

THE VALUE OF BIODIVERSITY TO FARMING ON THE PRAIRIES

Saskatchewan



Farmers integrate environmental and economic concerns on a daily basis. Agricultural productivity depends on and benefits from **biodiversity***. As a result, farmers are, and need to be, stewards of Saskatchewan's **natural capital***. Diverse **agroecosystems*** can contribute to a healthy environment and improve agricultural productivity.

We have seen what happens when biodiversity is reduced. The consequences are most apparent with increased pest problems as crop monocultures expand, replacing the diversity of natural vegetation. The natural predators of these pests decline as local habitats decrease. Maintaining biodiversity is an excellent way for producers to achieve a healthy landscape.

The Agriculture & Biodiversity series includes the fact sheets 'The Value of Biodiversity to Farming on the Prairies', 'The Value of Biodiversity to Ranching on the Prairies' and 'Biodiversity Benefits – Companion Sheet'. Words and phrases in green with an * are defined in the glossary in the Companion Sheet.

Biodiversity and the Farming Industry

Biodiversity is of great importance to farmers. Crops, livestock, insects, water systems, soils and natural landscapes all interact with each other. If the balance of these factors is carefully maintained, they function together to the benefit of agriculture.

The first aspect of biodiversity is genetic variability within a species. Genetic variability is vital to the long-term health and economic feasibility of farming, as well as the world's food supply. For example, variability within a crop species is essential for the development of disease resistance, and yield and quality improvement. Genetic variety also allows crops to tolerate a variety of soil or climate conditions.

Encouraging different species is the second level of biodiversity. Having the ability to select different crop species increases a farmer's arsenal for events such as pest infestations, climate shifts or new market pressures. It is essential to maintain both levels of biodiversity to ensure the sustainability of the world's food supply.

Farmers have long depended on nature and the land for their livelihood and lifestyle. Farms also play a vital role in the maintenance of biodiversity and healthy ecosystems. Farmers have the opportunity to make great contributions without making major changes to their practices.

Farms act as a buffer between urban or industrial use of the land and nature itself. As human activity increases, the long-term sustainability, production and stability of agriculture and ultimately society is threatened. Farmers who monitor and encourage biodiversity help reduce those threats.

Producers may be surprised by the subtle changes that can be made to improve biodiversity. These changes have the potential to reduce inputs and increase economic outputs. Research and resources are available to anyone interested in learning how farming practices can be adapted to further promote biodiversity.



Biodiversity and Farming Working Together

"In the intensively cultivated crop-producing areas of Saskatchewan, remnant areas of native prairie, aspen bluffs and wetlands preserve soil biodiversity, conserve moisture, reduce soil erosion and provide important habitat for our native flora and fauna." Lorne Scott, Producer, Indian Head, SK

Remarkably, as few as 80 plant crops provide approximately 90% of the world's food (estimated by the Food and Agriculture Organization). Thousands of other plant species are actively farmed on a small scale, and tens of thousands of plants worldwide are known to have edible parts. In Saskatchewan, about 70 plant species are farmed for human consumption and the majority (70% or about 50 species) of these are fruits and vegetables produced on a small scale. Wheat, rice and corn are now the three most abundant plants on earth, providing about 60% of human food. Agriculture and Agri-Food Canada states that the low diversity of our major crops is a serious problem for Canadian agriculture.

As the genetic diversity of crops declines, the risk of major failures in the world food supply increases, while the ability to forge advancements in food technology decreases. Durum wheat, developed in Saskatchewan, provides an example that illustrates the benefits of biodiversity. Durum, a species well-suited to our growing conditions, was bred with a wild wheat species from the Eastern Mediterranean to increase protein content. This development could not have been accomplished without the natural ecosystems from which the wild wheat came.

In cultivated areas, most biodiversity is in the soil. The farm benefits when the soil's natural productivity is managed sustainably. When soil is rich in biodiversity, reliance on purchased inputs declines, while land productivity and income potential increase. Soil is the most biologically diverse part of the earth. Topsoil has a rich complement of organisms that decompose plant and animal residue, and then release their stored nutrients slowly over time. An acre of living topsoil contains approximately 900 lbs of earthworms, 400 lbs of fungi, 1500 lbs of bacteria, 133 lbs of protozoa, 890 lbs of arthropods and algae, and small burrowing mammals, all working to till and fertilize the soil so plants on the surface can thrive.

Natural areas provide buffers to minimize erosion and filter migrating pollutants. These areas are rich in biodiversity and are great sources of beneficial insects such as pollinators, predators and parasites of crop pests. Biodiversity conservation is supported by small natural or semi-natural habitats and by the production of a wide variety of crops and breeds of livestock.

The long-term viability and profitability of agriculture depends on maintaining diversity within crops and their wild relatives, within natural ecosystems and within the agricultural landscape.

World View – Biodiversity Saves the Economy

Cuba represents the world's largest shift from conventional agriculture to conservation farming practices that benefit, and depend on, biodiversity.

Prior to 1990, more than 40% of Cuba's land base produced one crop, sugar cane, for primarily one market, Russia. This crop was produced using intensive farming methods dependent on high inputs of imported pesticides, fertilizers, machinery and fuel. When the Soviet Union collapsed, Cuba lost its lucrative sugar export market, and its imports of agrochemicals, fuel and machinery. Cuba lost 85% of its commercial trade

overnight. Trade with other countries was restricted by the American economic blockade against Cuba. Production of sugar cane, on a per acre basis, dropped by 50% in one year. Country-wide electrical blackouts occurred, gasoline could not be purchased, and food shortages resulted. The country could no longer afford the food imports upon which it had relied so heavily. The average Cuban lost 10 lbs between 1992 and 1993.

The Cuban government responded to the crisis by implementing a policy that encouraged self-sufficiency in food and energy production.

Biodiversity – it's not just about numbers.

Farming practices that increase invasive, non-native species do not benefit biodiversity. Although sometimes touted as contributing to species biodiversity, wildlife not native to Saskatchewan's prairie ecosystem such as raccoons, Norway rats and starlings are attracted by farmyards with shelterbelts and abundant supplies of grain. These species can have a devastating effect on natural biodiversity, especially prairie birds and waterfowl.

Food Webs Add Value

Here's food for thought: 3.5 tons of alfalfa hay can feed 175 rabbits which produce 875 lbs of meat and 7 tons of wet manure. The meat can be directly marketed, but the production does not have to stop there. Rabbit manure is highly compatible with earthworm compost. The compost produced by earthworms from rabbit manure is very high in nutrients such as nitrogen and phosphorus.

Both the alfalfa feed and the rabbits contribute micro-organisms that end up in the compost. Many of these organisms are efficient producers of nutrients. Effectively, the vermicomposting process produces a 1:1 return – one acre of alfalfa fed to 175 rabbits produces one acre's worth of fertilizer. Earthworms can also be harvested from the compost. The rabbit-alfalfa-earth worm-microbe food web represents a perpetually sustainable system.

Low-cost Ways Farmers Can Help Biodiversity

1. Retain natural habitat
2. Leave crop residues on the soil surface
3. Extend crop rotations
4. Use organic fertilizers
5. Maintain or establish grass or woody buffers along riparian areas



World View – continued

Over the next decade, Cuba implemented several changes to achieve self-sufficiency. Less intensive farming practices reduced fuel dependency, a chain of 220 biological pesticide centres were created to provide farmers with pest control products produced from native species, 170 worm cultivation centres produced 5 million tons annually of composted soil to use as fertilizer, and farmland ownership has shifted from the state to small co-operatives. The outcome of these initiatives was diversification of crops and the development of local markets.

Renewable energy, using solar panels, water, and biofuel from byproducts of sugar cane, now supplies most of the country's urban energy while wind and water power

fuels the farms. An aggressive reforestation campaign was launched to reduce erosion and improve the limited fresh water supply. Forest cover increased from 15% to 25%.

Cuba could no longer import medicines. As a result, research was focused on developing medicinal products from the 6,500 native plant species, over half of which occur nowhere else in the world. These plants thrive on the 22% of the island that is protected as biosphere reserves and national parks. The research on medicinal products has resulted in several medical advancements including: a treatment for lung cancer, a method of preventing rejection in organ and bone marrow transplants, and a vaccine for meningitis B – all used world-wide. Pharmaceuticals have become Cuba's third largest export.

Today, farmers produce a variety of fresh produce and meat for the Cuban market. In fact, the availability of fresh food has led to a healthier national diet resulting in a 25% decline in heart disease. Farmers also grow a wide variety of medicinal herbs, which are used to produce medicines that are available in 'green pharmacies' throughout the country. Cuba now boasts one of the lowest rates of child mortality, as well as one of the highest rates of life expectancy among developing countries. Cubans say their most critical ecological achievement is a healthy population with long-term quality health care and education, guaranteed for all without exclusion.

An Example: Winter Cereals – “Good for Natural Biodiversity, Great for Farming”

Conservation farming practices are those tillage and seeding methods that maintain or improve the health of the soil. These practices have been adopted on approximately 40% of Saskatchewan's farmland – more than anywhere else in Canada. A recent study by the Saskatchewan Soil Conservation Association shows that nutrients from organic matter can increase net returns per acre.

Zero or minimum till of spring seeded crops provide numerous environmental and agronomic benefits. However, spring seeding, even on zero till, can provide an unsafe and unproductive nesting site for waterfowl including the northern pintail.

Winter cereals provide an alternative to spring seeded cereal crops that benefit the environment and farmers. Ducks Unlimited Canada research has shown that winter wheat, which is seeded in late summer or fall, produces over 16 times more hatched waterfowl nests than spring seeded cereals. This dramatic increase in ducklings is due to a combination of factors:

- ducks are attracted to fields seeded with winter cereals as they are likely to have more ground cover earlier in the season,
- elimination of disturbances to nests in the spring,
- early ground cover provides protection from predators.

The Canadian Wildlife Service has shown that, in addition to providing protective cover for waterfowl, minimum till crops such as winter wheat are beneficial to some grassland bird species such as the horned lark, savannah sparrow, Baird's sparrow and chestnut-collared longspur.



Duck nest in winter wheat field.

Photo courtesy of Ducks Unlimited Canada

There are additional benefits to producers of winter cereals, particularly winter wheat:

1. Improved Workload Management – Since seeding is done in the fall, there are less total acres to be seeded in the spring or more acres can be seeded using the same equipment. Harvest occurs 2 – 4 weeks earlier than spring seeded crops spreading out the fall workload. Also, the producer's risk of grade loss due to inclement weather is reduced.
2. Compatible with Conservation Tillage – Seeding into standing stubble for improved snow catch helps insulate and protect the overwintering seedlings from temperature extremes resulting in low winterkill.
3. Increased Yield Potential – Winter wheat can make efficient use of early spring moisture. The result is a substantially higher yield than spring seeded crops. Over the past 10 years, winter wheat has shown a 21% yield advantage over spring wheat, and a 35% yield advantage over the past 5 years. New semi-dwarf winter wheat varieties have the potential to increase yields by an additional 40% under favorable moisture conditions.

4. Improved Pest Management – Early spring growth and plant competitiveness significantly reduces the need for agrochemicals. Wild oat herbicide is rarely needed and early seedhead production reduces the likelihood of fusarium infection or sawfly and wheat midge damage.

5. Marketing Flexibility – Winter wheat is used for animal feed, milling wheat or ethanol production. Farmers may also benefit from earlier cash flow due to the early harvest.

Winter wheat is one of the most biodiversity-friendly annual cropping options available to Saskatchewan farmers. Reduced tillage, low chemical requirements and the maintenance of a crop residue cover on the soil contribute to making this crop profitable and nature friendly.

“Some of the practices often associated with organic farming such as the use of organic fertilizers, the restricted use of agrochemicals, lengthened and varied crop rotations, and diversification into livestock production can be of substantial benefit to biodiversity.”

**Brenda Frick, Prairie Coordinator
Organic Agriculture Centre of Canada
University of Saskatchewan**

Saskatchewan farmers are leading organic food production in Canada. Approximately one third of all Canadian organic producers farm in Saskatchewan, more than any other province.

The Klemenz Farm – Benefits for the Next Generation

Kevin and Myla Klemenz believe in taking control of their own destiny. To that end, Kevin is President of Red Coat Road and Rail Ltd., a community-owned grain transport company that owns and operates the local rail line. The Klemenz' take the same approach with farming. With about 1280 acres of farmland and 800 acres of pasture, they do what they can to retain and look after any natural habitat they have.

When Kevin purchased the farm from his dad, the wetlands were still intact. "It's exactly the way it was when I got it," says Kevin. Those wetlands help reduce erosion and replenish groundwater supplies. The grass buffer around the wetlands maintains good water quality and provides habitat for many species.

Any chemical runoff from the farmland is also filtered and broken down by the riparian vegetation along the water's edge. The wetlands and riparian buffers provide hay for the Klemenz' cattle. Annual haying operations get underway after the 1st of July each year to allow birds nesting in the grass buffer time to hatch and fledge their young before haying disturbs the site. The Klemenz' appreciate their native prairie for its abundance of plant and animal diversity, as well as the forage resource it provides to the farm. They plan to put a conservation easement on it.

The Klemenz' have some pasture adjacent to Channel Lake, home to many waterbirds including the endangered piping plover. In partnership with the Saskatchewan

Watershed Authority, Kevin and Myla have constructed a fence between their pasture and the lake that keeps cattle from disturbing the shoreline habitat used for nesting and feeding by the piping plover. They also partner with Nature Saskatchewan to maintain habitat for the threatened loggerhead shrike at the nearby Horizon Cemetery. Kevin and Myla believe in trying to conserve nature for the same reason they wanted to take control of their own business by helping the community purchase the rail line. They want the next generation of Klemenz' to have the opportunity to experience and appreciate a rural farming life enriched by a landscape diverse in plants and animals.



Photo by Michelle Yaskowich

Jenaya, Myla and Kevin Klemenz

Biodiversity "Hot Spots": Natural Habitat and Riparian Areas

Natural habitat provides the best source of biodiversity. Many species at risk depend on unfragmented remnants of native prairie or aspen parkland. Riparian areas, including streambanks, lakeshores and wetlands, are an essential component of habitat for up to 80% of Saskatchewan's wildlife. Much of Saskatchewan's most productive farmland contains or is adjacent to riparian areas. Using vegetation buffers along riparian areas, and retaining these hot spots as natural habitat, are the farm management practices that are most beneficial to biodiversity.

Climate change projections suggest temperatures in Saskatchewan will increase by 3 to 6° C by the end of this century. Some expected impacts to agriculture include more frequent and extreme droughts, decreased area and duration of snow cover, and longer growing seasons. Global climate change could have a serious impact on natural biodiversity by changing the local climatic conditions to which species have adapted. Management practices that increase organic matter within soil or bind nitrogen in the soil help reduce greenhouse gas emissions that drive climate change.

The Future?

Crop breeders in North America are developing native perennial grains that can be grown in dryland farming systems. Yields have reached 70% of annual wheat varieties, while production costs are much lower. No tillage is required and a variety of different crops can be grown together resulting in improved soil health, inhibition of weeds and pathogen resistance. Habitat values for native wildlife are expected to be many times higher than in conventional wheat fields.

How Farming Practices Can Benefit Biodiversity

Soil Management

- **Minimize summerfallow.** Reducing summerfallow minimizes erosion and helps rebuild soil health. Although summerfallow can be an effective tool for moisture storage, chemical free weed management and the provision of disturbance-free nests for ground nesting birds, it can be replaced with practices such as green manuring which can provide most of these benefits when seeded late in the year.
- **Seed directly into the previous year's stubble** to prevent erosion of valuable top soil. Soil removed by erosion typically contains about three times more nutrients than the soil left behind. It can cost up to \$40/acre annually to replace lost nutrients.
- **Reduce tillage.** While tilling releases nutrients when soils are rich in organic matter, this is only a short-term benefit. Reducing tillage rebuilds organic matter and allows the diversity of micro-organisms in the soil to increase. There is also a shift to more naturally occurring micro-organism species within the soil. Reduced tillage can reduce fuel costs by as much as \$10/acre. On the other hand, light shallow tillage can be beneficial to soil biological activity in some instances because of Saskatchewan's cold climate and long dormant season. A complete absence of tillage means reliance on herbicides, which can be toxic to some types of soil organisms.
- **Extend crop rotations** particularly with the use of legumes to increase soil nutrients and the diversity of soil organisms.
- **Adopt permanent conservation practices** such as grassed waterways and perennial grass barriers.
- **Carefully manage the application of chemical fertilizer** by applying no more than what the crop requires, at the time of year the crop can utilize it, and close to the root system to increase utilization efficiency.
- **Use organic fertilizers** such as manure or green manure, when possible.
- **Minimize pesticide requirements** by varying crop rotations and utilizing biological control methods to increase insect and soil organism diversity and activity. Precision farming technology can reduce waste and overapplication of agrochemicals.
- **Keep crop residue** on the soil surface. Residue improves soil organic matter replenishment, water infiltration, water storage, and particle aggregation. Crop residue also contains a wide range of nutrients.
- **Include perennial forages in crop rotations** to increase soil organic matter while reducing erosion and salinity.
- **Plant shelterbelts** to reduce wind erosion and catch snow, particularly in parts of the province that are naturally forested such as the Aspen Parkland and Boreal Transition ecoregions. Caution should be taken in the southern prairies where trees are not a large part of the natural landscape. Shelterbelts on, or in close proximity to, native prairie can attract undesirable predator or scavenger species. These species can have a devastating effect on natural biodiversity, particularly bird populations.
- **Plant cover crops or winter cereals** in late summer or fall to protect against late fall and early spring erosion, trap snow and reduce the number of weeds the following spring.
- **Square up fields** around wetlands and along watercourses by seeding perennial vegetation, ideally using native grasses. This practice reduces overlapping of operations and inputs.

Water Management

- **Maintain or re-establish wetlands**, both temporary and permanent. Wetlands benefit biodiversity and thus ecosystem stability, as well as moderate the effects of droughts and floods while maintaining groundwater levels.
- **Maintain or establish a grass or woody buffer** along stream, lake and wetland boundaries to minimize erosion and runoff of pollutants from farmland. A vegetation buffer zone can stop 70 to 96% of pollutants from entering the water. An added bonus for grain farmers is that these buffers can decrease salinity around wetlands.
- **Minimize use of agrochemicals** through alternative methods of pest control and soil fertility maintenance. Some studies show that crop yields on lands farmed without agrochemicals are similar to yields on lands where agrochemicals are used.

Natural Habitat and Wildlife Management

- **Retain any natural habitat** remaining on your farm. Studies have repeatedly shown that natural habitat supports greater biodiversity than any altered habitat.
- **Minimize farming activity during spring** when birds and other animals are reproducing. Wildlife mortality is much lower and reproductive success much higher if land is not disturbed during this period. Producing winter cereals and perennial crops are some of the farming practices that can help achieve this goal.
- **Maintain heterogeneity* across the landscape.** Different vegetation structures produced by different crops allow for use by different wildlife species. Structural variation can be achieved by planting different crops in different fields adjacent to one another.
- **Incorporate livestock.** Many of the practices listed above involve the establishment of perennial cover which provides habitat for numerous wildlife species. Livestock can utilize areas of perennial cover and natural habitat for economic benefit.



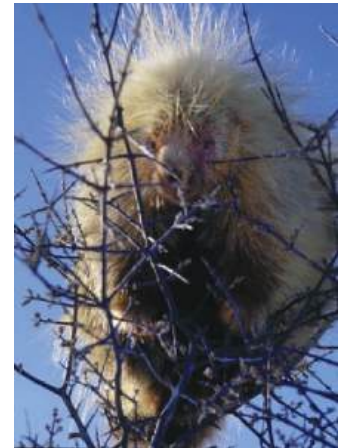
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Nature Saskatchewan is a charitable conservation and cultural organization of naturalists dedicated to protecting and promoting nature, its diversity, and the processes that sustain it.
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Our vision is "Humanity in Harmony with Nature".



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