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-- Dr. Bernie Sonntag, Director General, PFRA

Photo by Dave Reede

Executive Summary

Background

The Prairie Agricultural Landscapes (PAL) study is designed to help focus and direct the Prairie Farm Rehabilitation Administration's (PFRA) future programs and activities centred on sustainable land use, specifically in the area of healthy and productive agricultural lands.

Resource conservation and economic viability are paramount to the long-term prosperity of the agriculture industry and rural areas of the Prairie provinces. Economic factors are the dominant forces driving change on the Prairie agricultural landscape and will spur the growth in demand for primary and processed goods.

The Canadian Agri-Food Marketing Council (CAMC) has set an ambitious target for the agricultural industry. CAMC has challenged primary producers, processors and governments to significantly increase Canadian agriculture and agri-food exports to 4% of the global agri-food market share by the year 2005. The target is comprised of approximately 40% primary production and 60% processed goods.

Much of the primary production growth needed to meet the CAMC trade target is expected to come from the Prairies, which comprise more than 80% of Canada's agricultural land base. The increase in production and processing of goods in the Prairie region will pose numerous challenges for the sustainable management of the resource base.

The land base required to meet these targets is forecast to come from improved crop management, increased cropping intensity, reduction of summerfallow and increased pressure to cultivate environmentally sensitive lands. The implications of these changes in the agriculture and agri-food industry must be evaluated from economical, sociological and environmental perspectives.

State of Land and Water Resources

Soil Erosion

Soil erosion causes redistribution of soil in the landscape due to the action of wind, water and tillage. Much of the Prairies are affected by all three agents of erosion. The effects deplete the soil's capacity to grow crops, increase soil and crop yield variability within fields and cause environmental impacts such as reduced water and air quality.

The effects of erosion on crop yields and soil productivity are substantial. Erosion removes the soil fractions which contribute to nutrient availability and help maintain a good physical environment for plant growth. Severe loss of soil reduces the rooting volume available to plants, further depleting nutrient and water availability.

Better crop residue management through direct seeding has substantially reduced, but not

eliminated the risk of erosion. PFRA has determined that more than 50% of annually cropped fields are exposed to erosion each year on the Prairies. The reduction of fall tillage and summerfallow and the adoption of direct seeding systems, have decreased the period during which soils are exposed to a high erosion risk. However, there remains ample opportunity for erosion to occur. Severe and widespread erosion can take place during extreme weather events (high winds and heavy rains), and particularly during years of consecutive droughts.

Universal adoption of reduced tillage and low disturbance seeding systems will not eliminate soil erosion. Soils will still be exposed to high erosion risk after low residue crops, drought, disease, fire, or excessive straw harvesting. Permanent soil conservation practices are required to supplement crop residue management systems. Further work is needed to identify areas which are unsuitable for annual crop production and those areas that should be protected with perennial forages or windbreaks.

Salinity

Saline soils contain sufficient soluble salts in the root zone to hinder the growth of most crop plants. Soil salinity can also reduce the moisture extracting capability of plants. The net effect depends upon a number of factors, including soil texture, plant species and variety and proximity of the root zone to water sources. Other non-crop effects involve mired machinery, loss of fertilizer inputs and inefficiencies from farming fragmented fields.

Historic salinity arises from geologic and long-term climatic conditions, whereas *saline seeps* are believed to be primarily due to post-settlement factors such as the breaking of the Canadian Prairies and ongoing summerfallow practices. When the water table approaches the soil surface, evapotranspiration can concentrate soil salts at or near the surface.

Cropping for salinity control is far from a precise science. Practices that reduce the accumulation of excessive soil moisture may help to curtail or control salinity. These include cropping strategies within saline lands themselves or on upslope groundwater recharge areas. Lowering the groundwater table within the saline area itself is the ultimate objective.

Satellite imagery and aerial photography have commonly been used to visually map salinity. More precise ground survey techniques are also employed. The total extent of moderate-to-severe salinity on the Prairies (resulting in a 50% reduction in productivity) is estimated at 1.4 million hectares. An additional 10 million hectares may be slightly salinized.

Saline soils should be managed according to their salt content. To be effective, conservation practices applied and crops grown must reflect the history, current salinity status and productive potential of the land.

Organic Matter

Soil Organic Matter (SOM) is a vital component of the soil fabric, responsible for improving soil structure, tilth, fertility and health. Soils are able to store organic carbon and thus provide a sink for atmospheric carbon. SOM in Prairie soils dominates national accounts of SOM, and could play an important role offsetting greenhouse gas emissions through carbon sequestration.

The concentration and mass of organic matter in soil is extremely sensitive to soil management practices. Recent estimates suggest that 14-40% of the Soil Organic Carbon (SOC) originally in the Canadian Prairies soils has been lost since cultivation began. The time required to recover SOM concentrations to approach those of pre-cultivation lands is estimated at more than 75 years in the Brown soil zone, and more than 150 years in the Black soil zone.

Practices that maximize the addition of organic residues, or minimize the rate of organic matter decay and erosion, will be most effective in maintaining SOC. Such practices include growth of perennial crops, minimizing soil disturbance, reducing the frequency of fallowing, returning crop residues to the soil and maximizing crop productivity by including legumes in rotations and increasing fertilizer use efficiency.

Water Quality

Water quality is vital to the health of all living organisms, from fish and aquatic insects, to wildlife and humans. Water quality varies greatly in the streams, lakes, rivers and groundwaters of the Prairies, reflecting the region's many landscapes and land uses.

Agricultural development on the Prairies has resulted in widespread land clearing and drainage, soil erosion, water withdrawals, livestock concentration areas, land application of manure and inorganic fertilizer and the use of pesticides. There is increasing recognition that these developments have had a similarly widespread and adverse effect on water quality. Agricultural sources of water contamination include:

- runoff from fields to which fertilizers, pesticides and manure are applied
- runoff and wastewater from livestock operations
- leaching of land-applied contaminants to groundwater.

Across the Canadian Prairies, the ecological and health-related impacts of agriculture on water quality have generally not been studied. However, in some areas of the Prairies, agricultural activities have had significant localized effects, resulting in water quality guidelines being exceeded. While the overall significance of agriculture's impact on water quality across the Prairies is not well understood, it is generally accepted that the greater the level of agricultural intensity in an area, the greater the risk to ground and surface water quality. This is significant in light of the desire for expansion and intensification of agricultural production across the Prairies.

Riparian Areas

Riparian areas are transitional ecosystems between land and water environments. These corridors are characterized by lush vegetation bordering rivers, creeks, streams and wetlands. The health of a riparian area rests on its ability to maintain its overall structure in a dynamic setting, and to perform a number of important ecological functions. Riparian areas provide fish and wildlife habitat, dissipate stream energy, filter sediments and nutrients, stabilize streambanks, store water and contribute to aquifer recharge, and provide lush vegetation amenable to livestock grazing.

Although riparian areas account for less than 5% of the Prairie landscape, they provide essential habitat for the majority of the region's wildlife species and are important sources of biological diversity. Riparian areas can be negatively affected by agricultural activities both within and adjacent to the riparian zone.

Assessment tools have been developed to measure riparian health; however, to date no Prairie-wide assessments have been conducted. Studies at selected sites in Saskatchewan and Alberta have revealed that agriculture has contributed to reduced riparian function and capability. Similar extensive studies have not been reported for Manitoba, although qualitative assessments have been carried out on several watersheds in the province.

Riparian areas provide essential habitat for Prairie wildlife species and are important sources of biological diversity.

Rangeland and Seeded Forages

There are 23 million hectares of native rangeland and seeded forages dedicated to livestock production in the Prairie provinces. To date, few formal assessments or inventories of the condition of these lands have been done.

To obtain an estimate of rangeland condition, PFRA surveyed professionals knowledgeable in rangeland assessment. The survey found that more than half of Prairie rangeland is in less than good condition, with some areas reporting over three-quarters of the land in less than good condition.

Overall condition could be significantly improved through the implementation of planned grazing systems, combined with proven range management techniques. Such a shift in range management would increase production, reduce erosion potential, create wildlife habitat, and replenish deteriorated soil carbon levels.

Land Use and Farming Systems

To remain successful, Prairie producers adjusted to different climates and soil types, and to changing markets, technology and transportation systems. The relationship between current land use and farming practices in the many Prairie landscapes can be used to evaluate the potential of these landscapes to adapt to future economic and environmental scenarios.

The opportunities for agricultural systems to change are limited by landscape characteristics.

Photo by Dave Reede

It has long been understood that agricultural land use is related to landscape characteristics, and further, that the opportunity and ability of agricultural systems to change is limited by landscape. In the PAL study, areas with similar agricultural practices and land uses were grouped together. Then the soil and landscape types found within each group were characterized. This approach identified the range of landscapes which can support a given set of farming practices.

These Land Practices Groups were defined using a statistical analysis of the 1996 Census of Agriculture compiled by Soil Landscape of Canada (SLC) polygons. Distinctive soil landscape types from the SLC data were developed and the proportion of these landscapes in each Land Practices Group was determined. The combination of soils and land use helped relate the specific SLC polygon to the issues described in the State of Land and Water Resources section of this report.

Land Practices Group Descriptions

Dominantly Pasture

Two Land Practices Groups (differentiated by farm size) were identified as *Dominantly Pasture* with greater than 70% of the agricultural land used for grazing and forage. These areas are located in the drier areas and along the geographical limits of agriculture and contain mostly marginal land for cultivation. These groups are very important areas of natural biological diversity. Nearly three quarters (71%) of farmland in the *Dominantly Pasture, very large farms* (average farm size greater than 540 ha) group was in native vegetation in 1996, representing one-fifth of all native vegetation in the agricultural lands of the Prairies. The *Dominantly Pasture, small to large farms* has more managed hay and pasture.

Majority Pasture

Almost 20% of Prairie agricultural land is in the two *Majority Pasture* groups that have 40-70%

of the agricultural land in pasture and hay. There is a wide range in the intensity of crop inputs between the two groups. The *Majority Pasture, low level of crop inputs* group, which is generally found in drier areas and in the cooler wetter areas along the margin of cultivation. The *Majority Pasture, high level of crop inputs* which are found associated with areas of higher productivity.

Majority Cultivated, High Summerfallow

Three Land Practices Groups were identified as *Majority Cultivated , high summerfallow*. Located in the Brown and Dark Brown soils zones, they have summerfallow areas greater than 25% of cultivated land. These three groups are distinguished by the level of crop diversity.

The *Majority Cultivated, high summerfallow with pulses* group is in the more productive areas of the Dark Brown soils between Rosetown and Saskatoon, and Brown soils such as those near Swift Current. A quarter of the farms in this group grew lentils, comprising a significant portion of the 6% pulses. Another 6% of the land was cropped to oilseeds that included canola and mustard. The *Majority Cultivated, high summerfallow with oilseeds* group is found almost exclusively in the Dark Brown soils in Alberta near Drumheller, Vulcan and Warner, and in Saskatchewan near Unity, Davidson and Estevan. Most of the non-cereal annual crop production on these farms is canola or mustard seed.

The *Majority Cultivated, high summerfallow, low crop inputs and low crop diversity* group is almost exclusively in the Brown soil zone, and has traditionally been the wheat-fallow land of southern Saskatchewan and southeastern Alberta.

Majority Cultivated, with Flax

The *Majority cultivated, with flax* groups had a significant component of flax in the crop mix. The most diverse and intensive cropping on the Prairies occurs in the *Majority cultivated, very low summerfallow, very low pasture, and high crop diversity* group, which contains some of the most productive lands on the Prairies. This group had the lowest percentage of land in forages, and lowest number of cattle per farm on the Prairies.

The *Majority cultivated, very low summerfallow, medium to low pasture and high crop diversity* group is mainly found in Manitoba, on the more variable soils that surround the previous group.

The uniform Black till plain of east central Saskatchewan around the Indian Head area, is a good example of the *Majority cultivated, medium summerfallow with flax* group. Two-thirds of the farms with cropland reported summerfallow, a higher proportion than in other groups on similar soils.

Majority Cultivated, Low Summerfallow

The three *Majority cultivated, low summerfallow* groups have summerfallow less than 25% and were distinguished by crop mix. The *Majority cultivated, low summerfallow with very high oilseeds* group is almost exclusively confined to the Peace River district, and consists mainly of level or nearly level Dark Gray and Gray soils. The amount of land in oilseeds (32%) in 1996 exceeded the recommended rotation guidelines of one in four years.

The *Majority cultivated, low summerfallow with pulses* group is one of the largest groups, and is found in the moister areas of the Prairies. Annual cropping in this group is highly diversified, with oilseeds and pulses being significant components of the cropping system.

The *Majority cultivated, low summerfallow with cereals and oilseeds* group are dominantly in the Black soil zone and represent the typical Prairie farmland. Annual cropping in this group is primarily cereals and oilseeds. This group had the highest cattle numbers per farm of all the majority cultivation groups, suggesting that diversification to livestock has been more common than diversification of cropping.

The identification of Land Practices Groups provides a basis to predict changes in cropping, grazing and hay production over the Prairies. Each of the groups will behave differently to the changing pressures due to commodity prices, market opportunities, transportation changes, technological advances and environmental concerns. The Land Practices Groups can be used to identify where changing agricultural practices may present conditions that may negatively impact the agricultural land resource.

Issues Facing Management of Land Resources

Issues likely to affect changes in land management can be divided into four main categories. These categories are governed primarily according to public, environmental, community, and on-Farm considerations. Individual issues will be affected by a specific set of drivers.

Public Level Issues include those of policy and legislation, as well as international agreements. Tremendous pressure will be applied to the soil and water resource base to meet CAMC-style export targets, while at the same time seeking to reduce greenhouse gas emissions, and conserve natural biodiversity and wildlife habitat within farming systems.

Photo by Dave Reede

Environmental Issues encompass the public perception of agriculture; the need for abundant safe water, air and food; and the ability to cope with natural variability in such things as weather and pest cycles. Agriculture must clarify its actions and become more accountable in the public mind, while sustaining sensitive lands and reducing its effects on the environment. All of this must be balanced against the economic necessity that farmers face to hedge against significant crop loss and market forces.

Community Level Issues relate to demographic change, competing land use, rural infrastructure, and requirements for transportation and off-farm employment. There is little incentive for aging Prairie farmers to expand their land base. An increasingly educated rural labour pool will demand higher salaries. Rural communities will continue to decrease in size and number. Land use conflicts between rural residential and farming interests will increase. Expansion and improvement of existing production and processing facilities is required. Opportunities for off-farm employment will be critical to most farmers.

On-Farm Issues include a producer's ability to take risk, management of inputs and outputs, land tenure, and technological advances. Limited personal experience with highly variable soil and weather conditions, in tandem with restricted access to capital, will tend to favour the status quo in land management. Producers will seek to reduce inputs and associated costs where they can, while placing more emphasis on health and safety factors.

Sole proprietorship continues to decline across the Prairies. Short-term cash rental agreements will tend to discourage a stewardship approach to land management. Biotechnology will cause multi-national corporations to gain greater control over on-farm inputs. Farmer up-take of biotechnology may be slowed due to public concern over transgenic products. In the short term, precision farming technology will be confined to large scale operations and custom applicators.

Prairie Agricultural Landscapes - A Land Resource Review, includes a unique regional analysis to the array of resource assessments performed on the Prairie region over the past two decades. A second document, *Prairie Agricultural Landscapes: Foundations for Growth,* identifies opportunities for growth and impacts of agricultural expansion on land resources. Approaches to ensure sustainable development in the future are identified.

CAMC's growth targets require a shift in Canada's exports away from primary bulk commodities towards more processed products.