest Management involves a combination of techniques (e.g. scouting for pests, cultural practices like tillage and crop rotation, biological controls, and chemical controls, with triggers based on pest abundance, yield impacts, and economic costs). Rather than a specific practice like no till or cover crops (discussed above), Integrated Pest Management (IPM) is a menu or suite of practices. There have been few studies we can find directly assessing the impact of IPM on fish and wildlife generally, although there is some research on the impact of IPM strategies on beneficial arthropods[55].

However, it is clear that reducing pesticide use would have important benefits for a variety of wildlife. In a review of 122 studies of bird species associated with farmlands and grasslands in North America, Canadian researchers concluded recently that "pesticides (42% of all studies), followed by habitat loss or alterations (27%), were most predominant in negatively

Ron Nichols, NRCS

affecting farmland birds, with pesticides (93% negative) and mowing/harvesting (82% negative) having the most consistently negative effects." The researchers also said "modifications to farmland management such as reducing pesticide inputs through integrated pest management and maintaining or restoring uncultivated field margins and native habitat could positively influence farmland birds without significantly reducing agricultural crop yields.[56]"

A 2013 study of the causes of grassland bird decline said: "Best predictors of species declines were the lethal risk from insecticide use modeled from pesticide impact studies, followed by the loss of cropped pasture….this suggests that, in the U.S. at least, pesticide toxicity to birds should be considered as an important factor in grassland bird declines." Many of the grassland bird species of concern have been recorded killed directly in pesticide field trials, and many of the pesticides used are also designed to kill insects that serve as food for grassland birds and other wildlife[57].

Insecticides, herbicides, fungicides, and rodenticides can have serious and sometimes unexpected impacts on fish and other non-target aquatic species they touch. One study of four commonly used pesticides found that two insecticides, carbaryl (Sevin) and malathion introduced into an aquatic system substantially reduced aquatic species richness (by 15% with Sevin, and 30% with malathion). Herbicide glyphosate (Roundup) reduced species richness by 22%, while the more selective broadleaf herbicide 2,4-D had no impact on species richness. The two insecticides reduced the diversity of predatory insects, while the two herbicides had no impacts on predatory insects or snails. Glyphosate, an herbicide, completely eliminated two species of tadpoles and nearly exterminated a third species, resulting in a 70% decline in species richness of tadpoles[58].

Stephen Ausmus, USDA ARS

Beneficial insects, including pollinators like bees and butterflies, should also benefit from reductions in the use of broad spectrum pesticides.

For Soil Health …

Soil health depends on the microbial life in the soil: Beneficial bacteria, mycorrhizal fungi, nematodes, and other microorganisms help plants access nutrients, bind soil particles together as aggregates, and store carbon in the soil. Pesticides are designed to kill living things, whether insects, animals, plants, or fungi. Many fungicides used to treat fungal pests have been shown to harm the beneficial arbuscular mycorrhizal fungi that provide important benefits to plants[59].

Just as microbes in the soil can be disturbed or even destroyed by tillage, they can be disturbed or destroyed by pesticides and other chemicals. Urea herbicides have been shown to change the structure of the soil bacterial community, resulting in a less diverse community of bacteria[60].

Great Britain's Soil Association studied the impact on soil bacteria, mycorrhizal fungi, earthworms, and nematodes of glyphosate, one of the most widely used herbicide across the globe, and concluded that "the scientific evidence on the impact of glyphosate on the soil and soil life is far from conclusive. Research indicates potential impacts in increasing crop diseases, changing the composition and functioning of soil microorganism species and ecosystems, and recently published studies are showing a negative impact on earthworms[61]." The Association called for additional research on the impacts.

Managed Rotational Grazing

NRCS

Managed rotational grazing (also called *management intensive grazing*) mimics native herbivore grazing patterns, like the herds of bison that once roamed the Great Plains, by moving cattle, sheep, or other grazing livestock to a new paddock as often as once or twice a day. That provides fresh forage for the animals, and gives the vegetation weeks or months to rest and recover. Rotational grazing systems typically result in substantially higher forage production per acre than continuous pasture grazing, but they may require additional water facilities and fencing.

Many studies document the advantages of grassland over cropland in reduced soil erosion and reduced runoff of nutrients and pesticides. According to the USDA, research in Minnesota showed rotationally grazed buffers along streams benefit water quality compared to continuously grazed sites, reducing fecal coliform and turbidity in neighboring streams[62]. Its effectiveness has made managed rotational grazing one of the bedrock measures recommended by the USDA on grasslands.

While managed rotational grazing was developed as a strategy for grassland, farmers are gaining an appreciation for the benefits of incorporating livestock into their cropland operations, an age-old practice that lost favor in recent decades. Research in Wyoming shows that incorporating winter grazing into a cropping system boosted the soil organic carbon compared to a strip till field without livestock[63]. A study in Illinois showed that incorporating winter gleaning by livestock into corn production would boost soil carbon levels rapidly, compared to continuous corn without livestock[64], and the authors point to the economic and soil health benefits of incorporating both livestock and cover crops into crop production.

Jeff Vanuga, NRCS

In contrast to conventional grazing systems which rely on perimeter fencing, rotational grazing requires permanent or temporary fencing to create smaller paddocks, along with systems to provide access to water in each paddock. USDA reports supporting prescribed grazing on 3 million acres through Environmental Quality Incentives Program cost-share in 2017, and over 900,000 acres of prescribed grazing and grazing management with rest periods to improve wildlife habitat through the Conservation Stewardship Program in 2016[65].

For Fish and Wildlife …

iStock

By providing a mosaic of grassland heights and healthier grassland stands, managed rotational grazing delivers benefits for fish and wildlife. In Wisconsin, research showed that an intensive rotational grazing system resulted in a reduction in streambank erosion and a reduction in fine substrate in the channel, and that an intensive rotational grazing system performed as well as a grass buffer strip, and better than either a woody buffer strip or continuously grazed pasture, in protecting and rehabilitating Wisconsin trout streams[66].

Different grassland songbird species prefer different types of vegetation, from tall and dense to short and sparse, and rotational grazing results in a mosaic of vegetative cover that can help provide that diversity of habitat[67]. In North Dakota, rotational grazing was found to provide benefits for livestock operations while providing benefits in some years for a grazing-sensitive group of birds that included grasshopper sparrow, Savannah sparrow, Western meadowlark, bobolink, and Baird's sparrow[68].

Livestock tend to congregate in riparian areas, especially in more arid western parts of the country. Livestock over-use can have a negative impact on vegetation, fish habitat, and wildlife. Riparian areas are considered some of the most productive and critical habitats for wildlife[69]. Amphibians, water-dependent mammals like river otter, beaver, and mink, and birds and other wildlife that use the more lush vegetation typical of riparian areas can all benefit from a rotational grazing system that limits the duration of livestock presence in those riparian zones.

Charlie Rahm, NRCS

Elk in Montana saw benefits from a rotational grazing system put in place to address conflicts between elk and livestock on a wildlife management area. The system provided winter cover and forage for elk, enhanced native vegetation, and provided forage for cattle in the spring, summer, and fall[70.] Neighboring cattle ranchers also saw benefits because the improved elk winter habitat on the wildlife management area reduced the elk use of nearby private lands during the winter.

For Soil Health…

As Washington State University Extension Educator Tipton Hudson explains, "planned grazing that promotes healthy plants also promotes healthy soil by ensuring root occupation throughout the soil profile, facilitating aeration and creation of new organic matter, and maintaining optimum litter levels on the soil surface. Soil with these qualities is able to maximize the infiltration of precipitation and its capacity to hold water, which in turn is optimal for keeping manure onsite, recycling nutrients, and preventing overland water movement that might carry bacteria[71]."

Research in North Dakota and South Dakota showed that the soil under grasslands where cattle were rotationally grazed have more of the proteins that form soil aggregates than grasslands that are over-grazed, and native grasses have more of the proteins in the soils under them than those under non-native grasses[72].

Other research at North Dakota State University showed that rotational grazing strategies result in better soil health than moderate or intensive continuously grazed pastures, or an un-grazed brome grass Conservation Reserve Program field[73].

Well managed rotational grazing can boost the accumulation of soil organic carbon significantly[74]. Research on Wyoming shortgrass prairie showed that short-duration rotational grazing was at least as good as other grazing strategies, and better than light continuous grazing or no grazing at all, in storing organic carbon in prairie soil[75].

Putting it Together

Ron Nichols, NRCS

A Wisconsin farm combines multiple conservation practices.

Each of the conservation systems described in this report provide multiple resource benefits, delivering water quality, fish and wildlife habitat, and soil health benefits. Each is the kind of conservation system that policy-makers and agencies should prioritize and promote. But the real magic can come when they are used in combination.

No till, cover crops, and buffer strips used in combination can virtually eliminate sediment and nutrient runoff into nearby streams in most situations. Adding in Integrated Pest Management can substantially reduce the risk of pesticide drift or runoff as well.

For wildlife, no till, cover crops, buffer strips, and rotational grazing used together can provide winter cover and forage and habitat throughout the year. Incorporating Integrated Pest Management can also reduce or eliminate the unintended impacts of pesticides on fish and wildlife.

For soil health, any one of the conservation systems above should help build soil carbon and regenerate soil health, but research is confirming what the soil health pioneers discovered through trial and error: Used together, no till, cover crops, buffer strips, Integrated Pest Management, and managed rotational grazing can supercharge soil health and much more rapidly restore soil organic matter, mycorrhizal fungi, and healthy bacteria to a farm or ranch.

As those soil health pioneers are showing, systems that regenerate soil health pay for themselves in reduced fertilizer, pesticide, fuel, and feed costs, boosting profits and eliminating the need to provide ongoing incentive payments for maintaining practices.

Programs and strategies that help farmers incorporate these multiple conservation systems, rather than focus on putting in place a single conservation practice, will ultimately deliver a higher level of conservation benefits for each dollar invested.

Leveraging Conservation

Conservation dollars at the federal and state level are scarce, and America's natural resource problems far outstrip the conservation budgets Congress and state legislators have dedicated to solving them. Farmers and ranchers need conservation tools. Taxpayers also need assurance that conservation dollars will be invested in ways that generate maximum conservation benefits.

Members of Congress, state legislators, and conservation agencies can provide both conservation tools and assurances for taxpayers by designing conservation programs and targeting conservation funds to put in place systems like the five above that support *all three* important goals: water quality, fish and wildlife habitat, and soil health.

The opportunities seem clear:

►Congress, which enacts the federal Farm Bill, and the U.S. Department of Agriculture, which administers Farm Bill conservation programs, can boost the conservation benefits delivered by designing programs and prioritizing practices and systems like these that deliver benefits for multiple natural resources.

►State and local governments can also provide funding and direction to promote more widespread adoption of conservation systems like these that solve multiple natural resource problems.

End Notes

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