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## Prairie Grasslands: An Undervalued Resource Grass, Cows and Environmental Management on the Canadian Prairies

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**PRAIRIE GRASSLANDS:  
AN UNDERVALUED RESOURCE  
GRASS, COWS AND ENVIRONMENTAL MANAGEMENT  
ON THE CANADIAN PRAIRIES**

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**ABSTRACT**—Grasslands are integral to the economic health of Canada's rural prairies, making up 30% of the agricultural land base in Canada's three prairie provinces. These grasslands support agriculture, through grazing of livestock, and recreation, such as hunting and ecotourism. These grasslands are also environmentally significant, providing habitat for native plants and animals. The economic and environmental significance of these grasslands should not be undervalued. Economic opportunities and environmental policies and regulations affect the management of these lands. Current issues that may affect how the prairie is used include the: potential species-at-risk legislation, other initiatives for biodiversity enhancement, greenhouse gas regulations or incentives, carbon sequestration opportunities, and economic diversification to support economic growth. Decisions on these issues will affect the way prairie grasslands contribute to the region's economic and environmental sustainability.

**Introduction**

Grassland ecosystems dominate the populated parts of the prairie provinces (Fig. 1), and grazing is a traditional use of this type of ecosystem.

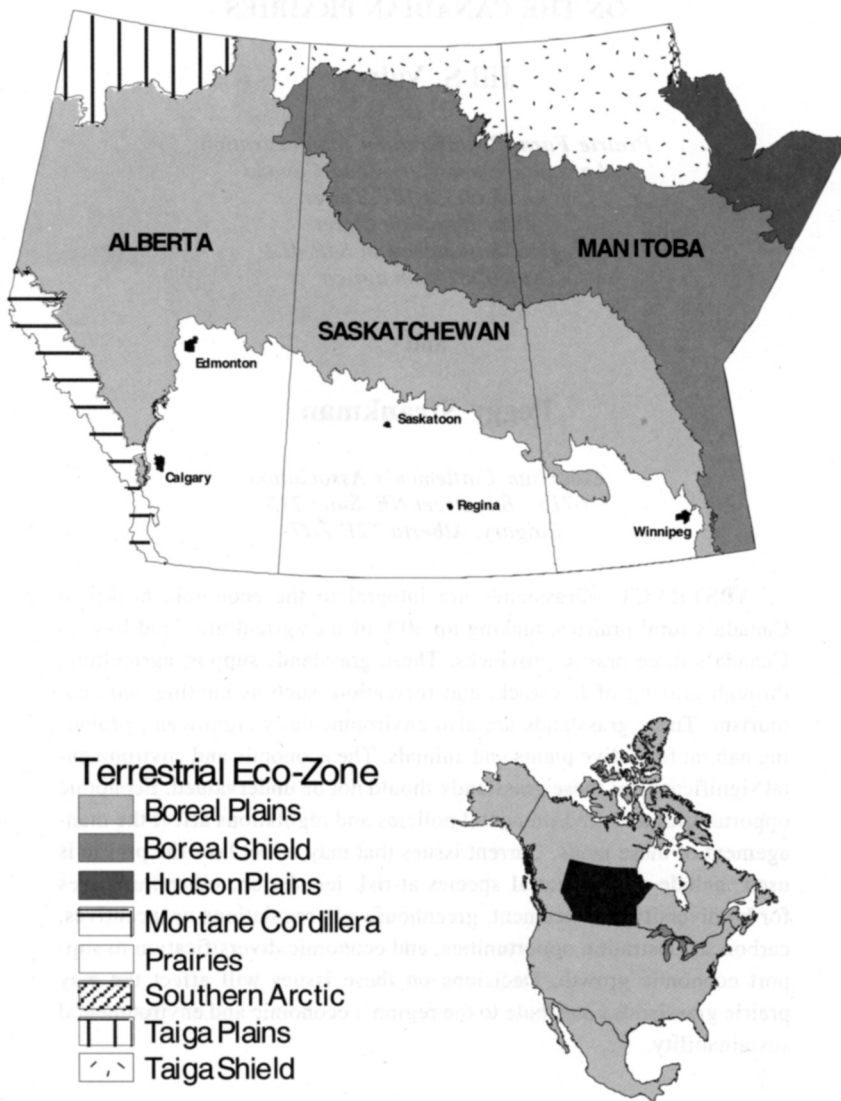


Figure 1. Ecozones of south-central Canada, illustrating the significance of prairies. Adapted from maps of the Ecological Stratification Working Group (1995).

Aboriginal populations used bison, the native grazing animal. European settlers moved in and developed the region's agricultural potential for cattle grazing and latter for other types of agricultural production (Friesen 1984).

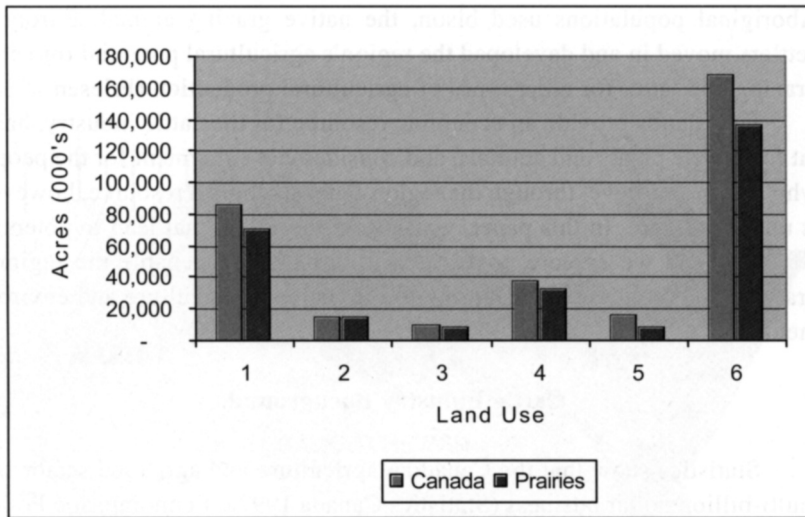
Grasslands provide an economic resource for the cattle industry, habitat for prairie plants and animals, and considerable enjoyment for the people who live in and travel through the region. This ecological resource, however, is under pressure. In this paper, we address the issues that lead to potential conflicts, and we explore possible solutions that will enable the region's grasslands to continue contributing to the region's agriculture and environment.

### **Cattle Industry Background**

Statistics show that the Canadian agriculture and agri-food sector is a multi-billion dollar business (Statistics Canada 1997a; Economic and Policy Analysis Directorate 1998). Livestock is an important part of this industry. Canada produces about 13 million head of cattle, exporting about half of what it produces, and it ranks about 4th in the world for beef and beef cattle exports (Canadian Cattlemen's Association 1998b, 2000d). The annual, on-farm production value of beef cattle is estimated to be \$4.7 billion (Statistics Canada 1997b). The Canadian Cattlemen's Association (1998b) estimates that, with multipliers, the cattle industry contributes over \$20 billion to the national economy. The prairie region dominates this production, supporting 73% of the beef animals raised in Canada (Statistics Canada 1998), and this region accounts for approximately \$3.5 billion of the annual value of beef production (Statistics Canada 1997b), again about 75% of the Canadian total.

Agriculture is a land-dependent business. While Canada has a land base of some 3.85 million square miles, only 7% or 170 million acres is suitable for agriculture (Ecological Stratification Working Group 1995). The rest is agriculturally restricted, because of climate or other significant constraints. Most of the nation's 30 million people live within this agricultural zone.

Grasslands are a significant component of Canada's agricultural base (Fig. 2). Pasture makes up 49 million acres of the total farmland (Statistics Canada 1996), or about 30% of the total farm area. Statistics Canada (1996) reports that close to 80% of this pasture is 'natural', meaning range land where the predominant plant species that are native to the region. The remainder is considered 'tame,' i.e., range that is composed predominantly



<u>Land Use</u>		<u>Canada</u>	<u>Prairies</u>	<u>Prairies</u>
		(Acres(000's))	Acres (000's)	(percent)
1	Land in Crops (incl. tame hay)	86,286	70,782	82.0
2	Summerfallow	15,471	15,300	98.9
3	Tame/Seeded Pasture	10,747	8,659	80.6
4	Natural Pasture	38,578	33,020	85.6
5	Other	17,085	8,963	52.5
6	Total Farm Area	168,167	136,724	81.3

Figure 2. Canada's agricultural land base. Adapted from Statistics Canada (1996).

of introduced plant species. The prairie region supplies 42 million acres of this grassland, or 84% of the country's total pasture (Statistics Canada 1996). In addition, Canada has some 15.8 million acres of tame hay, where hay is grown in rotation with annual crops, of which 9 million acres is in the prairie provinces (Statistics Canada 1996). These range-land resources provide the basic resource — grass — for cow-calf operations.

### **Government Involvement**

Governmental interests in environmental resources focus on conservation and on economic production. In the case of grasslands, the primary economic use is agricultural. Both federal and provincial governments have a direct interest in environmental resources. Under the Canadian constitution, the responsibility for agriculture is shared between the provincial and federal governments (Department of Justice Canada 1999a). Provinces are responsible for resources that are within their boundaries, whereas the federal government is responsible in areas that have interprovincial and international implications (Department of Justice Canada 1999b).

Grasslands have been recognized as ecologically important for over a century. This ecosystem has been targeted, or affected by, a significant number of federal government initiatives. In 1887, North America's oldest waterfowl refuge was established to protect breeding grounds for "wild fowl" at Last Mountain Lake in south-central Saskatchewan (Environment Canada 1987). In 1916, Canada and the United States signed the Migratory Birds Convention, so both countries would cooperate to conserve the shared migratory bird resources (Consolidated Statutes of Canada 1999a). In 1993, the Canada Wildlife Act (Consolidated Statutes of Canada 1999d) was passed; this law allows the creation of National Wildlife Areas to conserve areas for wildlife. The federal government may also conserve ecosystems by establishing national parks (Consolidated Statutes of Canada 1999b). And, in 1988, a federal-provincial Grasslands National Park Agreement was signed to create a park in southern Saskatchewan (Parks Canada 1999). Legislation to conserve species-at-risk is being actively considered (Environment Canada 1999b). Since managing habitat is part of managing land and water, both resource users and environment interest groups are being consulted as part of the development process for this potential legislation.

Provincial interests in managing ecosystems — land, water and wildlife — are implemented through regulatory and licensing responsibilities within their boundaries (Department of Justice Canada 1999a, 1999b). In the three prairie provinces, governments have also developed strategies to conserve ecologically distinct categories of land: "Special Places" in Alberta (Alberta Environment 2000), the "Representative Areas Network" in Saskatchewan (Saskatchewan Environment and Resource Management 1997, 1999), and the "Network of Protected Areas" in Manitoba (Manitoba Natural Resources 1996).

Governments also have a direct responsibility for managing crown lands. In the grasslands ecosystem, including the forest fringe area, grazing is the common agricultural use. Calculations show that approximately 16 million acres of provincial crown lands in the three prairie provinces are available for grazing use (Saskatchewan Agriculture 1985; Manitoba Agriculture 1998; Alberta Agriculture Food and Rural Development 1998). Federally, there are approximately 2 million acres in community pasture in the prairies (Prairie Farm Rehabilitation Administration 1995).

The federal experience with its community pasture system provides an example of the combination of land conservation and economic objectives in grassland management. In Canada, one of the responses to the droughts in the 1930s was to establish the Prairie Farm Rehabilitation Administration (Consolidated Statutes of Canada 1999c; Gray 1967). This Branch of Agriculture and Agri-Food Canada focuses on sustainable development in rural areas, with an emphasis on land and water resources (Prairie Farm Rehabilitation Administration 1997); the management of the Community Pasture Program is one of its responsibilities. In the 1930s, rehabilitating land that was eroding, and sometimes had been abandoned due to drought, was a major issue. The Community Pasture program consolidated some of the highly erodible lands that were not really suited to annual crop production with the intent of returning them to productive use under grazing and, so, conserving them for future generations (Prairie Farm Rehabilitation Administration 1987). Currently, there are 87 community pastures encompassing 2.2 million acres of land, 1.9 million acres of which is native rangeland. The system operates on a fee-for-service basis, and it serves some 4,000 producer-patrons with approximately 214,000 head of livestock (Prairie Farm Rehabilitation Administration 1998).

The Prairie Farm Rehabilitation Administration's land management practices have been successful in meeting the dual objectives of providing grazing for livestock and conserving the natural resource base (Prairie Farm Rehabilitation Administration 1987). Correspondence from provincial officials recognizes these pasture lands as reservoirs for biodiversity (Saskatchewan Parks and Renewable Resources 1987). Further, since 1998, the 1.7 million acres of federal pasture land in Saskatchewan have been included within the Province's Representative Areas Network, a system of ecological representative lands managed to conserve biodiversity (Government of Canada and Government of Saskatchewan 1998). Additional evidence of a growing recognition of the importance of grazing in managing grassland ecosystems is found in the fact that grazing is being used in the

management of some National Wildlife Areas (Environment Canada 1987, Prairie Farm Rehabilitation Administration 1999a), and it occurs in the discussions over re-introducing grazing animals to the Grasslands National Park in order to maintain the health of that prairie ecosystem (Parks Canada 1999).

### **Challenges and Opportunities For the Industry**

The strong interdependence between the livestock sector and grasslands means that challenges for the sector translate into pressures on the grassland resource. Palliser's exploration of Canadian territory in the mid 1800s (Spry 1995) found an area of grasslands that is naturally arid and subject to recurring droughts. Perennial grasses from semi-arid climatic regions have a range of adaptations that increase their water use efficiency (Redman 1999); these adaptations increase their ability to survive this climate type. Consequently, grazing uses of land have a natural advantage over crops in the semi-arid prairie region, and there has been somewhat less conversion of native range to annual crop regimes than in other parts of the country. Calculations of land use, from Statistics Canada (1996) data, show that 96% of the native rangeland remaining in Canada is in the prairies. Another characteristic of the prairie grasslands is the distribution of land that is held publicly and privately (McCartney and Horton 1997). Calculations show that the private agricultural sector controls about 65% of the region's grasslands.

Economic growth is an objective for most sectors of the economy, and agriculture is no exception. Within the prairies, the livestock sector is identified as an area of growth potential (Serecon 1999). Achieving growth requires a recognition and accommodation of economic issues related to livestock production, environmental concerns in areas such as manure management and water quality, and societal pressures for non-agricultural land uses. The following examples illustrate these issues. However, for this to be effective, producers will need information on the costs of land management alternatives, and the benefits that they can expect, in order to weigh the economic and environmental implications of their decisions.

**Grazing land management.** Grazing management can effectively increase grassland productivity and, therefore, livestock production (Savory 1988). Changes in land management practices may enable increased carrying capacity in some areas, as estimates show that a 25% increase in range produc-



tivity can be achieved by improving range condition by one class, from poor to good, for example (Abouguendia 1990; Trembley and Kirychuk 1998). While demand for additional forage could be met by increasing the acres of tame hay, there may be competition for the land for use in production of annual crops. The degree of potential competition is uncertain at present, and it will be driven by market prices for agricultural commodities. Farm operators try to realize the best return from their land resources (Howden 1997). Consequently, with the current low price of cereal grains on world markets, significant pressure to convert forage acres to annual crop production is unlikely. If grain prices return to higher levels, however, farmers may choose to increase production of those commodities. Any conversion of existing tame hay or pasture land to other uses will increase the pressure on existing native grass resources. It will also increase environmental risks, as the land that is still in pasture is usually classified under the Canada Land Inventory (Agriculture Canada 1974) as having low productivity, and/or high risk to erosion under annual crop production.

**Manure management.** Management of manure, a by-product of livestock production, is a current issue for the sector. There are concerns that manure, particularly from intensive operations, could wash into surface waters or leach into groundwater. Yet, when managed appropriately, manure is also a valuable organic fertilizer on both cultivated land and forage land (Cavers 1999; Bolton 1999). The impact of liquid hog manure applications on a seeded pasture is being assessed in a pilot project involving the Prairie Farm Rehabilitation Administration, a Community Futures Development Corporation, and Manitoba Agriculture. The manure was first applied in the summer of 1998, using four different methods of injection. Applications will continue for three consecutive years, and the data on productivity responses will be collected in 1999, 2000, and 2001 (Prairie Farm Rehabilitation Administration 1999a).

**Riparian area management.** Management of riparian areas provides another opportunity. Trampling and use of these areas by large numbers of animals for extended periods can damage shorelines. The resulting erosion can be negative for water quality and aquatic species, and shifts in species composition can reduce grazing capacity (Adams and Fitch 1995; Godfrey 1999). Information on the options that are available for complementary management of this landscape type is one of the steps necessary for producers to improve management of this part of their land base. Examples include

controlling: access to water by fencing and off-site watering, or controlling the time and intensity of grazing to facilitate more managed selective grazing and to reduce potential negative impacts (Adams and Fitch 1995; Agriculture and Agri-Food Canada 1997b).

**Water quality.** Agriculture has the potential to impact the quality of both of the surface and groundwater supplies (Harker and Wettlaufer 1999). For the livestock sector, the issue of water quality is directly related to both manure management and riparian area management, which are reviewed in the preceding sections.

**Biodiversity and species at risk.** There is a public desire to conserve rare plant and animal species, especially those whose numbers are known to be declining. An essential element in conserving species is protecting and enhancing their habitat (Agriculture and Agri-Food Canada 1997a). While all agricultural landscapes have some value for wild species, the greatest value is usually associated with non-cultivated lands, such as pasture (Neave and Neave 1998). As mentioned, most of this land is in private hands. Consequently, the impact and land management responsibility is most direct for the producers who depend on that land for their livelihood.

In Canada, legislation is being considered to conserve species-at-risk (Environment Canada 1999). While there appears to be general agreement on the objective, there is less agreement on the method. For example, a mandatory approach is preferred by groups such as the Sierra Club Legal Defense Fund (1999). Alternatively, a more incentive-based, stewardship approach is preferred by producer organizations, such as the Canadian Cattlemen's Association (1998a).

**Non-agricultural land uses.** Non-agricultural uses are placing increasing demands on the land base. Examples include: exploration for oil and gas; tourism through hunting, trail rides, nature walks, etc; and collection of plants, berries or seeds. While land owners will frequently give permission for use, with due consideration for their operational requirements, there are increasing numbers of cases of damage by people trespassing (Strankman 1999). This trend is expected to continue with pressure for access to scarce resources and a growing, primarily urban population.

Competing demands, such as residential acreage development, present another issue. For example, many people from Calgary, Alberta, want a house or acreage in the nearby foothills. This can result in land prices that are

higher than economical to maintain grazing uses, thereby driving the land out of agricultural use (Avram 1998). Fragmentation of rangeland, for example due to acreage development, is another issue. Fragmentation makes the management of grazing units more difficult for both the livestock producer and the wildlife that depend on that land for habitat (Agriculture and Agri-Food Canada 1997a).

**Food safety.** The public has a strong concern about “healthy” food. This may be expressed as a concern about: the use of chemicals to promote growth or to fight diseases, insects and other pests; the role of biotechnology, and what that might mean for human or animal health; linkages between animal diseases, such as bovine spongiform encephalopathy (BSE), and human health; and, the welfare of domestic food animals. An industry response to this concern has been to provide information for both the public and the producers. The Canadian Cattlemen’s Association, for example, released “Just Facts” (1995) to respond to public apprehensions. They also see a clear need to produce safe and high quality food product that will be accepted in the market place (Canadian Cattlemen’s Association 2000a); and, as one response, the industry association has released several documents on best management practices through their “Quality Starts Here” initiative (Canadian Cattlemen’s Association 2000b, 2000c).

**Demographic Change.** Population shifts may be a factor that affects public understanding and concerns about agriculture. In 1946, over 40% of the Canadian population was considered “farm” (Statistics Canada 1946). By 1991, less than 10% of the population was on the farm (Statistics Canada 1991); and, by 1996, the farm numbers were small enough that Statistics Canada did not separate them from “rural.” The trend for the Prairie region (Fig. 3) shows a similar decline in farm population. The inference from these data is that the majority of Canadians no longer have a direct connection to the land, or direct knowledge of how their food is raised. Consequently, there is less knowledge and understanding of the issues and decisions faced by private land managers to balance livelihood and stewardship.

### **Land Management for Multiple Uses**

The environmental, economic and societal pressures faced by the agricultural sector today present a specific set of challenges for the cattle industry. In order to maintain their livelihood, producers must manage animal and

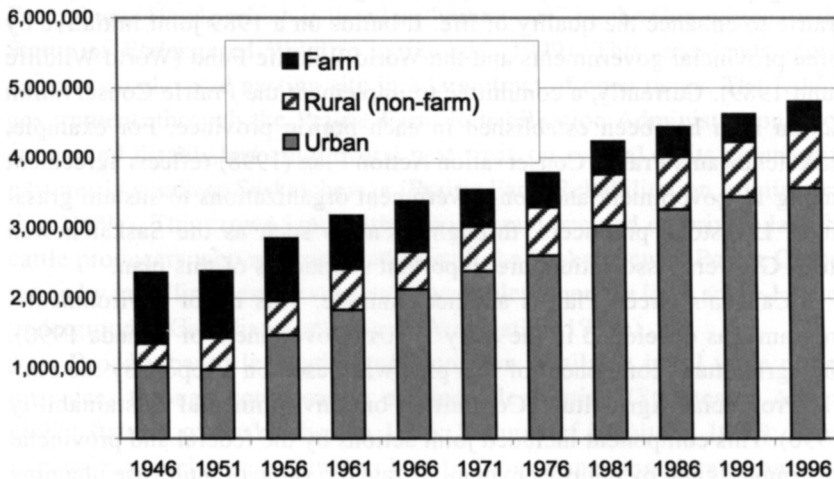


Figure 3. Prairie population trends. Adapted from Statistics Canada (1946-1996).

range conditions for continued livestock production. They must respond also to society's expectations for safe food and a healthy environment. In summary, they must produce a high quality, safe food product at a low price in an environmentally sustainable way, in a context where an increasing proportion of the population has no experience with the issues and challenges involved.

Multiple land use management is a key to meeting the economic needs of producers and the environmental needs of the public. Cattle grazing and wildlife occurrence are generally compatible land uses. We illustrate this point in the following sections, with examples that demonstrate stewardship through land use that meets multiple objectives, some focused on range management and others on riparian management.

**Range Management Initiatives.** The Prairie Conservation Action Plan is one example of land management practices in the prairie provinces that demonstrate joint activity by agricultural and environmental interests to

meet the needs of livestock and wildlife. This action plan focuses on conserving prairie biodiversity and promoting the sustainable use of native prairie to enhance the quality of life. It builds on a 1989 joint initiative by three provincial governments and the World Wildlife Fund (World Wildlife Fund 1989). Currently, a committee to implement the Prairie Conservation Action Plan has been established in each prairie province. For example, Saskatchewan's Prairie Conservation Action Plan (1998) reflects agreement among 16 government and non-government organizations to sustain grasslands. Livestock producers, through agencies such as the Saskatchewan Stock Growers Association, are important supporters of this plan.

Canada's Green Plan is another example. This major environmental program was developed in the early 1990s (Government of Canada 1990). The agricultural component of this plan was based on a report by the Federal-Provincial Agriculture Committee on Environmental Sustainability (1990). This component included joint actions by the federal and provincial governments and by industry to demonstrate the value of multi-use planning for both agricultural and environmental objectives. An example of a prairie grassland program developed under the Green Plan is the Grazing and Pasture Technology Program in Saskatchewan. This program provides producers with information on managing range and pasture, and on adopting new technologies demonstrated in field situations (Grazing and Pasture Technology Program 1995). While Green Plan has ended, the Grazing and Pasture Technology Program is being continued under other federal-provincial arrangements.

The goal of multiple use is also recognized in formal partnerships. Saskatchewan's Representative Areas Network is committed to conserving ecologically important areas that are representative of provincial landscapes (Saskatchewan Environment and Resource Management 1997). The network recognized the importance of multiple uses for land management by including Saskatchewan community pastures of the Prairie Farm Rehabilitation Administration (Government of Canada and Government of Saskatchewan 1998). This reflects an understanding that grazing is a component of grassland management that is essential to the health of this ecosystem, and that it can benefit both habitat and agriculture. Private arrangements are also possible. For example, Ducks Unlimited Canada (1999a) has management agreements with producers, for example to delay haying, in order to provide water-fowl nesting habitat; payments are used to offset the loss in nutritional value of the hay that comes with a later cut.

Site-specific initiatives can also be effective in achieving multiple land use objectives. This is illustrated by the project to establish nest sites for the Ferruginous Hawk, which is listed as “vulnerable” by the Committee on the Status of Endangered Wildlife in Canada (1999). This grasslands raptor requires an elevated nesting site in a large tract of open range. The federal government, through the Prairie Farm Rehabilitation Administration, took action and established cottonwood nest trees on several of its community pastures in southern Saskatchewan (Prairie Farm Rehabilitation Administration 1999c). This crown land initiative is complemented on private land by cattle producers who are cooperating with the Saskatchewan Power Corporation by installing nesting sites on power poles when the lines are re-located underground (Canadian Cattlemen’s Association 1998a).

Broadly-based legislative tools are now available in all three prairie provinces through conservation easement legislation (Statutes of Alberta 1992; Statutes of Saskatchewan 1996; Statutes of Manitoba 1997). Land-owners can receive an income tax benefit for guaranteeing certain conservation activities and, in some cases, they may also receive a payment from the organization that holds the easement. An easement is placed on the land title, legally requiring current and future land owners to meet this commitment. Both producer and environmental organizations have indicated an interest in holding easements. For example, Ducks Unlimited was interested enough in the potential of easements to achieve their conservation objectives, that they sponsored the development of a Conservation Easements Guide for Saskatchewan (Annand and Curry 1997). Also, organizations such as the Saskatchewan Stock Growers Association and the Southern Alberta Land Trust Society consider easements to be one way to deal with land development pressures (Strankman 1999).

**Riparian Area Initiatives.** Riparian and wetland areas are green zones bordering streams, lakes, reservoirs and other areas with water, and they link the terrestrial and aquatic zones (Godfrey et al. 1999). Work in the western United States indicates that, while riparian areas comprise less than 1% of the land area, they are used by three-quarters of the wildlife species (Northwest Resource Information Center 1990). They are essential to cattle for access to water, shade, and a variety of forage. Wildlife depends on the water and on the shore area for habitat. Downstream users depend upon the filtering capabilities of wetland to reduce sediment and nutrient transport and, therefore, improve water quality (Godfrey et al. 1999). Consequently, these areas are often targeted in land management discussion and actions.

In Alberta, the Cows and Fish program (Adams and Fitch 1998) demonstrates balanced management of grazing in riparian areas, and it provides information to foster a better understanding of how agricultural management can enhance landscapes. The program is a partnership among cattle producer organizations, Trout Unlimited Canada, and federal and provincial agencies. This partnership has been expanding slowly, from a southern Alberta initiative to a whole province approach as more municipalities have become involved. Fisheries and Oceans Canada provided initial support for the current initiative (Canadian Cattlemen's Association 1998a). This cooperation indicates a recognition of the contribution of agriculture to the environment.

Other pilot initiatives also emphasize the integration of grazing management with riparian area management. For example, the Canadian Cattlemen's Association (1998a) reported the following examples. A partnership among cattle producers, Saskatchewan Environment and Resource Management, and the Saskatchewan Wetland Conservation Corporation was formed to investigate riparian areas management along the Arm River in central Saskatchewan, to jointly benefit both cattle and pike production. And, in Manitoba, the Canadian Cattlemen's Association and the Manitoba Habitat Heritage Corporation will cooperate on an economic analysis of riparian management strategies.

**Recognition for initiatives.** Public recognition of stewardship can provide effective reinforcement for producers who are making decisions that affect their livelihood, and it can provide valuable information to the public on stewardship decisions by land managers. Two examples of awards that provide recognition for stewardship in agriculture are the LB Thompson Award, initiated by the Prairie Farm Rehabilitation Administration in 1987 to honour prairie leaders in conservation (Prairie Farm Rehabilitation Administration, 1999d), and the National Environmental Stewardship Award presented by the Canadian Cattlemen's Association (1999). This award is now in its fourth year. The winner is selected by judges representing the conservation, agriculture, and government communities (Strankman 1999).

### **Future Challenges**

**Climate change.** Some projections suggest that, over the next several decades, the prairie region may see temperatures increase by as much as 5°C in summer and 7°C in winter (International Institute for Sustainable Develop-

ment 1998). If this happens, and if substantial extra precipitation does not offset the extra drying, significant economic shifts in the region's agriculture are likely. One potential response could be a shift in the drier regions away from annual crops and into perennial forage crops (Hill and Vaisey 1995). However, this would depend on continued growth of the livestock industry to productively use the increased forage acres to generate an economic return.

The Canadian target under the Kyoto Protocol of the United Nations Framework Convention on Climate Change is to reduce greenhouse gas emissions in the years 2008-2112 to an average of 6% below 1990 levels (Agriculture and Agri-Food Climate Change Table 2000). However, emissions are already higher than they were in 1990. If emissions continue to increase, as is projected under "business-as-usual" scenarios, the actual reduction required could be 25% from projected 2012 levels (Gray 1998).

The agricultural sector contributes about 9.5% of Canada's total greenhouse gas emissions in the form of nitrous oxide, methane, and carbon dioxide (Agriculture and Agri-Food Climate Change Table 2000). However, the sector can also contribute to reducing greenhouse gases, through the sequestration of carbon in the soil. Bruce et al. (1998) identified significant carbon sequestering potential for three categories of land use: management of cultivated land, revegetation of land currently under cultivation, and management of pasture land. There are several outstanding issues to be resolved, however, before carbon sequestering by agricultural land can be accepted as a positive contribution under the Kyoto Protocol (Bruce et al. 1998; Gray 1998; Agriculture and Agri-Food Climate Change Table 2000). These include the acceptance under the Protocol of: agricultural soils as potential sinks for greenhouse gases, the potential trading rights for sequestered carbon, and measurement and validation of sequestered carbon.

If agricultural soils are accepted as carbon sinks, then there are potential linkages with the livestock sector via an increase in the supplies of forage. In the Canadian prairies, an estimated 8 to 10 million acres (3.25 - 4M ha) of marginal land are currently under annual crop production, when marginal land is defined as soil class 4, 5, and 6 of the Canada Land Inventory (Prairie Farm Rehabilitation Administration 1998). Based on assumptions about the amount of carbon lost over eighty years of cultivation, some 45-55 million tons of carbon could be returned to the soil over 25 years (Prairie Farm Rehabilitation Administration 1998). A subsequent analysis that considered the greenhouse gas emissions from more livestock to be grazed on the added forage land, still found a net carbon gain to the system (Prairie Farm Rehabilitation Administration 1998; Agriculture and Agri-Food Climate Change Table 2000).



Bruce et al. (1998) summarized potential greenhouse gas benefits from improving the forage productivity on existing rangeland. Using this information, the Prairie Farm Rehabilitation Administration (1999b) conducted an internal analysis to determine benefits from pastures. The results showed that improvement from poor to good pasture condition could increase carbon sequestered by approximately 0.1 ton per acre per year (0.2 t/ha/yr). However, since better condition range can support more cattle, some of the greenhouse gas gain could be offset by emissions from increased numbers of cattle. Using cattle emissions calculated in carbon equivalents of 0.058 tons per animal unit per month (Prairie Farm Rehabilitation Administration 1998), the expected increase would range between 0.03 to 0.12 animal unit month, for a net carbon equivalent sequestration of 0.09 t/ac/yr (Prairie Farm Rehabilitation Administration 1999b). If this figure is applied to the 33 million acres of native range in the prairie provinces, there could be a potential to sequester as much as 2.97 Mt of carbon per year until a new soil carbon equilibrium is reached.

**Economic Diversification.** New products and new uses for existing resources are continually sought as part of remaining competitive in the world economy. New opportunities for productive use of rangelands are found in alternative livestock, such as bison and elk (Canadian Bison Association 1999; Alberta Elk Association 1999). Horses continue to be raised on prairie grasslands, for recreational uses and for a supply of pregnant mare's urine for the pharmaceutical industry (North American Equine Ranching Information Council 1999). Sheep production continues to be small, but stable in the prairies. Interest in sheep may increase with evidence of their success in controlling invasive weeds, such as leafy spurge (Olson and Lacey 1994).

In addition, there is interest in harvesting seed from native prairie plants, for use in gardens or as sources of genetic material and new product development. For example, *Echinacea*, a plant native to prairie grasslands, has potential pharmaceutical applications (Tyler 1993; Manitoba Agriculture and Food 1999). Native seeds may also be used in projects to re-establish native range on cultivated land and on sites disturbed through mineral exploration. For example, the Prairie Farm Rehabilitation Administration (2000) requires re-establishment of native species, following any land disturbance, as a condition on any right-of-entry permits for community pastures. Also, Ducks Unlimited has established an Ecovar Program to use in its own cover restoration program and to expand the supply of seeds for other users (Ducks Unlimited Canada 1999b).

Recreational use of range land, where it makes economic sense, may also offer diversification opportunities for some land managers. Vacation ranches and trail rides are two examples that are identified in some tourism brochures (Alberta Country Vacations Association 1999). These, and other examples of ecotourism (Anderson/Fast Marketing Solutions 1996), provide an opportunity for people to appreciate prairie ecosystems and to develop a better understanding of the issues that land managers face in both making a living and managing the grassland resource.

### **Conclusions**

Livestock producers, farmers, and other land managers are under pressure to make a living, produce good quality and inexpensive food, and look after the environment. These agricultural producers are custodians and stewards of land that is some of the best remaining habitat for wildlife. There is increasing pressure on land managers to take special action to conserve species where the populations are low enough that they are considered to be “at risk”, like the Burrowing Owl, Swift Fox, and Ferruginous Hawk. Such actions, however, are often a cost to individual producers. At present, there are few mechanisms for the public to share in this private cost. Mechanisms that provide appropriate incentives and rewards, monetary or otherwise, can encourage stewardship practices that achieve both economic and environmental objectives.

Land owners and operators, usually farmers or ranchers, will make the majority of land use decisions in the Canadian prairies. Their cooperation and commitment is key to long term sustainable land use. Equally, the continued productivity of these land resources is one of the keys to rural sustainability, since so many of the economic opportunities in rural areas today depend on the resource base — agriculture, forestry and tourism, for example. In order to achieve this potential, the land managers need good information about the advantages and costs of land management practices that will improve the sustainability of their operations.

There are many opportunities to make economic and environmental objectives compatible. Good management practices, such as grazing rotations, livestock watering site distribution and riparian area management, can make a positive difference to both the bottom line and the habitat potential for wild species. Rangeland restoration or improvement can increase productivity for livestock as well as increase plant biomass, providing associated benefits for the ecosystem and for sequestering greenhouse gases. Good

information on the implementation and applicability of practices under local circumstances and some support for trying new technologies are two tools for encouraging land owners to adopt new management systems. Equally important is recognition by the non-farming public that producers are taking positive steps to provide food for people to eat, to care for their animals, and to look after the land.

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