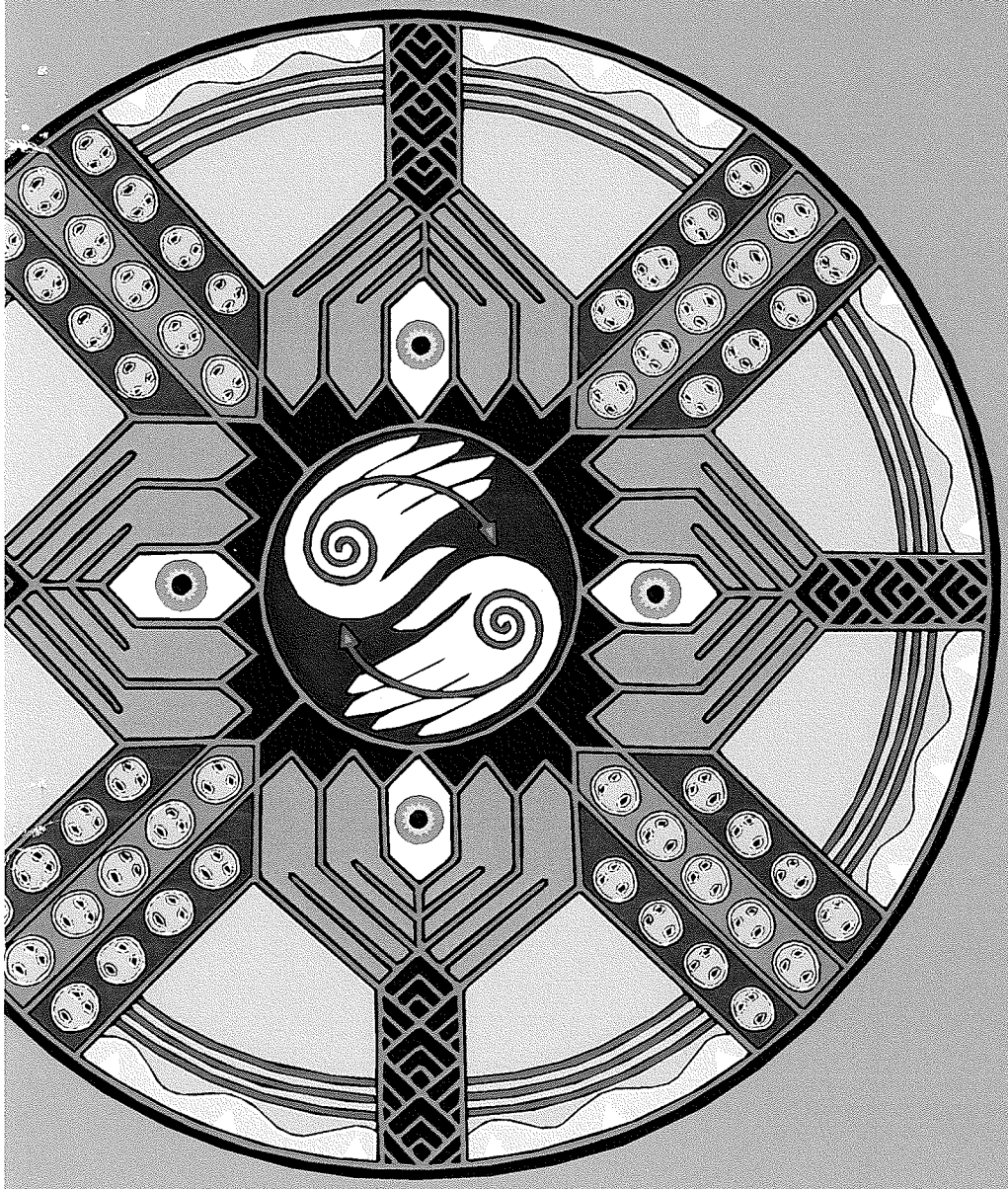
Reporting Progress on Sustainable Development for Manitoba's Prairie Ecozone

Focus chapter from State of the Environment Report for Manitoba, 1997



IISD in partnership with

Manitoba Environment

INTERNATIONAL INSTITUTE FOR SUSTAINABLE DEVELOPMENT

INSTITUT INTERNATIONAL DU DÉVELOPPEMENT DURABLE

MOVING TOWARD SUSTAINABLE DEVELOPMENT REPORTING

- Conditions and Trends
- Facts and Figures
- Problems and Solutions

STATE OF THE ENVIRONMENT REPORT FOR MANITOBA

1997

Manitoba
Environment

CONTRIBUTORS

EDITORS
Tammy Gibson, Susan Nicol, Laurie Streich

EDITORIAL BOARD
Chair: Norm Brandson
Members: Tammy Gibson, Peter Hardi, Emil Kucera, Max Morelli, Laszlo Pinter, Serge Scrafield, Jerry Spiegel, Laurie Streich, Dave Wotton

TECHNICAL ADVISORY COMMITTEE
Co-chairs: Tammy Gibson, Laurie Streich
Members: Grant Baker, Jim Bakken, Elena Benes, Joanne Buth, Brendan Carruthers, Amar Chadha, Gary Dickson, David Greenwood, Donna Harasymec, Peter Hardi, Chuck Jones, Gail Kozun, Emil Kucera, Chris Leach, Peter Mah, Jim Petsnik, Laszlo Pinter, James Popplow, Bruce Proctor, Michael Rennie, David Sprange, Harvey Stevens, Gordon Trithart, Barry Warrack, Robert Witzke

AUTHORS AND CONTRIBUTORS
Canada-Manitoba Infrastructure Works Secretariat: Fred Binne

City of Brandon: Grant McMillan

City of Flin Flon: Ken Shoemaker

City of Thompson: Malli Aulakh

City of Winnipeg: Rick Borland, Andrew Cowan, R. Bruce McPhail, Paul Olafson, Jim Thompson

Environment Canada: Norman Treloar

International Institute for Sustainable Development: Colin Duffield, Charray Dutka, Peter Hardi, Marion Meyer, Bryan Oborne, Laszlo Pinter, Allen Tyrchniewicz, Terry Zdan

Manitoba Agriculture: Daryl Domitruk, Gordon Mills

Manitoba Association of Native Languages

Manitoba Culture, Heritage and Citizenship: Gary Dickson, David Firman, Edward Ledohowski, Sylvia Nicholson

Manitoba Education and Training: Jim Bakken, Terry Lumb, Robin Miller, Tom Glenwright

Manitoba Energy and Mines: Robert Witzke

Manitoba Environment: Dave Bezak, Dennis Brown, Ed Chorniak, Bernie Chrisp, Steve Davis, David Ediger, Jim Ferguson, Arvin Gray, Dave Green, Sharon Gurney, Trent Hreno, Colin Hughes, Dale Jones, Bert Krawchuk, Don Labossiere, Cliff Lee, Lisbeth Liebgott, Leslie MacCallum, Rod McCormick, Dave Olinyk, Randy Pelser, Floyd Phillips, Richard Rentz, Don Rocan, Rick Sokolowski, Ed Sorba, Mark Stephens, Larry Strachan, Bill Tichon, Karen Warren, Dwight Williamson

Manitoba Government Services: Elena Benes, Al Pastars

Manitoba Habitat Heritage Corporation - Tim Sopuck, Phil Weiss

Manitoba Health: Jamie Blanchard, Ann Jolly

Manitoba Highways and Transportation: David Barham, Barry Blair, Jack Craven, Michael Creft, Doug Fisher, Bryan Petzold, Ulysse Poirier, David Selby, Harshendra Singh, Jamie Thould, Victor Weslak

Manitoba Industry, Trade and Tourism: David Sprange

Manitoba Natural Resources

Manitoba Northern Affairs: Jennell Majeran

Manitoba Rural Development: Fred Butler, Lyle Duguay, Jane Inouye, Carla Szabo, Dick Menon

Manitoba Urban Affairs: Jon Gunn

Prairie Farm Rehabilitation Administration: Floyd Wilson

Statistics Canada: Ron Wonneck

Sustainable Development Coordination Unit: Brett Eckstein, Fraser Koch, Eric Troniak

Transportation Safety Board of Canada: Brian Bell, Susan Fortier

Winnipeg International Airport: Wil Dewit

FOCUS GROUP PARTICIPANTS - PRAIRIE CHAPTER
Don Alexander, Robert Annis, James Bezan, John Bodie, Paula Braun, Paul Bullock, Alexa Campbell, Gerry Caplap, Pat Clift, Ron Coley, Lorne Colpitts, Heidi Cook, Richard Dawson, Denis De Pape, Jack Dubois, Alison Elliot, Ken Foster, Earl Geddes, Harvey Glick, Herb Goulden, Richard Goulden, Celia Guilford, Al Harris, Thomas Henley, Leslie Hughes, Shep Kaastra, Glen Koroluk, Harry Mardon, Jerome Mauws, Owen McAuley, Harry Mesman, Ted Muir, Beverley Nicholson, Merrell-Ann Phare, Ted Poyser, Alan Ransom, Richard Rounds, Libby Sally, Sam Schellenburg, Michelle Scott, Muriel Smith, Kathy Swan, Larry Walker, Gaile Whelan Enns, Ian Wishart

PHOTO CREDITS
Cover Photo: Donna Derenchuk
(Tall-Grass Prairie Preserve, Tolstoi)

Text photos: Dave Campbell, Child and Family Resources - Cranberry Portage, Dennis Fast, Tammy Gibson, Bill Harper, Heather Mowat, Diane Kunec - Critical Wildlife Habitat Program, Manitoba Agriculture, Ted Muir, Petryk Brothers Ltd., Richard Rentz, George Siamandis, Larry Strachan, Travel Manitoba, Maurice Mazerolle, Ian Ward, Karen Warren, Dwight Williamson

DESIGN
Makus Design

The editors wish to acknowledge the participation of the many external reviewers who assisted in finalizing this report.

Canadian Cataloguing in Publication Data
Manitoba. Manitoba Environment.
State of the environment report for Manitoba, 1997.
Biennial.
Some issues have distinctive title.
Includes bibliography and index.
ISSN: 1185-5762.
1. Environmental policy – Manitoba – Periodicals.
2. Environmental protection – Manitoba – Periodicals.
3. Sustainable development – Manitoba – Periodicals.
4. Environmental monitoring – Manitoba – Periodicals.
5. Conservation of natural resources – Manitoba – Periodicals.
TD171.5.C32M35 333.7'2'097127'05 C92-080045-9

CONTENTS

THE PRAIRIE ECOZONE

FOCUS ON SUSTAINABLE DEVELOPMENT

Manitoba's Prairie ecozone today is an ecosystem reconstructed by human activity. Fertile soils that once sustained vast, mixed grassland and tallgrass prairie now support a three-billion-dollar agriculture industry, one of Manitoba's most vital economic sectors.

•

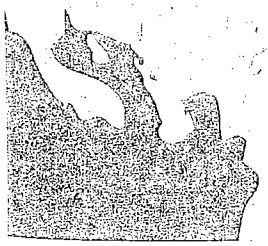
Although agriculture and related industries have changed the landscape, they still depend on the quality of the ecozone's natural resources. The most important natural resource on the Prairies is productive soil. Clean water is needed for irrigation, industrial processing, livestock watering, wildlife habitat and human consumption. Air quality affects everything from soil acidity to human health.

•

As well as providing wildlife habitat, most waterways serve land drainage, water supply or recreational functions. Many wetlands have been lost to agricultural development and few natural areas remain. With the disappearance of natural habitat, almost 40 species native to the ecozone are known to be at risk.

•

A substantial proportion of Manitoba's population is located on the Prairies. The workforce is largely dependent on resource-based or primary industries, but secondary industries such as manufacturing and processing are also strong. Capital assets, community health and individual well-being are affected by issues such as global trade, rural depopulation and the diversification of crops and livestock.



•

Although there are some differences among the ecozone's communities, prairie people share many characteristics, hopes and concerns. In many ways, they are a group with features as unique as the landscape itself.

•

This chapter examines sustainable development according to issues identified by prairie residents and key stakeholders. Indicators that assess the state of natural, economic, community and human resources are presented. Trends are identified to provide a baseline for future comparison.

A HISTORY OF CHANGE

Patches of green and gold fields, quilted together by straight roads, drainage ditches and meandering rivers, comprise the familiar aerial view of the Manitoba Prairies. The region is an important part of the "bread basket" of Canada and the world. Behind the tranquil and romantic image lies a history of major change affecting both land and people. This is the area of the province where settlement has had the most impact, transforming a predominantly mixed and tall-grass native prairie into an agricultural landscape in just over a century.

The focus of this chapter is Manitoba's Prairie ecozone. Ecozones are large areas of land with similar geographic features such as soil, land forms, watercourses, vegetation and climate. The Prairie ecozone is unique in that the original prairie ecosystem has virtually vanished. The prairie ecosystem today is one dramatically created by, influenced by, and dependent on agricultural development.

Canada's Prairie ecozone comprises the northern extension of open grassland in the Great Plains of North America.[17] It arcs from the western edge of Alberta to the eastern edge of Manitoba and extends south to the United States border.

Manitoba's Prairie Ecozone Boundaries

Within Manitoba, the Prairie ecozone covers 74,000 square kilometres or 12% of the province, making it one of the smaller of the province's six ecozones. Located in the southwestern corner of the province, it extends from the Saskatchewan border to the Red River Valley. Its northern and eastern boundaries adjoin the coniferous and deciduous forests of the Boreal Plains ecozone.

The Prairie ecozone is predominated by plains and some foothills covered by tall and mixed grassland and aspen parkland. The organically rich, fertile soil overlays moraine and lake bottom materials provided by glacial Lake Agassiz. Cold winters, warm to hot summers, and moderate to minimal precipitation characterize the prairie climate.

The Prairie ecozone in Manitoba encompasses most of the province's rich farmlands and a varied industrial and manufacturing base of economic activity. Although Winnipeg lies within the ecozone's boundaries, the city is classified as an "urban ecozone" because of its distinct economic and environmental features. This chapter deals with the rural section of the Prairie ecozone, but linkages to Winnipeg are made where appropriate. *(see box story on Winnipeg, p. 15).*

As of the 1991 census, 944,552 people live in Manitoba's Prairie ecozone, including the 616,790 people who live in Winnipeg. If the city's population is excluded, approximately 27% of Manitoba's total population of 1.1 million people live within the ecozone. The 1991 census is the latest for which information is available at the time this report was printed.

The Concept of Sustainable Development and Indicators

The concept of sustainable development was born out of the need to harmonize economic, environmental and social considerations in decisions made by business, community groups, government and individuals. Resources can be managed in a sustainable way by monitoring progress toward objectives by using indicators that communities understand and accept.

Indicators are familiar to us, but we rarely call them indicators. Instead, we call them signs, symptoms, signals, tips, clues, grades, trends, rankings, pointers, warnings or measurements. Indicators are central to decision making.[62]

For example, the area of Prairie ecozone lands affected by serious soil erosion is an indicator that demonstrates natural susceptibility to erosion, attitudes toward conservation, and the success of soil conservation programs.

Process of Indicator Selection

The Prairie ecozone was selected for a pilot project to develop a reporting format and indicators of sustainable development in this *State of Environment Report for Manitoba 1997*. In this focus chapter, trends in community development, human well-being, the natural environment and the economy demonstrate options for sustainable development reporting in the future.

To select and assess appropriate indicators of sustainable development, Manitoba Environment, the Sustainable Development Coordination Unit (SDCU), and the International Institute for Sustainable Development (IISD) in Winnipeg formed a partnership. In the first step, a core team designed a process for working with Prairie ecozone residents and stakeholders.

Through focus groups, this team identified and ranked the most critical issues for sustainable development in the Prairie ecozone. The result was a comprehensive indicator set that is specific to Manitoba's Prairie ecozone. Many of the indicators are aggregated into indices to reflect general conditions of broad issues within the Prairie ecozone. Many of the indices and indicators can be compared to other regions in Canada or throughout the world. Figure 2.1 provides a brief outline of the process.

Figure 2.1

PROCESS OF INDICATOR SELECTION

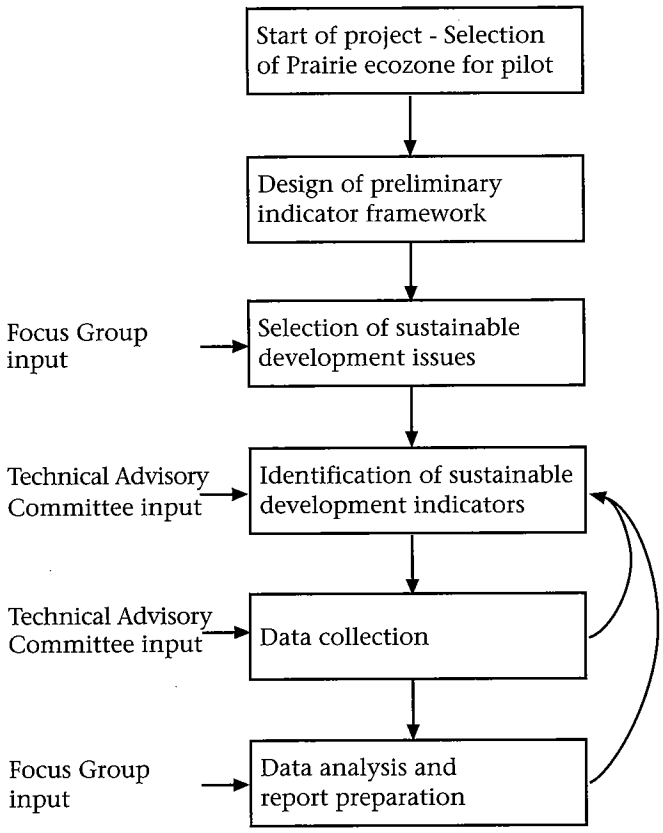


Figure 2.2

FRAMEWORK FOR SUSTAINABLE DEVELOPMENT ISSUES AND INDICATORS

Organizing Indicators: The Framework

To ensure all aspects of sustainable development were addressed, a four-part framework was used in the indicator selection process. *(see Fig. 2.2)*. The same framework was used in organizing the focus chapter. The framework identifies four main categories of issues and indicators relevant to sustainable development. These are:

- natural resources
- human made capital
- community assets
- individual well-being

The first category refers to the current stocks and condition of natural resources — such as balancing the use of water for domestic consumption and waste assimilation with the needs of aquatic ecosystems.

The second category, human made capital, refers to the economy. It includes agriculture, industries, infrastructure, trade and financial wealth.

Community assets, the third category, includes vital community services and institutions.

The fourth category, individual well-being refers to the condition of human life that is the ultimate outcome of the development process. It includes the physical health of residents as well as their wealth of knowledge, psychological and spiritual balance.

The framework also reflects equitable allocation of assets within and between generations as an overriding concern of sustainable development. A situation in which assets are generated and consumed excessively at the expense of others is not sustainable.

The indicator set was revised in several drafts until a final set was adopted. The list of indicators reported in this chapter is by no means exhaustive. Data are lacking on many issues that concern prairie residents. Wherever feasible, an attempt was made to identify measures that still describe the issue, albeit indirectly. Linkages between human well-being, environmental and economic factors are discussed in box stories. Symbols are used to represent the trend toward, or away from, sustainable development. *(see Fig. 2.3).*

Figure 2.3
SYMBOLS TO EVALUATE INDICATOR TRENDS.

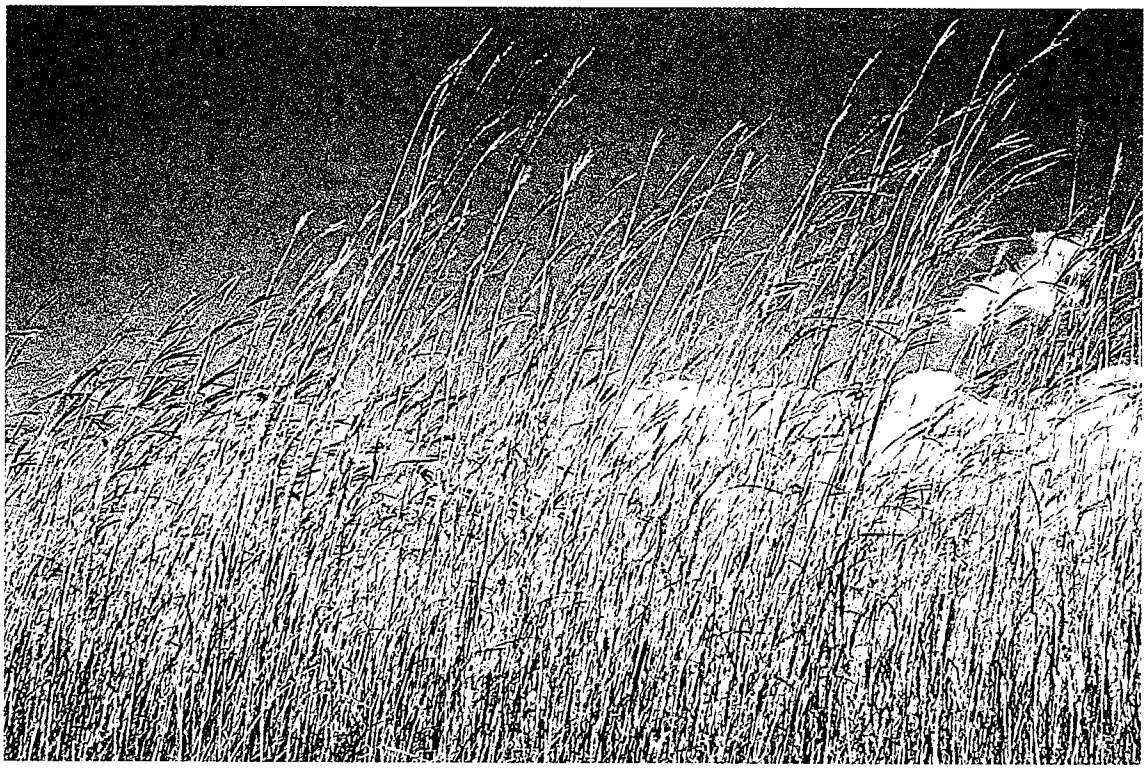
▲	**Improvement**
▼	**Decline**
〓	**Steady**
??	**Trend unclear**
○	**Insufficient data**

Challenges of Moving Toward Sustainable Development Reporting

There were many challenges faced in the preparation of this focus chapter. Readers need to keep the following points in mind to make best use of the information.

- The number of indicators had to be limited. Therefore, issues thought to be less important to the ecozone were left out.
- In many cases, data are not collected on an ecozone level. As well, because of the way some information is organized, it cannot be separated from data for the entire province, i.e. GDP. In some cases, data were not available at all.
- In many instances, it was impossible to generalize regional trends based on data from a limited number of discrete monitoring stations.
- Regional stakeholders identified many factors of sustainable development that are not measurable directly such as equity, and many quality-of-life issues. Wherever possible, approximate measures were used to represent these issues.

The indicator summary that follows lists indicators used in this chapter, and the trend toward or away from sustainable development.



INDICATOR SUMMARY

PRAIRIE ECOZONE CHAPTER

Category	Sub-Category	Indicator	Trend	Page
TRENDS IN THE NATURAL ENVIRONMENT	Soil Quality, Quantity and Conservation	SOIL QUALITY	=	22
		• organic matter		
		• risk of salinization		
		SOIL QUANTITY	▲	24
		• risk of wind and water erosion		
		SOIL CONSERVATION PRACTICES	=	26
		• shelterbelt plantings		
		• land in summerfallow		
		• Manitoba-North Dakota Zero-Tillage Association workshop attendance		
		• PFRA permanent cover program activity levels		
	Surface Water	WATER QUALITY		29
		• water quality index	=	29
		Fertilizer application rates	??	32
		Water quantity	○	35
	Air	Air quality	=	36
		Stratospheric ozone	▼	37
	Diversity of the Natural Environment	SPECIES AND HABITAT DIVERSITY	○	38
		• wetlands affected by agricultural activities		
		• tall-grass prairie preserve size		
		• endangered and threatened species in Manitoba		
		• May pond counts in southern Manitoba		
		• ducks in southern Manitoba		
		• Canada geese in southern Manitoba		
		INTEGRATED CONSERVATION PROGRAMS	=	42
ECONOMIC TRENDS	Production	Gross Domestic Product by industry	=	44
	Farming	Farm ownership	??	48
		Farm bankruptcies	▲	48
		Debt to capital ratio	=	49
		Expenses as a % of revenue	=	49
	Employment	Employment rates by industry	=	50
		Average weekly earnings	▲	51
	Consumption	Energy consumption	??	52
		Household expenditures	=	52
COMMUNITY ASSETS	Demographics	POPULATION TRENDS	=	54
		• historical population trends		
		• past and projected population		
		• net migration		
		• number of households		
	Services	Access to water and sewage treatment	=	57
	Transportation Services	Investment in road transportation	=	58
	Information Services	Newspapers and Libraries	▲	59
		Single line telephone service and Internet servers		

Category	Sub-Category	Indicator	Trend	Page
	Environmental Protection	Government expenditures on environmental services	=	61
		WASTE MANAGEMENT • waste reduction achievements • eligible materials and recovery rate • household hazardous waste collected • municipal recycling • pesticide containers collected • tires recycled	▲	62
	Health Care	ACCESS TO HEALTH CARE SERVICES		
		• beds per 1,000 population	▼	65
		• rural GPs per 1,000 population	▼	65
	Education	EDUCATION AND TRAINING • basic education levels • government investment in training programs • enrolment rates	=	67
	Community Participation	COMMUNITY INSTITUTIONS AND PARTICIPATION • UMM meetings related to sustainability • number of community round table initiatives	=	68
		Extension and community development program trends	=	69
	Culture, Heritage and Recreation	CULTURE, HERITAGE AND RECREATION TRENDS • number of historic sites • historic site preservation expenditures • attendance at provincial park interpretive programs	=	70
HUMAN LIFE ON THE PRAIRIES	Individual Health	INDIVIDUAL HEALTH TRENDS • disability-free life expectancy (years) • % of Manitobans with high blood pressure • % of Manitobans overweight • % of Manitobans with high blood cholesterol • Manitoba teen pregnancy rate per 1,000 • low birth weight rate • cancer incidence per 100,000 • % of Manitobans smoking • % of deaths attributable to smoking • % of Manitobans who drink on a regular basis • % of Manitobans drinking and driving • % of Manitobans reporting 2 or more sex partners • rate of sexually-transmitted disease per 100,000	??	73
	Social Equity	EQUITY AND POVERTY • residents living below low income cutoff • number of people on social assistance • First Nation average wages and unemployment • female average wages and unemployment	??	74
	Personal Safety	PERSONAL SAFETY • agricultural accidents and agricultural-related deaths • reported child abuse cases • criminal offences	??	76
	Quality of Life	QUALITY OF LIFE BENCHMARKS • % of Manitobans rating their health as "excellent" • % of Manitobans rating their well-being as "high" • % of Manitobans "very satisfied" with their jobs • Manitoba suicide rate per 100,000	??	77

TREND SYMBOLS

▲ **Improvement** ▼ **Decline** = **Steady** ?? **Trend unclear** ○ **Insufficient data**

TRENDS IN THE NATURAL ENVIRONMENT

Most natural resources, such as flora, fauna, water and even soil, are renewable; that is, they are capable of recreating themselves over a period of time. In the early days of development in Canada, people believed our resources were limitless. Now we know they need to be carefully managed to ensure continued benefits for future generations.

The following discussion addresses the issues of soil quality, quantity and conservation; surface water quality and quantity, air quality; and diversity of the natural environment.

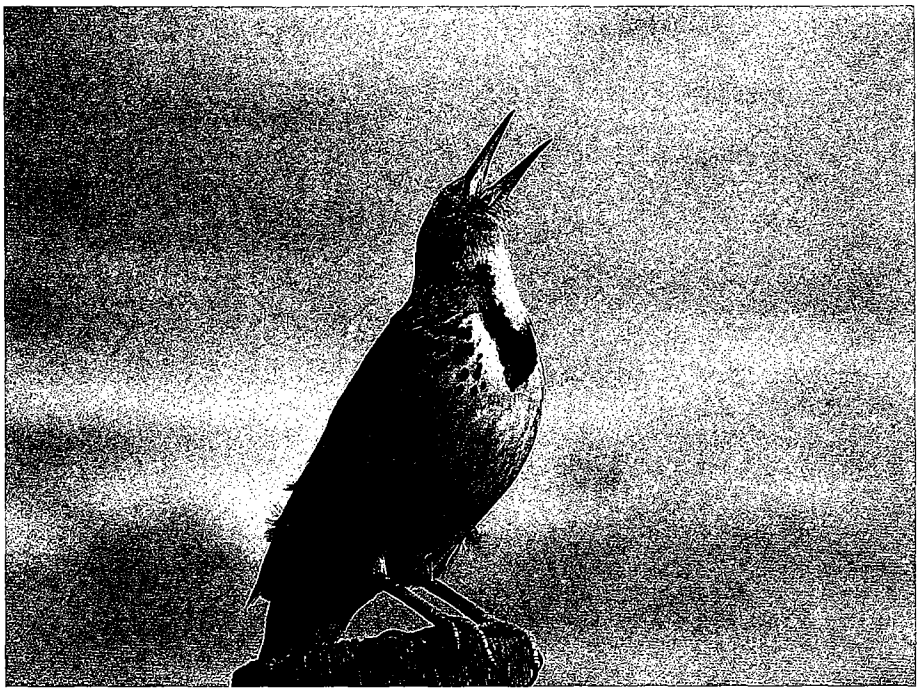
SOIL QUALITY

Soil health is characterized by specific soil properties, functions or conditions. In addition to environmental factors, the management practices of farmers contribute to future trends in soil quality. Generally, rates of change can be detected only over several decades.

The influence of land management practices on soil quality and health has been evaluated from 1991 Census of Agriculture data. A study, entitled *The status of land management practices on agricultural land in Canada* was used as a baseline for determining change in land management practices.[16]

Two of the most important indicators of soil health are soil organic matter and salinity. Soil pH also affects plant nutrition directly. However, a serious pH problem in prairie soils is unlikely to occur given their good buffering capacities, a low rate of fertilizer use and the relatively insignificant amount of acidic precipitation in Manitoba.

Another important aspect of soil health is the quantity of soil. Soil erosion by wind and water is the most critical factor affecting agricultural sustainability in the Prairie ecozone.



Organic matter is an important component of soil that supplies plants with nutrients, holds soil particles together, improves tilth and reduces erosion. Organic matter also improves soil drainage and water-holding capacity while controlling the effectiveness of some pesticides. Biological processes of plant growth and human activities, such as tillage, have affected the present state of soil organic matter.

Soil salinity can increase if evaporated water leaves its salt content on the surface layer of soil. This may happen as an undesirable side effect of excessive irrigation or because of a natural discharge of groundwater. Soil salinity reduces the ability of plants to withdraw nutrients from the soil.

Figure 2.4

AREAL EXTENT OF SOIL CLASSES WITH DIFFERENT ORGANIC MATTER CONTENT
In the Prairie Ecozone

Class	Percent organic matter	Areal extent	
		Hectares	Percent
1	<3.4	150 336	2.2
2	3.4-5.0	1 040 121	14.9
3	5.2-6.7	2 746 730	39.3
4	6.8-8.4	1 562 450	22.4
5	8.5-11.8	1 112 130	15.9
Organic soils	>30	-	-
Unclassified		-	-
Water		378 513	5.3
Total		6 990 280	100.00

Source: Canada Soil Inventory 1989

TREND: 〓

The trend for soil quality is steady. Organic matter content in agricultural soils has declined by some 15-30% since cultivation began just over a century ago.[31] The rate of decline occurred rapidly during the early years of cultivation, but, over time, the decline slowed. Land management practices such as conservation tillage (leaving some crop residue on the soil surface) and the reduction of summerfallow (leaving tilled land unseeded) are helping to stabilize organic matter content. [9]

Between 1981 and 1991, there was no change in the risk of soil salinization on 80% of farmland in the ecozone. Salinization risk was down on 19% of farmland, but a small increase (on 1% of the land) was noted.

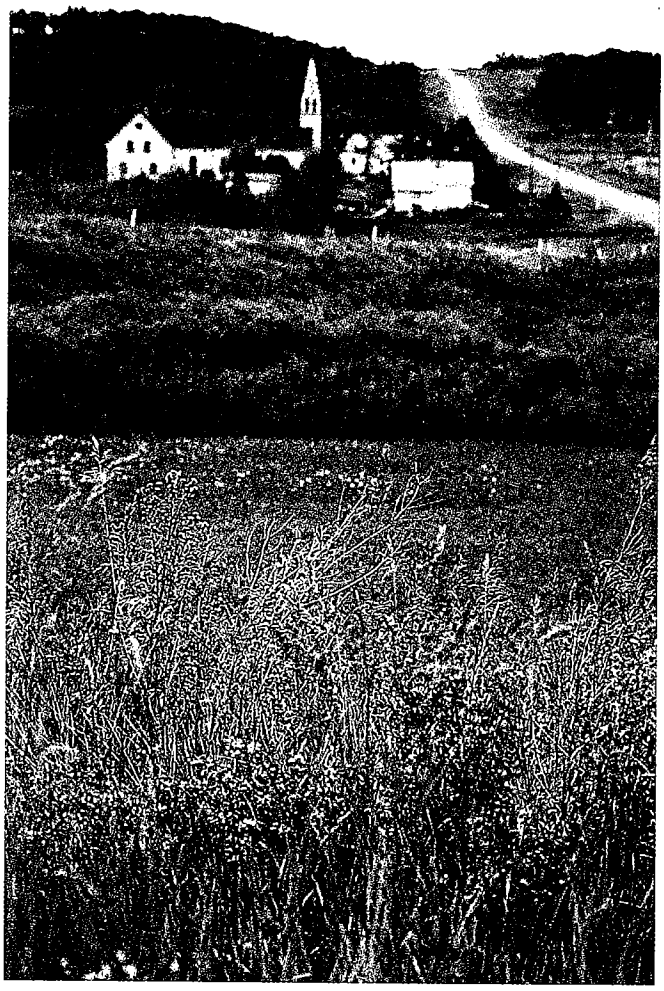
About 275,000 hectares in Manitoba are highly saline. Wheat yields are reduced on an additional 306,000 hectares because of too much salt.

Implications For Sustainable Development

Given today's dominant land use practices, soil quality changes are detectable only over several years or decades. It is anticipated that an increase in livestock operations in the Prairie ecozone will add large amounts of manure and organic matter to the soil. Land management practices will need to be adjusted to benefit from increased organic matter while preventing water quality problems linked to excess nutrients.

Most of the farmland in agro-Manitoba has low surface salinity. Areas of moderate surface salinity are often found in drains and depressions or near wetlands. Areas of high surface salinity are fairly small and localized. Such patches usually occur as a result of groundwater discharge due to shallow water tables. An increase in irrigation may contribute to a higher risk of salinity in areas with sensitive soils.

Soil health also includes a biological component. We are only beginning to understand the positive benefits of microorganisms and earthworms on the productive capacity of soil and thus have not introduced an indicator for this.



TREND SYMBOLS
▲ **Improvement** ▼ **Decline** 〓 **Steady** ?? **Trend unclear** ○ **Insufficient data**

SOIL QUANTITY

TREND: ▲

Erosion is a natural process in the landscape which is often accelerated by agricultural management practices.[16] Cultivation can result in the loss of topsoil, the decline of organic matter and the subsequent breakdown of soil structure.[82]

The economic and social consequences of large scale soil loss can be very costly, although in many cases, the immediate costs are off the farm and related to drainage. Once soil is lost, several decades to centuries may pass before conditions improve. Perhaps the people most aware of this are prairie people who lived through the "dust bowl" era of the 1930s. While those days have passed, the struggle to keep our soils in good condition is a never-ending task.

Although it is possible to measure the amount of erosion on a field or small plot of land, it is difficult to measure erosion over large areas such as Manitoba's Prairie ecozone.

For this reason, features of the soil, landscape and climate are used to predict which soils are susceptible to natural erosion and which are susceptible to erosion caused by land management practices. Various soil erosion risk categories have been developed as a result. Factors determining risk include:

- geological features such as slope or exposure
- physical characteristics of the soil, such as texture and organic matter
- climatic factors such as wind speed.

To assess the risks of soil erosion on an equal footing, the calculation assumes that all soils in the assessment area are bare of vegetation and are managed using conventional rather than conservation practices.

Figure 2.5

RISK OF EROSION ON CULTIVATED LAND
in Manitoba

	Cultivated Land (%)	
Risk Class	**Wind Erosion**	**Water Erosion**
Negligible	8	35
Low	37	41
Moderate	19	6
High	30	4
Severe	5	14
Reduction in actual erosion risk (% change in risk between 1981 and 1991)	6.4	15

Source: Manitoba Agriculture

The trend for soil quantity is improving. The effectiveness of conservation practices in reducing soil erosion was assessed by comparing changes in erosion risk between 1981 and 1991.[82] Actual wind erosion risk decreased about 6.4% because of cropping systems (2.5%) and tillage practices (3.9%). A combination of cropping practices (about 6%) and tillage practices (about 9%) resulted in an overall reduction of 15% in actual water erosion risk over the same period.

The risk of wind and water erosion on cultivated land under management practices widespread in 1991 has been estimated for Manitoba.[82] This evaluation indicates that about 45% of cultivated land is at negligible-to-low risk of wind erosion, and about 35% is at high-to-severe risk.

About 76% of agricultural land is at negligible-to-low risk of water erosion and about 18% is at high-to-severe risk. Water erosion risk is higher in areas with slope gradients, such as the Manitoba Escarpment in the Riding Mountain area. Areas with light, sandy soils are also problematic. *(see Fig. 2.5).*

Implications For Sustainable Development

Improvements in soil quality are the result of soil and water conservation efforts of the past several decades. Shelterbelts, grassed waterways, zero and minimum tillage, and permanent cover programs help ensure that we do not degrade our natural resources of soil and water.

Aerial view of a grassed waterway.

EUROPEAN UNION INTRIGUED BY WHITEMUD WATERSHED CONSERVATION DISTRICT

Manitoba's first conservation district, the Whitemud Watershed based in Neepawa, is being evaluated as part of a European Union (EU) project on sustainable development. Research was conducted by Winnipeg's International Institute for Sustainable Development (IISD) for the EU study team in Austria.[70]

The Whitemud Watershed Conservation District (WWCD) covers 6,216 square kilometres in south-central Manitoba. Except for its northwestern section that is part of the Boreal Plains ecozone, the district lies within the Prairie ecozone. Its boundaries are defined by the natural drainage areas of the Whitemud River and its main tributary, the Big Grass River.

Since its creation in 1972, the WWCD has established a formal institution and a network of local residents to deal with flooding and soil loss in the Whitemud River watershed. The conservation district works to correct problems through education and conservation programs.

The activities of the WWCD are concentrated in five main areas: water management, soil conservation, habitat, wildlife and public education programs. Although the emphasis in the last few years has shifted somewhat, water management is still the highest priority issue in the watershed.

Specific field activities include:

- maintenance of drainage channels
- construction of small dams to create wildlife habitat and livestock watering sites
- maintenance and planting of shelterbelts
- a grassed waterways program to reduce soil erosion
- assistance to farmers in planting forage crops to control erosion on marginal lands
- stabilization of gullies to reduce soil erosion
- preservation of natural lands to maintain wildlife habitat
- a conservation corridor program to restore natural habitat on unused road allowances
- fish habitat protection and stocking program
- public education program promoting soil and water conservation practices
- heritage conservation through the protection of natural and cultural landscapes.

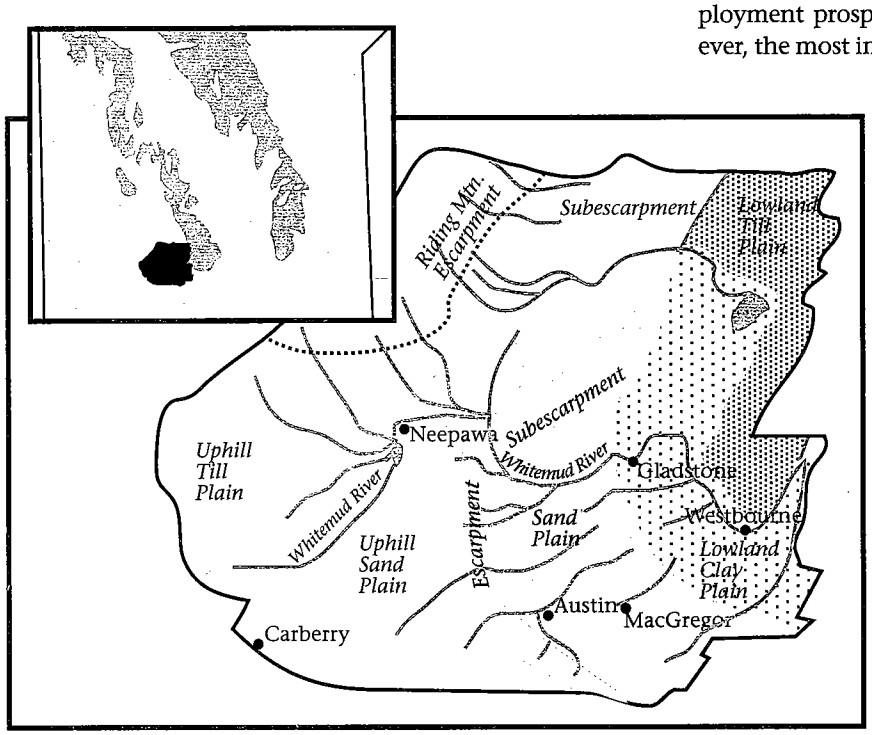
Evaluating Sustainable Development Contributions

There is much improvement in the Whitemud area, especially when compared to the massive soil and water problems that occurred during the early decades of this century. The WWCD has been particularly effective in building local support through the participation of landowners. Residents determine areas of concern, allocate resources and solve problems cooperatively.

The conservation district also addresses the social dimensions of sustainable development through public education, field tours, heritage conservation and by increasing the employment prospects of young people in the region. However, the most important social impact may be the existence of the conservation district itself, as a forum for public involvement.

The WWCD won the 1992 Sustainable Development Award of Excellence in the public sector category.

Figure 2.6
WHITEMUD WATERSHED AREA



Source: Whitemud Whatershed Conservation District.

TREND SYMBOLS
▲ **Improvement** ▼ **Decline** = **Steady** ?? **Trend unclear** ○ **Insufficient data**

SOIL CONSERVATION PRACTICES

When applied in a coordinated manner, i.e. within a watershed, conservation has been proven to result in improved agricultural production and substantial cost savings for governments in the maintenance of local infrastructure.

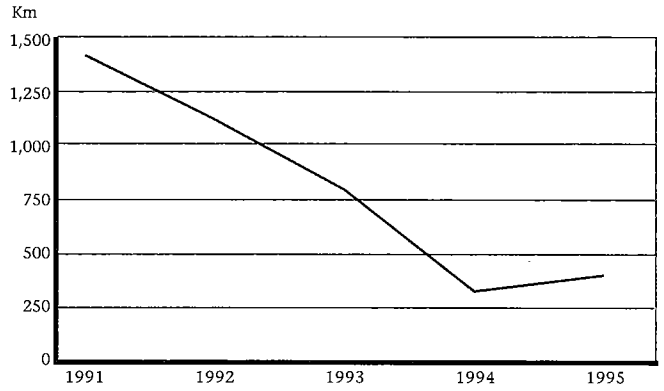
Unfortunately, solid data are not available regarding most soil conservation indicators. However, there are individual data sets that may assist in establishing a trend during the five-year period covered by this chapter.

It should be noted that these indicators are imperfect. Ideally, longer-term cumulative trends would be used. As well, most indicators are derived from publicly-funded program data and this does not fully represent actual trends on the landscape.

Figure 2.7

SHELTERBELT PLANTINGS

In the Prairie Ecozone per year



Source: PFRA

Shelterbelts are rows of trees, shrubs, or other appropriate vegetation which are planted in rows, perpendicular to prevailing winds, specifically to minimize soil erosion in agricultural areas. They also prevent white out conditions on adjacent highways.
Shelterbelt plantings are down, but the overall amount of land protected has increased since shelterbelts planted in the past continue to provide protection against soil erosion.

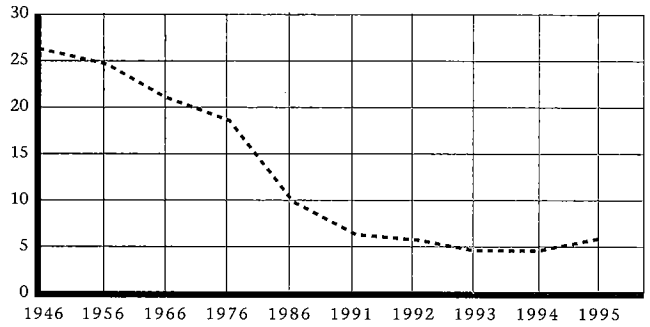
Grassed waterways minimize soil erosion by facilitating water drainage and protecting the land from the erosive power of flowing water.

Other conservation measures include small dams, which are built to store and slow the flow of water, minimizing downstream erosion and forage crops, such as natural grasses, which are used by livestock and/or wildlife and minimize soil erosion.

Figure 2.8

SUMMERFALLOW IN MANITOBA

Percent of improved land



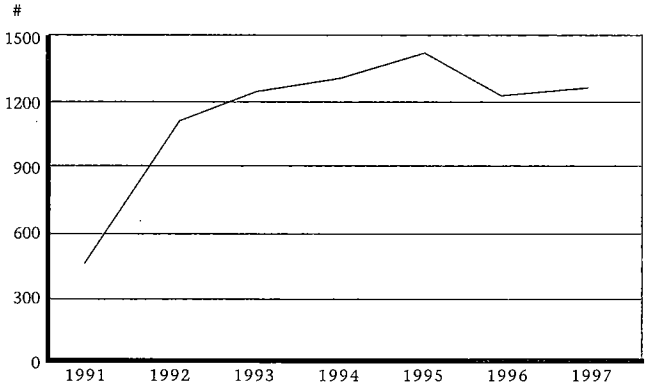
Source: Canadian Wheat Board
1946-1991 Statistics Canada census years

Summerfallow is an agriculture practice which results in a parcel of land resting idle and without cover during the farming season. In Manitoba's Prairie ecozone, this practice is likely to cause substantial soil erosion by wind. The amount of land in summerfallow has remained relatively stable at approximately 6% of cultivated land, or 303,500 ha. in 1995.

Figure 2.9

MANITOBA-NORTH DAKOTA ZERO-TILLAGE ASSOCIATION

Attendance at Annual Workshop



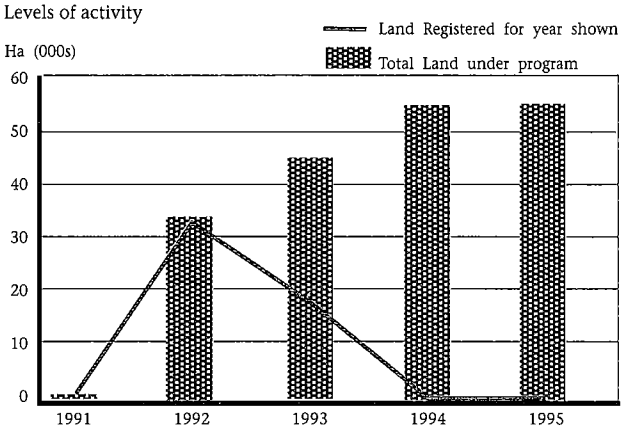
Source: MB-ND Zero-Tillage Association

Zero-tillage involves planting crops into the stubble of the previous crop with little or no previous cultivation.

Figure 2.10

PFRA PERMANENT COVER PROGRAM

Levels of activity



Source: Prairie Farm Rehabilitation Administration

The Permanent Cover Program was an initiative of PFRA which aimed to reduce soil erosion by keeping highly erosive land under the protection of forage crops, zero-tillage or haylands.

TREND: =

The trend for soil conservation practices is steady. Shelterbelt plantings are down after reaching a peak in 1992. Interest in using zero tillage as a farming practice is steady. Also after reaching a peak in 1992, the annual amounts of land registered for the Prairie Farm Rehabilitation Administration's (PFRA) Permanent Cover Program experienced a downward trend. The program is now fully subscribed with hundreds of hectares registered in 21-year agreements.

In 1991, the last year for which Statistics Canada data are available, conservation tillage practices were used on 28.7% of farmland while zero till was practised on 5% of farmland. In the same year, 66.3% of agricultural land was farmed using conventional tillage practices.

This is a specific instance in which a longer-term view is critical. Conservation tillage, promoted through innovative organizations such as the Manitoba-North Dakota, Zero-Tillage Association, has increased substantially during the past decade. Yearly trends, however, are influenced by seasonal weather variations.

Implications For Sustainable Development

Sustainability in agriculture depends on the health of the soil in which crops are grown. Since the 1930s, prairie landowners have been interested in soil conservation. In recent years, several publicly-funded programs have built successfully on this interest; funding levels for these programs fluctuate over time. Although conservation programs may be required still to encourage wider use of conservation techniques, much research has focused on demonstrating the economic benefits of conservation to landowners and the broader community.

TREND SYMBOLS

▲ Improvement **▼ Decline** **= Steady** **?? Trend unclear** **○ Insufficient data**

THE DEERWOOD SOIL AND WATER MANAGEMENT ASSOCIATION

The Deerwood Soil and Water Management Association (DSWMA) is an organization of some 150 landowners who farm along the Manitoba Escarpment in south-central Manitoba.

The Deerwood group has addressed concerns by integrating conservation activities into the farm management plans of individual members. Its future will be tied to broader, long-term watershed management initiatives comprising the South Tobacco Creek project.

Agricultural Impacts Investigated

Launched in 1991, the South Tobacco Creek project is a 10-year investigation of the impacts of agriculture on land and water ecosystems in the Red River basin. The project is a joint effort of the federal and provincial governments and the DSWMA. South Tobacco Creek is located near Miami in south-central Manitoba.

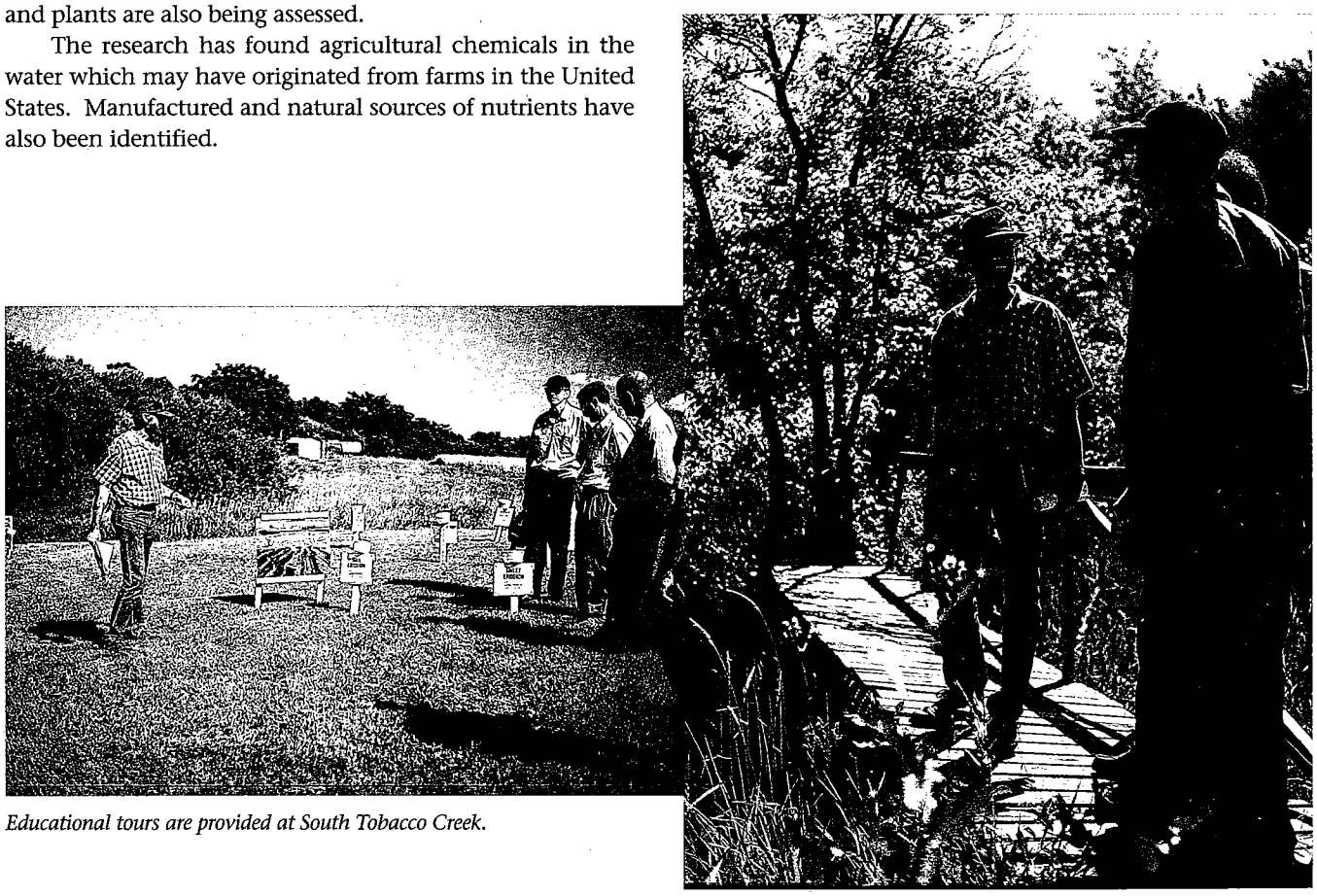
Project participants are documenting the condition of the soil and the movement of water, soil, fertilizers and pesticides. Researchers are studying samples taken from two farm fields at the headwaters of Tobacco Creek, from the Tobacco Creek system, the Red River, and finally from Lake Winnipeg itself. Impacts of land use practices on wildlife and plants are also being assessed.

The research has found agricultural chemicals in the water which may have originated from farms in the United States. Manufactured and natural sources of nutrients have also been identified.

Researchers hope to gain a greater understanding of the sources of pollutants and the ways in which chemicals move through the ecosystem. The result of the research will be suggestions on alternative land use practices.[30, 39]

Other DSWMA achievements include:

- installation of a network of small dams to control downstream erosion and flooding. Twenty-six headwater retention structures now control water flows across 30% of the 18,000-acre watershed, resulting in a 25% reduction in overall peak flows. Localized, individual dams have reduced high-intensity runoff by as much as 90%. And, two rural municipalities have reported cost savings in the maintenance of roads, bridges and ditches in the amount of $25,000 per year.
- comprehensive field management demonstrations. Area farmers have been given assistance to employ conservation measures such as minimum and zero tillage, rotational grazing, shelterbelts, gully stabilization, grassed waterways, rotating forages on sensitive lands, and enhancing wildlife habitat.
- leading-edge water quality monitoring and experimentation. Several major partnership projects exist with external groups such as the University of Manitoba, Environment Canada and NASA.



Educational tours are provided at South Tobacco Creek.

WATER QUALITY

Human activity that affects the land will ultimately affect water bodies. Water provides habitat for aquatic organisms from algae and bacteria to fish and wildlife. Agricultural uses, such as irrigation and livestock watering, are also prominent. Other uses include recreation and human consumption.

Most communities in the Prairie ecozone are connected to municipal water systems while most homesteads rely on their own water supply, mainly private wells. A considerable number of Manitobans, unless they use sophisticated water purifiers, are affected directly by water quality change. Water used for watering livestock is usually not purified; therefore, the animals are affected directly as well. *(see related story on toxic algae, p. 31).*

Just as with soil quality, water quality is a complex issue that cannot be described by a single indicator. In Manitoba, water quality is assessed by measuring up to 70 variables, including various types of bacteria, chemical elements and organic compounds. All variables need to be examined individually to assess samples according to water quality guidelines.

To provide information on water quality and water uses, a water quality index (WQI) was adopted to assess Manitoba's surface water. It incorporates information on water quality based on comparisons to guidelines or objectives. Twenty-five variables were selected for use in the index. The variables were chosen because they provide direct information on important concerns or because they represent related variables. *(see Fig. 3.17 on p. 95 for an overview of the index).*

The index presumes water quality is excellent when all water quality objectives are met all the time. Both national water quality guidelines and Manitoba-specific objectives were used to calculate the index.[80, 86]

Water quality degrades progressively according to the:

- number of variables for which objectives are not met (Factor 1)
- percentage of time they are not met (Factor 2)
- magnitude of the exceedances (Factor 3).

Progressively larger index values result when:

- guidelines are exceeded for more than one variable
- exceedances occur over long periods of time
- the magnitude of the exceedances increase.

Figure 2.11

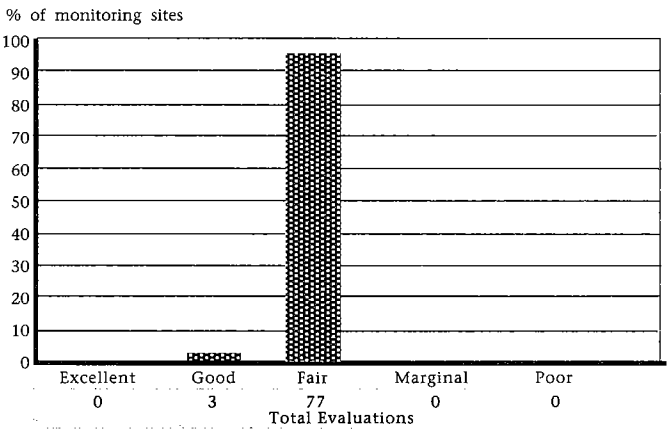
RANK AND WQI RANGE

Water Quality Rank	Index
Excellent	0 - 3
Good	4 - 17
Fair	18 - 43
Marginal	44 - 59
Poor	60 - 100

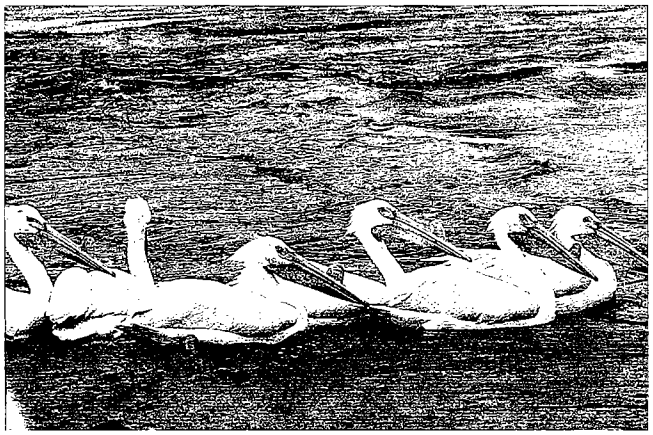
Source: Manitoba Environment

Figure 2.12

WQI SUMMARY FOR THE PRAIRIE ECOZONE
1991 - 1995



Source: Manitoba Environment



TREND SYMBOLS
▲ **Improvement** ▼ **Decline** = **Steady** ?? **Trend unclear** ○ **Insufficient data**

Figure 2.13

WATER QUALITY INDEX RANKS

For water bodies located in the Prairie Ecozone for the years 1991 to 1995*

Prairie Ecozone	1991	1992	1993	1994	1995
Assiniboine River downstream of Portage la Prairie	33	36	34	32	36
Assiniboine River upstream of Brandon	33	32	34	32	32
Assiniboine River upstream of Portage la Prairie	41	36	35	31	33
Assiniboine River at Headingley	28	28	35	37	41
Boyne River near Carman	29	33	26	31	30
La Salle River near St. Norbert	32	37	36	34	35
Little Saskatchewan River near Rivers	28	23	22	26	27
Rat River near Otterburne	27	28	34	33	28
Red River downstream of Winnipeg	41	41	39	34	36
Red River upstream of Winnipeg	34	31	35	30	30
Roseau River near Dominion City	33	27	32	35	24
Seine River upstream of Winnipeg	31	30	36	39	37
Souris River near Treesbank	29	34	30	34	36
Turtle River near Ste. Rose du Lac	31	32	25	28	28
Valley River north of Dauphin	16	16	24	27	25
Whitemud River at Westbourne	23	17	25	30	27

Source: Manitoba Environment

** Graphs for each water body in Figure 2.13 are located in the Appendix, beginning on p. 153.*

TREND: =

Overall water quality is fair and has shown little change across the Prairie ecozone from 1991 to 1995. Water quality reflects agricultural activities, natural sediment load carried by prairie rivers and streams, and seasonal variation of prairie rivers.

On occasion, the herbicide dicamba exceeds the guidelines for irrigation at every sampling location in the Prairie ecozone. Exceedances are most frequent at the Red River north of Winnipeg and in the La Salle River.

Guidelines or objectives for the Red River downstream of Winnipeg were exceeded on occasion, for almost all substances analysed over the five-year period. As a result, the WQI for the Red River downstream of Winnipeg is consistently at the high end of the "fair" rating and is of slightly poorer quality than the Red River upstream of Winnipeg.

The WQI for the Assiniboine River at Headingley increases steadily each year within the "fair" rating, indicating a possible trend. However, levels of aluminum, iron and manganese – which have exceeded water quality guidelines and objectives consistently – are available for only the last three years. The WQI at this location may, in fact, be relatively constant over this period.

Periodically, fecal coliform levels higher than the water quality objective appear at each monitoring location in the ecozone. They occur more frequently in the Red River downstream of Winnipeg where 67% of all measurements exceed the guidelines. Fecal coliform densities reflect the impact of population centres and agricultural activities near watercourses.

Several herbicides evaluated were found to exceed the water quality guidelines in the ecozone. They include the herbicides dicamba, MCPA, bromoxynil, simazine and trifluralin. Dicamba exceeded the guidelines at every location sampled, while MCPA exceeded guidelines at approximately half the locations sampled. The presence of a variety of herbicides in the watercourses reflects the high degree of agricultural activity in the Prairie ecozone.

Implications For Sustainable Development

Conventional agriculture on the Prairies today necessitates the use of various production-enhancing chemicals; fertilizers and pesticides serve to make farming an economically viable lifestyle choice for many families in the ecozone. Above certain concentrations, however, many of these products may have harmful effects on the land, water, wildlife and humans.

Given that most prairie farmers live on or near the land they farm, it is reasonable to assume that they strive to use farm chemicals wisely. However, much research continues to be devoted to the assessment of chemical use over the long-term. There is currently no information available on the quantity of pesticides used in the ecozone.

To maintain and protect water quality, Manitoba works cooperatively with upstream jurisdictions through various forums such as the Prairie Provinces Water Board and the International Joint Commission.

TOXIC ALGAE IN DOMESTIC WATER

Occasionally, blue-green algae containing potent toxins appear in nutrient-rich dugouts and lakes in southern Manitoba. A recent study conducted by Manitoba Environment on rural water quality discovered that the extent of toxic algae is more widespread than previously thought.

There are two main classes of blue-green algal toxins. Neurotoxins (nerve toxins) attack the central nervous system and can be fatal. Hepatotoxins (liver toxins) can damage the liver and may cause death in some cases.

Despite the lethal potential of these toxins, there have been few cases of acute poisoning in humans. Animal deaths have been more common since algal blooms tend to occur in nutrient-enriched water near fertilized land, stock yards, pastures and municipal sewage discharge sites.

- In June 1996, a livestock producer in Baldur, Manitoba lost 16 cattle and his dog after they watered in an impoundment area. Samples showed the presence of algae known to produce nerve toxins.
- Also in 1996, Killarney Lake experienced a massive bloom of blue-green algae. Beach areas were posted with signs that advised against swimming.
- In September 1996, the highest reported levels of liver toxins in Canada — 300 micrograms per litre were found in water samples collected from Victoria Beach.
- Beaches were also posted along Dauphin Lake when two dogs died after drinking lake water. Neurotoxins were suspected to be responsible for the animal deaths.

Blue-green algae toxins cannot be detected by a change in the colour or taste of water, nor do they correlate with the total amount of algae present. Sometimes wind and waves concentrate algal blooms along shorelines. This can create problems for cottage owners and municipalities who have intake lines located near the shore.

Historically, the most common remedy for algal blooms was to add copper sulphate ($CuSO_4$), generally known as bluestone, to the water supply. However, in the case of blue-green algae, the use of bluestone can pose problems. Bluestone kills the algae and releases the toxins directly into the water.

Manitoba Study Yields New Data

In 1995, Manitoba Environment initiated a two-year study on toxic algae and rural water quality, with partial funding from Canada-Manitoba Agreement on Agricultural Sustainability (CMAAS). In 1995, 70% of municipal water supplies had detectable levels of liver toxins. Existing treatment systems removed only a small amount of the toxins present.

Data suggest the exposure period for algal toxins may be up to six months or longer. Also, the toxins appear to be extremely stable. Boiling does not remove them.

The best way to prevent blue-green algal blooms is to restore shoreline habitats that filter nutrients before they can reach the water. Livestock access to water sources should be controlled. This can help to prevent the serious economic losses producers experience when livestock are lost after drinking toxic water.

The use of nose pumps for livestock watering allows livestock to obtain water, while limiting their access to watercourses.

TREND SYMBOLS

▲ **Improvement** ▼ **Decline** 〓 **Steady** ?? **Trend unclear** ○ **Insufficient data**

FERTILIZER APPLICATION RATES

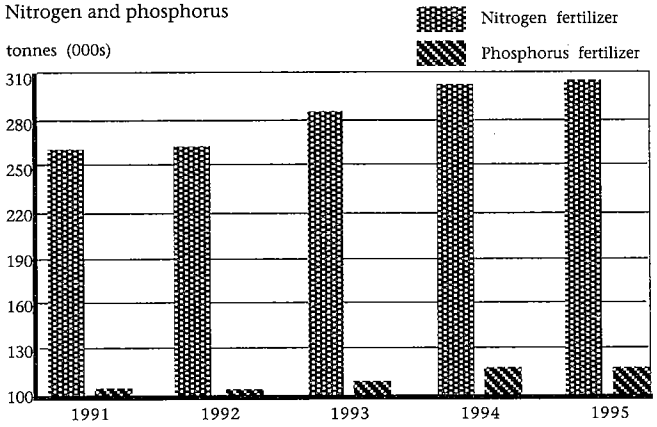
While fertilizers are important to agricultural production, they can leach into surface and groundwater sources. In water, they increase nutrient content to levels that are stressful for both humans and animals.

The data presented are for total nitrogen and phosphorus fertilizer applications in Manitoba, shown in 1,000 tonnes per year.

Figure 2.14

FERTILIZER APPLICATION

Nitrogen and phosphorus



Source: Manitoba Agriculture

TREND: ??

Fertilizer application has increased since 1991, except for 1995. It is still too early to determine whether the slowdown was a temporary or more permanent phenomenon.

Implications For Sustainable Development

Whether fertilizer use can be sustained at current levels depends on measuring its economic benefits against public and ecological concerns about its negative impact on the environment.

Given the loss of nutrients from soil through the removal of crops and crop residue, some form of fertilization is necessary. Increasing the sustainability of fertilizer application could mean decreasing the rate of fertilizer loss through leaching, and a corresponding increase in the proportion of fertilizer actually contributing to plant growth. Solutions with such results would not only have clear environmental benefits, but would also improve the financial bottom line of producers.

MANITOBA'S HOG INDUSTRY — STRIVING TO FARM IN HARMONY WITH THE ENVIRONMENT

Pork is an important food item in many Asian countries and Manitoba is now stepping up production to meet world demand. Hong Kong, Taiwan, Korea and Japan are the primary focus for future marketing efforts. Currently, more than 80% of Manitoba pork is sold to customers outside the province, most of whom are in the United States.

In November 1996, the Manitoba government and the hog industry formally launched the Manitoba Pork Advantage. This hog production and marketing program highlights the economic advantages of producing high quality pork for the global marketplace. Its main objective is to increase export sales and investments in the industry.[46]

More than 1,600 hog farmers in Manitoba produce some three million animals per year. About 13,000 people are employed in all aspects of production, transportation, processing and distribution. From 1991 to 1995, the value of exports jumped from $29 million to $82 million. Overall, the industry contributes $1.25 billion to the provincial economy.

With the growth in the hog industry, there is some concern over manure management. One specific concern relates to the impact on surface water quality when hog manure is applied to snow-covered fields. It has been uncertain whether manure applied over snow stays on the fields or is flushed into ditches and streams by spring runoff.

Manure Management Practices Studied

Manitoba Environment conducted a study in the Interlake region during the spring of 1996 to determine if residues from hog manure were moving off fields with spring runoff. Bacteria did not seem to be a concern since all values were very low (2 - 3 organisms/100 ml).

However, there were fairly high concentrations of nutrients (nitrogen and phosphorus) from fields with manure applications compared to fields with no manure applications. There were also statistically significant increases of nutrients in drainage ditches immediately downstream of these fields. The runoff volumes from study fields were relatively small compared to the overall runoff volume for the watershed area. The increased nutrient concentrations were diluted substantially as the runoff moved farther away from study fields.

The study indicated that fairly substantial contributions of nutrients were also coming from other sources in the watershed.

Manure Management Studies Under Way in Brandon

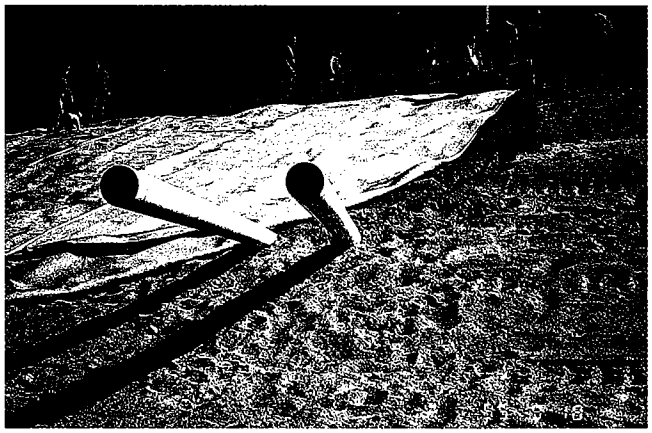
To evaluate hog waste management trends, a major new research project is now under way at the Brandon Research Centre of Agriculture and Agri-Food Canada. Findings will contribute to the development of environmentally sustainable manure management throughout the Prairie ecozone.[1]

Many Manitoba hog producers are already implementing effective manure management procedures on their farms. One example is the manure "injection" method to fertilize fields. Injection ensures manure nutrients are well-utilized by the soil.

Environmental Stewardship Initiatives

Several environmental stewardship initiatives have been put into place by the Manitoba Government in cooperation with Manitoba Pork. Initiatives have also been undertaken by associations of hog producers both provincially and nationally. These include:

- Farm Practices Guidelines for Hog Producers in Manitoba. The guidelines provide information on acceptable ways of controlling nuisance farm odours, storing and managing manure and disposing of livestock carcasses.
- The Livestock Waste Regulation under The Environment Act has provisions to prevent livestock operations from polluting the environment. At the time of printing, this regulation was under review.
- Canadian Code of Practice for Environmentally Sound Hog Production. The Canadian Pork Council developed the code in concert with its provincial associations to promote environmentally sound farming practices.
- Environmental Stewardship Program. The thrust of this new program, developed by Manitoba Pork, is to promote sustainable farming practices and enhance the image of manure as a valuable organic fertilizer.



Construction of a manure storage lagoon.

TREND SYMBOLS
▲ **Improvement** ▼ **Decline** 〓 **Steady** ?? **Trend unclear** ○ **Insufficient data**

WATER QUANTITY

The security of water supply is a critical issue for the Prairie ecozone. Most of the ecozone's water is spring runoff from melting snow and it flows out of the ecozone without being used for community and industrial requirements. In the Prairie ecozone, the agricultural sector is the largest consumer of water mainly through irrigation and food processing.

Communities obtain water from both surface and groundwater sources. Most farm families depend on groundwater, although many rural residents of the Red River Valley haul their water from other centres. Increasingly, rural residents are able to take advantage of expanding rural pipeline systems that service small communities and individual farms.

Future Depends on Secure Water Sources

With agricultural processing and irrigation sectors experiencing rapid growth, the allocation of water in the region will become the focus of significant public policy attention in the very near future.

The Manitoba government, through the water rights licensing system, is responsible for allocating the use of water resources within the province. The water rights licensing system operates under the legal authority of The Water Rights Act. The Water Rights Act establishes the priorities of allocating Manitoba's water resources. In allocating water, the provincial government must ensure that the rate of use does not exceed the natural recovery rate of the supply.[75] Domestic usage is given the highest priority, followed by municipal, agricultural, industrial and irrigation uses. Other uses, such as maintenance of natural ecosystems, recreation and waste assimilation are also important. A water rights licence establishes the legal right to use a prescribed amount of water over a specified time. The Water Rights Act is currently under review.

Data on stream flows are available at various points throughout the Prairie ecozone. Detailed consumption figures are also monitored for municipal, commercial and industrial usage. There are major gaps regarding irrigation water use, the largest user of surface and groundwater in Manitoba, but these gaps are being addressed through an extensive water use monitoring program to be managed by the Water Resources Branch of Manitoba Natural Resources.

Ideally, a regional water budget or balance would be the predominant indicator of the sustainability of the Prairie ecozone's water supply. Similar to a cash flow budget, a water budget could include reserves and intakes on one side and outflows, losses and consumption the other. Using water faster than it can be replenished means "drawing down" on reserves. Using water wisely means the resource can be sustained.

Assiniboine River Used As Proxy

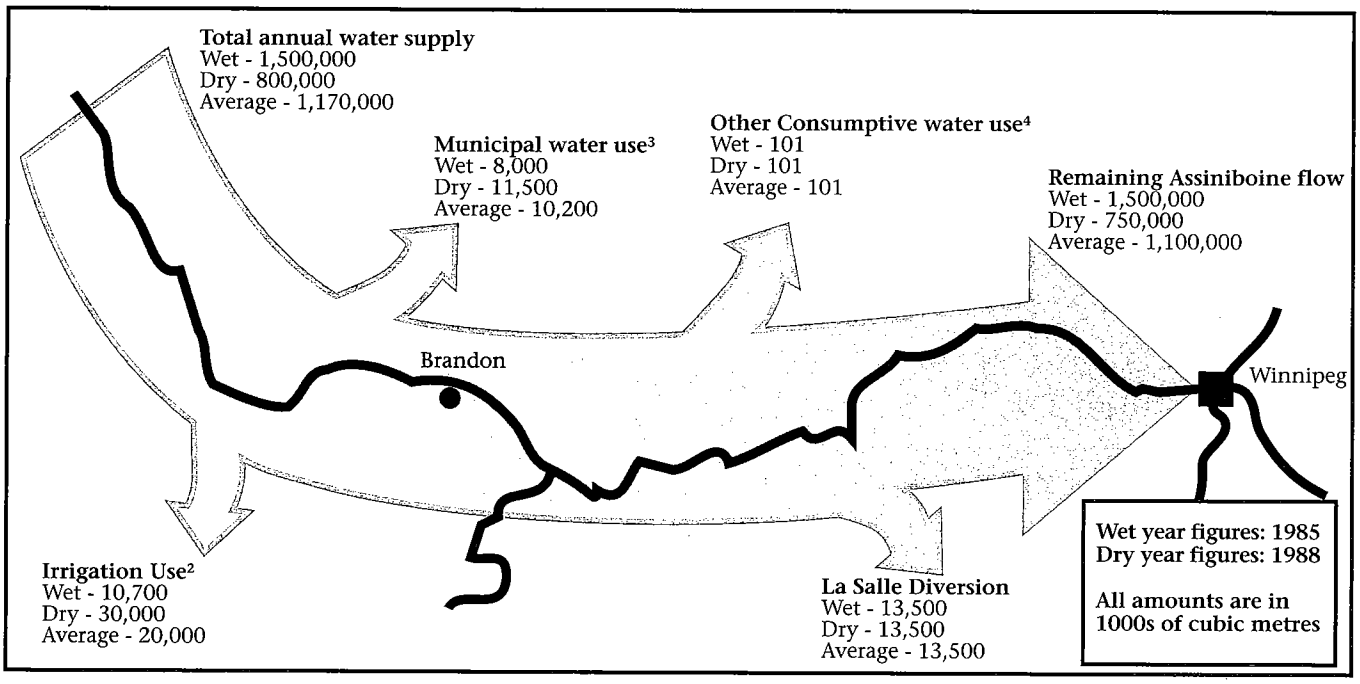
Rigorous monitoring and modeling have been carried out for the Assiniboine River system because it is the most heavily used water source within the prairie region. The Assiniboine River serves as a baseline for evaluating the sustainability of water supplies up to 1991. Estimates beyond this are being refined with the assistance of the Assiniboine River Management Advisory Board. Given the importance of water to the region, it is reasonable to expect future monitoring efforts to increase.

Annual and seasonal variations in water flows are also significant to compare the possible range of flows in the Assiniboine River from year to year. Figure 2.15 represents the total annual flows and the various uses for Assiniboine River water during wet, dry and average years. Of note is the tremendous impact of irrigation during a dry year. Estimated irrigation volumes are triple those of a wet year.

When using the pre-1991 Assiniboine River data to represent the entire ecozone, annual figures have limited use since river flows change dramatically on a seasonal basis. Minimum flows required to maintain a healthy river system are not yet known. They have been estimated to be in the range of 5.66 cubic metres per second (m3/s). During August 1989, flows on the Assiniboine River near Winnipeg dropped to 4.72m3/s.

Example of irrigation equipment.

Figure 2.15
WET, DRY, AND AVERAGE YEAR WATER SUPPLY CONDITIONS[1] AND ESTIMATED ANNUAL USE
on the Assiniboine River



Source: Manitoba Natural Resources, 1996

All amounts are approximate.

[1] Net local flows (local runoff - local use - evaporation is included).

[2] Potential volume for irrigation, according to the number of licensed operators.

[3] Includes the cities of Brandon and Portage la Prairie only.

[4] Includes various industrial, commercial, and agricultural usage outside of Brandon and Portage la Prairie.

TREND: ○

There is insufficient information to determine a long-term trend for water availability. Monitoring and protecting priority water uses will be necessary to balance water allocation with availability.

However, Manitoba Natural Resources reports a 36% increase in irrigated land from 1991 to 1994. In 1991, 15,072 hectares of land in Manitoba were irrigated compared to 20,504 hectares in 1994. The amount of irrigated land is expected to continue to increase.

Implications For Sustainable Development

Irrigation is increasing due to growth within the vegetable processing industry, especially potatoes. The food processing sector may have other impacts such as increased stress on the sewage treatment infrastructure of communities in the ecozone.

Meeting the increasing demands from irrigation and food processing will be a major challenge. The agri-industry's opportunity for local wealth creation through value-added production will create significant pressure to use water efficiently, to protect its quality and to store excess water during high runoff periods.

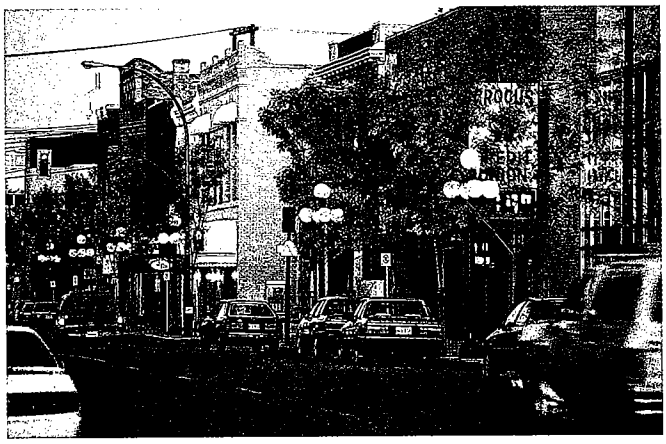
Manitoba Natural Resources reports that, among communities of more than 1,000 people, only Carman has experienced problems with water quantity between 1991 and 1995. In fact, a related indicator — water quality — may be more indicative of a problem. Often, when supplies drop, quality concerns arise. Information from Manitoba Environment indicates that nine communities of more than 1,000 people experienced water quality problems during the same time period.

TREND SYMBOLS
▲ **Improvement** ▼ **Decline** 〓 **Steady** ?? **Trend unclear** ○ **Insufficient data**

AIR QUALITY

Manitobans living in rural areas of the Prairies enjoy clean air year round because of low population densities, relatively few emission sources and a topography that favours the dispersion of pollutants. Only in Brandon and Winnipeg is air quality monitored on a regular basis. Here, transportation-related emissions have the potential to cause air pollution. *(see p. 86 for information on the Air Quality Index).*

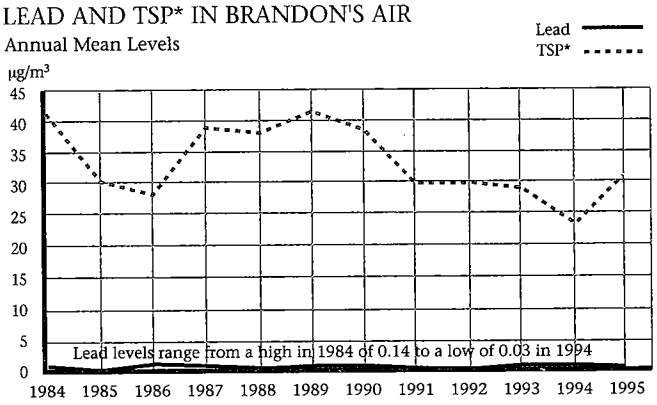
The monitoring program in Brandon covers four key pollutants: nitrogen dioxide (NO_2), ground level ozone (O_3), total suspended particulate (TSP) and lead.



Downtown Brandon

Figure 2.16

LEAD AND TSP* IN BRANDON'S AIR

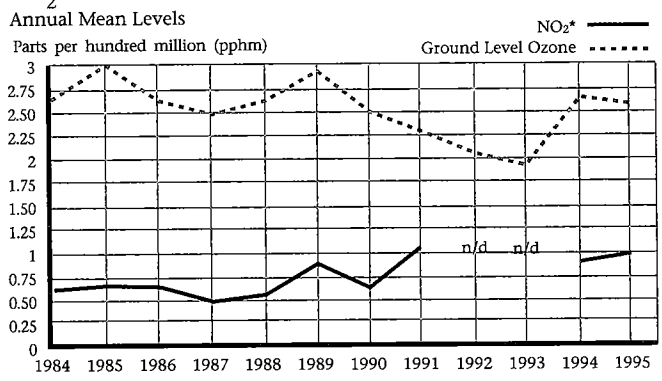


Source: Manitoba Environment

**TSP = Total Suspended Particulates*

Figure 2.17

NO_2* AND GROUND LEVEL OZONE IN BRANDON'S AIR



Source: Manitoba Environment

**NO_2 = Nitrogen Dioxide*
n.d. = no data

TREND: 〓

Generally, ambient air quality throughout Manitoba's Prairies is excellent. There are isolated and seasonal air quality problems that may affect people highly sensitive to air quality.

Implications For Sustainable Development

Localized concerns about air quality do exist. The projected increase in hog operations has the potential to create nuisance odour problems.

A regulation was enacted in 1993 to control the practice of stubble burning. This resulted in significant improvements in air quality and minimized the impacts of smoke on personal health and safety. However, stubble burning continues to cause seasonal problems for some people.

Based on Canadian statistics, on a per capita basis, Manitobans contribute more transportation and energy-related air pollution than citizens of many other countries of the world. Nitrogen oxides and carbon dioxide are two of the transportation-related gases that contribute to global climate change.

Although the large distances in the prairies will never shrink, people can make positive changes. Alternative fuels, such as ethanol or natural gas, or technological innovations permitting distance work are examples where changes in lifestyle and consumption can make a difference. *(see related story on climate change, p. 85).*

STRATOSPHERIC OZONE

Since the mid-1970s, the condition of the stratospheric (upper atmosphere) ozone layer protecting the earth from the harmful ultraviolet (UV-B) rays of the sun has been used as a key indicator of global environmental quality. Unlike ground-level ozone, which is a major air pollutant, stratospheric ozone is a key part of the Earth's atmosphere that needs to be preserved.

Stratospheric ozone undergoes an expansion and reduction cycle every year. In the late 1980s, public concern about ozone depletion peaked as ozone over Antarctica dropped to zero during the reduction phase in late winter. A smaller ozone hole has been observed during the last few years over the northern polar region, gradually extending to high latitudes of North America and Europe.

The chemicals causing the Earth's ozone layer to thin are found in many common household appliances and products. Until the late 1980s, aerosols, propellants and refrigerants typically contained chlorofluorocarbons or CFCs. Once released into the atmosphere, these chemicals cause an irreversible long-term reaction with stratospheric ozone causing it to break apart and form other compounds.

Increased incidence of skin cancer (estimated at a 2% increase for every 1% decrease in total stratospheric ozone) and damage to crops and wildlife are all potential impacts of increased ultraviolet radiation. Scientists have also raised concerns about increased human eye disease and suppression of the human immune system from increased exposure to UV radiation.

Collecting Data for Local Analysis

Environment Canada conducts some of the most comprehensive and accurate stratospheric ozone level monitoring in the world. This monitoring is done by a ground-based instrument called a Brewer ozone spectrophotometer. A number of the 12 monitoring stations, which comprise the Canadian stratospheric ozone network, have data going back to the late 1950s. Three of these stations are located on the Prairies: Winnipeg, Saskatoon and Edmonton.

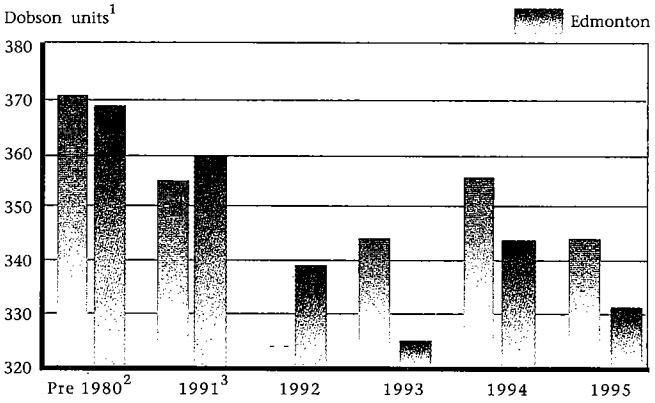
Unfortunately, Winnipeg's and Saskatoon's monitoring stations, which can provide data directly applicable to the Manitoba Prairie ecozone, do not have a lengthy data record. However, a good approximation of what the local atmosphere was like before ozone reduction is available using satellite data from the United States. The third monitoring site on the Prairies, Edmonton, does have a long-term, high-quality data record.

Stratospheric ozone levels were used in assessing trends within the Prairie ecozone because of the availability and quality of data. Trends in UV-B radiation are more difficult to discern given the extreme variability of data. The variability is caused primarily by climatic effects including clouds, and natural and human-caused atmospheric effects such as dust. Data history at the Winnipeg site was analysed as the primary source of Prairie ecozone data. This was compared to information from Edmonton. The Winnipeg data are a combination of pre-1980 estimates and measurements conducted since July 1992. Edmonton offers data from 1957 and is a solid check for accuracy at Winnipeg.

Figure 2.18

STRATOSPHERIC OZONE LEVELS

2nd quarter averages measured at Winnipeg and Edmonton



Source: Environment Canada, 1996

1. An estimate of total ozone within the stratosphere in a column above the measuring station.

2.Calculated using US. satellite data as reported in Beattie, B. and K. Keddy, 1995. Pre 1980 Ultraviolet Index Climatology for Canadian Locations, Environment Canada.

3. 1978-1991 Average total ozone (calculated from US. satellite measurements) as reported in Burrows, W.R. et al, 1992. Climatology of Daily Total Ozone and UV-B Radiation Levels, Environment Canada.

TREND: ▼

Analysis of the Winnipeg data reveals that levels of stratospheric ozone are decreasing, especially during the first several months of the year. Ozone measurements are affected by climatic conditions and local weather so there may be significant variations from year to year. Consequently, a five-year analysis is somewhat limited.

A significant decreasing trend is evident during May and June, with levels during the next three months being steady. Slight increases occur during October and November. Using the more accurate Edmonton measurements, with a similar decrease occurring during January and February with obvious drops occurring over the following four months. The remainder of the year is steady.

It can thus be assumed that the trends observed at Winnipeg are accurate.

Implications For Sustainable Development

Because of its potential impacts, stratospheric ozone depletion should be of major concern to Prairie ecozone residents. The long-term impacts of increased UV-B radiation on the growth cycles of commercial crops are not known. Increases in the incidence of skin cancer would continue to place costly burdens on the health care system. It is clear that Manitobans alone cannot solve the problem of stratospheric ozone depletion. However, their help in solving this global problem is essential.

TREND SYMBOLS

▲ **Improvement** ▼ **Decline** 〓 **Steady** ?? **Trend unclear** ○ **Insufficient data**

Figure 2.20

LAND USE
For the Prairie Ecozone

Land Use Type	Hectares
Agricultural Cropland	3,957,168
Deciduous Forest (>75%) cover	1,124,098
Water Bodies	980,542
Grassland/Rangeland	1,945,769
Mixed Wood Forest	412,132
Marsh and Fens (Wetlands)	525,574
Bogs	106,457
Treed Rock	6
Coniferous Forest	142,726
Burnt Areas	1,426
Open Deciduous (<50% cover)	511,981
Forage Crops	176,927
Cultural Features	26,359
Forest Cutovers	9,963
Bare Rock, Gravel and Sand	5,325
Roads and Trails	312,660

Source: Manitoba Remote Sensing Centre, Manitoba Natural Resources, 1996

The Manitoba Remote Sensing Centre, of Manitoba Natural Resources provides cloud-free, satellite images of North America on a weekly basis. These images are used for assessing crop patterns, global change, land use practices and land cover.

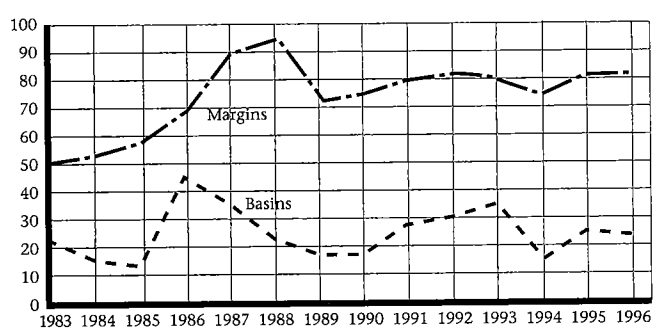
SPECIES AND HABITAT DIVERSITY

Natural diversity is a valuable commodity in the Prairie ecozone. An area with diverse natural resources can respond better to challenges, whether they come from the outside or are imposed internally.

Assessing biological diversity, or biodiversity, is one of the most challenging yet critical issues for sustainable development. The Canadian Biodiversity Strategy (1995) defines biodiversity as "the variety of species and ecosystems on Earth and the ecological processes of which they are a part." Three components of biodiversity are ecosystem, species and genetic diversity.

Figure 2.19

WETLANDS AFFECTED BY AGRICULTURAL ACTIVITIES
In Southwestern Manitoba



Source: Canadian Wildlife Service

Fig. 2.19 refers to the % of wetlands that have been cultivated. In dry years, basins are sometimes cultivated. If the basin is too wet, a farmer may cultivate the margin of the wetland. When water levels return to normal and basins fill up, the margins will still show the effects of previous cultivation for a period of time. That is why the % of margins affected by agricultural activities is higher than the % of basins affected.

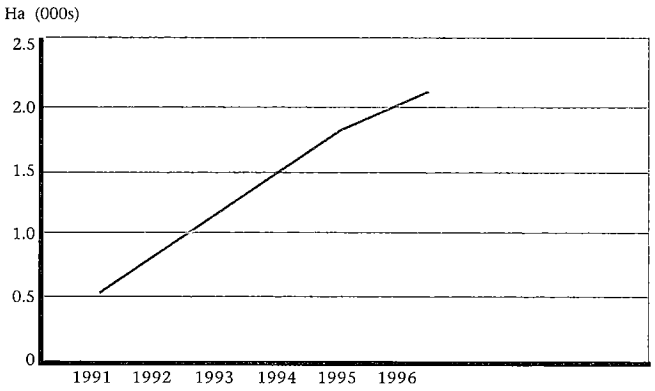
The best measure of biodiversity relates to habitat, the natural environmental requirements for all species native to Manitoba's Prairie ecozone. However, as the original prairie environment has been dramatically altered; only remnants remain where agricultural development has not taken place. The tall-grass prairie environment is virtually gone. Fortunately, some parcels remain in the Manitoba Tall-Grass Prairie Preserve near Tolstoi, which the Critical Wildlife Habitat Program (CWHP) reports has grown from 515 ha. in 1991 to 2,200 ha. in 1996. The preserve is featured on the cover of this report.

Presenting a convincing numerical trend for biological diversity is not possible because of the complexity of the issue and the scarcity of relevant data. Populations of all species are changing continually in response to many factors ranging from weather patterns to land use practices. Most monitoring efforts involve wildlife species of economic value, such as waterfowl. In Manitoba, the Conservation Data Centre serves as the repository of conservation-related information.

Biodiversity can be assessed indirectly by examining the population trends of species that are sensitive to environmental stresses. They may serve as standards for the broader ecosystem. However, the choice of these species and the interpretation of their population changes is very difficult, and what their population levels mean for entire ecosystems is under discussion.

Figure 2.21

TALL-GRASS PRAIRIE
Preserve size



Source: CWHP, 1996

Burrowing owl

Figure 2.22

ENDANGERED & THREATENED SPECIES
In Manitoba

Endangered Species	**Population: 1991 - 1995**
Baird's Sparrow	Has declined from 290 to 97 nesting pairs in 1994. Populations tend to fluctuate in relation to drought years.
Burrowing Owl	Has declined from 23 to 4 nesting pairs.
Loggerhead Shrike	Has declined from 246 to 147 nesting pairs.
Peregrine Falcon	Has shown a moderate increase from 1 to 4 nesting pairs in the urban areas of Manitoba.
Piping Plover	Declined from 80 to 66 in 1993, but has since increased to 82 nesting pairs.
Small White Lady's Slipper	Has shown a modest population increase from 2,437 in 1993 to 13,721, as new sites have been located and documented.
Western Prairie Fringed Orchid	Populations fluctuate widely from 418 in 1992, to 9,115 in 1994, and down to 1,818 in 1995. Continues to exist in a very restricted range in southeastern Manitoba.
Whooping Crane	Has experienced a slow and steady population increase in North America. Occurs as a non-breeding migrant in Manitoba.
Threatened Species	
Ferruginous Hawk	Manitoba populations have been stable over the past 5 years at about 45 nesting pairs.
Western Spiderwort	Has exhibited a modest population increase over the past 5 years in Manitoba, partly as the result of a new site being located.

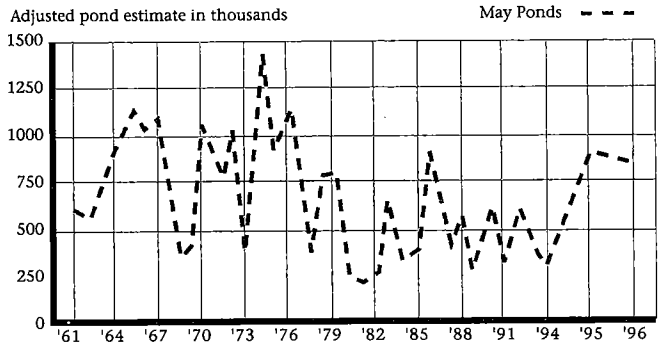
Source: Manitoba Natural Resources

Endangered and threatened species are designated under The Manitoba Endangered Species Act. Most of Manitoba's endangered and threatened species are found in the Prairie ecozone, except for the whooping crane, which is found mostly in the Boreal Plains ecozone.

TREND SYMBOLS
▲ **Improvement** ▼ **Decline** ▬ **Steady** ?? **Trend unclear** ○ **Insufficient data**

Figure 2.23

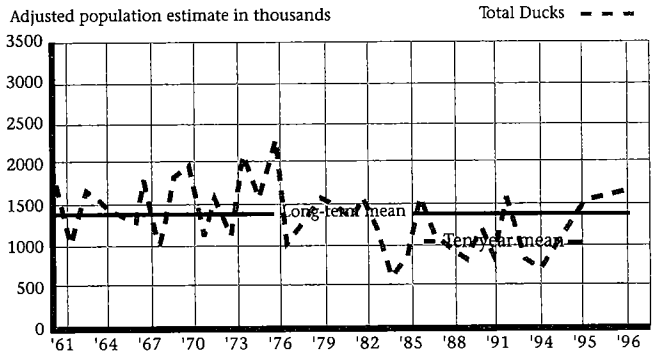
MAY POND COUNTS
In Southern Manitoba



Source: Canadian Wildlife Service

Figure 2.24

DUCKS IN SOUTHERN MANITOBA
Total Ducks



Source: Eastern Prairie Population, Mississippi Flyway Report, 1996.

May Ponds

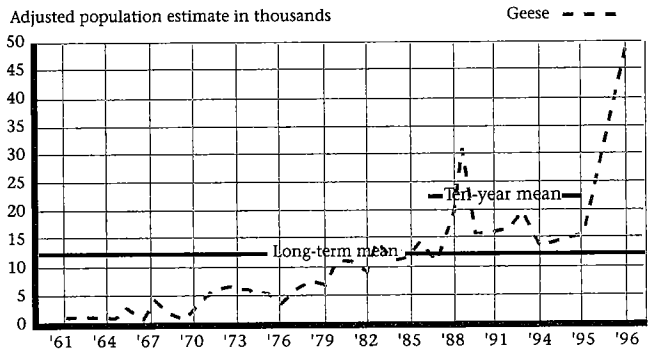
May ponds are counted in May of each year during the North American Waterfowl Breeding Pair Survey conducted in the Prairie ecozone. May ponds contain water anywhere from three weeks to a year. Some of these basins have maintained water through extended periods of drought.

Figure 2.23 illustrates the trend in the number of ponds from 1961 to 1996. Water conditions were excellent in the spring of 1996. The 1996 estimate of May ponds, the third highest estimate since 1976, was marginally below the 1995 estimate, but exceeded 10-year and long-term means. The area or size of the surveyed ponds is not available; only the number of ponds are recorded. Ponds are not counted in the Manitoba's other ecozones.

The number of May ponds in the Prairie ecozone does not reflect the percentage of wetlands that are affected by agricultural activities on a year-round basis. *(see Fig. 2.20).*

Figure 2.25

CANADA GEESE
In Southern Manitoba



Source: Eastern Prairie Population, Mississippi Flyway Report, 1996.

TREND: ○

Looking at population trends for endangered and threatened species presents a mixed picture. Some populations are recovering while others are in decline *(see Fig. 2.22)*. It is not possible to form a clear conclusion about biological diversity using this information. *(see related story, p. 126)*.

Given the enormous technical difficulties of counting species or populations, information on habitat availability is the best complementary resource for assessing biological diversity. Waterfowl habitat, especially ponds and potholes, is well documented because of the importance of these species to landowners and hunters. The number of ponds changes seasonally and is higher after snow melt. To avoid seasonal fluctuation, the indicator measures the number of ponds in May of every year.

In 1996, May ponds were 28% higher than the long-term average. The duck population in southern Manitoba was greater than in 1995 (+9%), greater than the 10-year average (+41%) and greater than the long-term average (+7%). Spring Canada goose populations were the highest on record and populations appear to be increasing in both southern and northern Manitoba. *(see also, p. 129)*.

Burrowing Owl in Decline

Despite reintroduction efforts and protection of nesting sites, the population of the burrowing owl continues to decline. In *The State of the Environment Report for Manitoba 1995*, the 1993 population was reported to be fewer than 28 nesting pairs.[39] The 1995 population was estimated to be only four nesting pairs - a dramatic decline from the 110 pairs reported to have nested in southern Manitoba in 1978.

The decline in burrowing owls has been attributed to habitat loss, inadvertent poisoning by carbofuran, (an insecticide to control grasshoppers) and losses due to other animals and motor vehicles.

Controls have been placed on the use of carbofuran near nesting sites. But with low breeding rates and continued high mortality, both in the Canadian breeding ground and possibly on migration and during winter, the outlook for this small owl is not encouraging.[30]

Implications For Sustainable Development

Living species not only provide the genetic basis for improved crop varieties or new medicines, but they also fulfil essential ecosystem functions, which are essential to human existence. Conservation practices and preserving natural landscapes are important strategies to protect and enhance biodiversity. *(see also, Natural Lands and Special Places, p. 118-123)*.

Earlier this century, maintaining biological diversity was not considered important. Today, zero-tillage, wildlife corridors, grassed waterways and other practices meet economic as well as conservation objectives for landowners.

The North American Waterfowl Management Plan (NAWMP), CWHP, the Prairie Habitat Joint Venture (PHJV), and many other initiatives help farmers manage the land to increase wildlife habitat and species diversity.

CRITICAL WILDLIFE HABITAT PROGRAM

The focus of the Critical Wildlife Habitat Program (CWHP) has been to identify, preserve and manage Manitoba's flora and fauna. CWHP places particular emphasis on protecting rare and endangered species, the prairie landscape and remaining natural habitats.

CWHP activities have been concentrated in the grassland and parkland regions of Manitoba where the majority of the land is privately owned. The program demonstrates integrated land management and complements other conservation programs. CWHP has created Canada's largest tallgrass prairie preserve by protecting over 2,200 hectares through land acquisition and leasing. Land management techniques focus on enhancing native grasslands. Also, the economic benefits of cooperative grazing have been demonstrated to producers throughout Manitoba.

Increased involvement by landowners and local governments is vital to conserving habitat on private land. Valuable information on wildlife-friendly land use alternatives is being presented to municipal governments and planning districts. The adoption of these alternatives will preserve habitat, maintain natural biodiversity and protect rare species.

A Guide to Conservation Programs and Funding

In 1996, CWHP produced the Land Stewardship Directory: A Guide to Conservation Programs and Funding Sources in Manitoba. It contains the latest information about conservation programs and various funding sources. It has become a handy reference for landowners, municipal representatives and conservation staff because it includes information about where programs are available, what types of projects are supported and who to contact in each area.

CWHP recognizes the efforts of various agencies working to protect wildlife habitat in the Prairie ecozone. Various resource inventories conducted by the program have helped to focus future efforts toward the most vulnerable areas. Also, they have provided resource users and municipal councils with information on existing habitats to assist in land use planning.

Critical
Wildlife Habitat Program

TREND SYMBOLS
▲ **Improvement** ▼ **Decline** 〓 **Steady** ?? **Trend unclear** ○ **Insufficient data**

INTEGRATED CONSERVATION PROGRAMS

While many conservation programs focus on soil erosion, others focus on a wide range of wildlife, fisheries and vegetation-related initiatives. These programs incorporate payments to individual landowners and have a substantial economic impact on rural communities. *(see related story, p.47)*

In many areas, conservation districts serve as a local coordinating body for these and many other integrated conservation programs. They also ensure program delivery, using their extensive network of local landowners.

The most significant conservation program in the ecozone is the Prairie Habitat Joint Venture (PHJV) of the North American Waterfowl Management Plan (NAWMP). Since its inception in 1986, NAWMP has developed into a continent-wide effort to restore and conserve waterfowl habitat and promote habitat management through education and research. Canada, the United States and Mexico cooperate in conserving habitat most critical to the migratory needs of waterfowl. With their millions of hectares of wetlands, Canada's three Prairie provinces constitute the largest and most important of NAWMP's 32 joint venture regions.

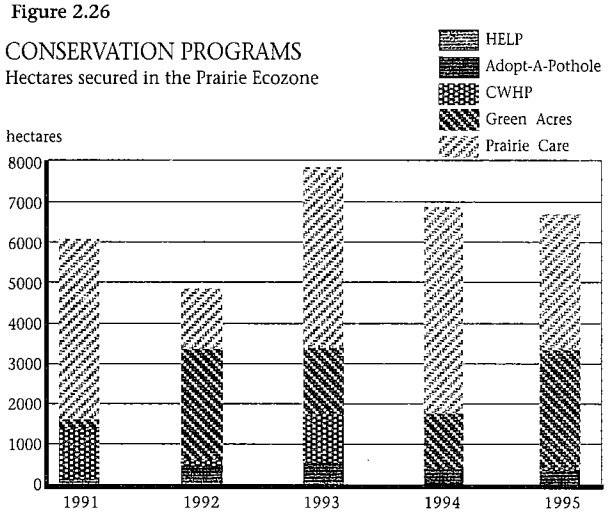
PHJV is coordinated by the Manitoba Habitat Heritage Corporation (MHHC). Manitoba's NAWMP partners are: Agriculture Canada (PFRA), Delta Waterfowl Foundation, Ducks Unlimited Canada, Environment Canada, Manitoba Agriculture, Manitoba Natural Resources, Wildlife Habitat Canada and Manitoba's conservation districts. *(see related story, p.69)*

TREND: =

Most conservation programs have remained steady during the 1991-94 period. Steady program delivery is also a sign of progress since many of these initiatives have been in place since the mid-1980s or earlier. The Habitat Enhancement Land Use Program (HELP) has ended. Prairie Care and Adopt-A-Pothole have remained the same.

Another conservation program is delivered through Manitoba Agriculture and PFRA under the Canada-Manitoba Agreement on Agricultural Sustainability (CMAAS). It involves a wide range of conservation initiatives that can maintain or improve habitat. On example is the fencing of sensitive waterways and shorelines (riparian areas) to protect their banks from the destructive effects of intensive livestock farming. Since 1993, 177 kilometres of riparian areas within the Manitoba Prairie ecozone have been fenced, with the active participation of 180 landowners.

Figure 2.26



Sources: Manitoba Habitat Heritage Corporation, Delta Waterfowl Foundation, Ducks Unlimited, Prairie Farm Rehabilitation Administration, 1996.

Leases totaling 4,373 ha, originally secured under the Habitat Enhancement Land Use Program, expired on September 30, 1995. This concluded MHHC's lease management responsibilities. Most of the conservation options once offered under HELP are now being offered through NAWMP.

Adopt-a-Pothole is a NAWMP program of the Delta Waterfowl Foundation, through which landowners are paid not to use portions of their land for agricultural purposes. The leased land increases the waterfowl habitat available.

CWHP operates with seven wildlife organizations to identify, preserve and manage Manitoba's flora and fauna. Particular emphasis is given to rare and endangered species and natural prairie habitat. Prairie lands are priority targets for acquisition.

Green Acres is MHHC's field delivery program for NAWMP. Efforts include land lease and purchase, a waterfowl nest tunnel program, a small dams program, conservation demonstrations and communications.

Ducks Unlimited Canada's Manitoba Prairie CARE is a NAWMP program that promotes land use changes that preserve wetlands, improve upland ground cover, and ultimately benefit both farmers and waterfowl. Financial assistance is paid directly to producers for implementing planned grazing systems, delaying haying and leasing land parcels for nesting cover.

Implications For Sustainable Development

These conservation programs are key indicators of sustainability within the Prairie ecozone because they:

- bring diverse partners together to solve long-standing concerns
- link a variety of agricultural soil and water conservation activities
- provide valuable economic contributions to landowners and communities
- involve public and private sector participation in conserving sensitive wildlife habitat

ECONOMIC TRENDS

Economic indicators have existed since the introduction of currency. They measure economic stability and growth as well as provide baseline tools for financial forecasting and comparisons of the costs and benefits of any initiative. The economy provides the financial base for livelihoods, but it also needs to enrich community life and ensure careful use of environmental assets in order to ensure sustainable development.

Areas of economic interest in the Prairie ecozone include production and infrastructure, trade, agriculture, employment, and consumption. The "economic base" is a combination of all these components.

The types of production and the availability of infrastructure indicate the diversity of the economic base and the potential for further development. Three major areas contribute to the well-being of the economy and its supporting infrastructure. These are production, trade and energy supply.

In-depth consideration of these issues is neither possible nor useful for this report. This is due to the detailed nature of these broad economic issues and the fact that only province-wide, rather than Prairie ecozone, data are available. However, the implications of these and other large scale economic forces emerge throughout the focus chapter.

Figure 2.27 introduce s the most relevant aspects of production in Manitoba that are directly applicable to the Prairie ecozone.

FROM STRAW TO GOLD

In conventional grain farming, straw left over after combining is often incorporated back into the soil as a means of maintaining organic matter levels. In years of excessive straw production, or in heavy soils where incorporation is difficult (e.g. in the Red River Valley), burning straw or stubble has been a common management practice.

Until three years ago, during late fall evenings, stubble burning caused serious problems for many residents of the Red River Valley, particularly those suffering from asthma. Today, regulations guide the burning of waste straw and burning is restricted to daylight hours and is only allowed when atmospheric conditions are suitable for the proper dispersion of smoke.

Creative approaches for addressing the issue of excess straw on fields are now emerging, including the development of the world's first major strawboard manufacturing plant at Elie, Manitoba.

Isobord Enterprises to Produce Particle Board

Isobord Enterprises Inc. will produce particle board from cereal straw and a nontoxic bonding agent. The product will be free of urea formaldehyde, a major barrier to previous strawboard manufacturing efforts.

The strawboard will be ideal for kitchen countertops, mobile home decking, ready-to-assemble furniture, moulded parts and laminated flooring.

About 80% of Isobord's production has been pre-sold to large manufacturers in the United States. These manufacturers include Sauder Woodworking of Ohio, the largest ready-to-assemble furniture producer in North America, and VT Industries of Iowa, a major kitchen countertop supplier.

Isobord will employ about 100 permanent staff and 100 individuals contracted to collect straw each fall. More than 350 local farmers have formed the Straw Co-op of Manitoba to supply the 200,000 tonnes of straw required annually. Collecting and transporting the straw will create a new industry that is expected to inject $6 million into the economy each year. Isobord is expected to spend about $30 million per year in operating expenses alone.

TREND SYMBOLS

▲ **Improvement** ▼ **Decline** 〓 **Steady** ?? **Trend unclear** ○ **Insufficient data**

GROSS DOMESTIC PRODUCT (GDP) BY INDUSTRY

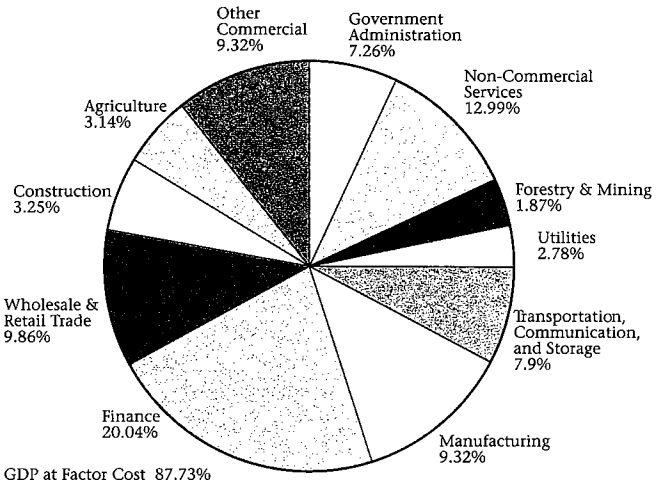
GDP represents the total economic value of products produced within a given jurisdiction. Analysing production on a sector by sector basis provides an outline of a region's natural and human resources. It also indicates the diversity of an economy.

A more mature economy will be characterized by a mix of primary production (agriculture, forestry and mining), value-added production (manufacturing) and the provision of a wide variety of services. A developing economy is often characterized by primary production alone. Adding value through secondary production characterizes the process of wealth creation and greater economic integration.

Production is determined by five factors: consumer demand, natural resources, human resources, the cost of these resources and the transportation costs of moving products to export markets. Given that some of these factors, especially some aspects of human and natural resources, do not have a market price attached to them, the GDP is an incomplete measure of sustainable development. Although it does tell us about economic activity, it does not place values on important environmental and social assets. This is why GDP figures need to be complemented with other indicators for a comprehensive picture.

Figure 2.27

GROSS DOMESTIC PRODUCT (GDP), BY INDUSTRY



GDP at Factor Cost 87.73%
Indirect Taxes - Subsidies 12.27%

Source: Manitoba Bureau of Statistics

Figure 2.28

VALUE OF IMPORTS AND EXPORTS
For Manitoba Sector: 1991-1995 ($000,000)

Year		1991	1992	1993	1994	1995
Agriculture	Imports	98.3	108.0	129.0	144.4	160.3
	Exports	1,190.3	1,266.8	1,205.6	1,369.9	1,465.2
Forestry	Imports	1.8	0.5	1.2	2.5	2.4
	Exports	0.2	0.2	0.2	0.3	0.2
Fishing, Hunting	Imports	4.1	7.0	7.7	11.4	10.8
and Trapping	Exports	9.0	6.9	5.8	6.6	7.2
Mining	Imports	45.6	35.9	41.0	55.4	78.5
	Exports	90.9	124.0	138.0	270.9	395.5
Manufacturing	Imports	2,800.0	3,093.2	3,814.9	4,831.3	5,577.5
	Exports	1,517.8	1,859.2	2,041.4	2,564.7	3,157.6
Electric Power	Imports	3.5	0.1	9.7	2.6	1.3
Industry	Exports	57.3	96.2	203.9	280.7	279.9
Wholesale Trade	Imports	9.3	15.3	28.8	32.7	34.4
	Exports	38.1	32.8	33.3	43.9	59.1
Total	Imports	2,962.2	3,260.0	4,032.2	5,080,3	5,865.2
	Exports	2,903.6	3,386.1	3,628.2	4,537.0	5,364.7

Source: Manitoba Bureau of Statistics, June, 1996.

TREND: 〓

Figure 2.27 indicates the contribution by each Manitoba industry to the provincial GDP. When interpreting the data, it is possible to exclude forestry, mining and power generation since these activities are concentrated primarily outside the Prairie ecozone. Since Winnipeg has been excluded from the ecozone for the purpose of this report, a substantial percentage of the government administration, finance and manufacturing industries can be eliminated from the data. Figure 2.28 shows that Manitoba's economy has remained relatively stable over the last five years.

Implications For Sustainable Development

Given a favourable climate with low inflation, low interest rates, and decreasing government deficits, it is fair to assume that a GDP growth rate of 2%-4% will prevail in the short term. Longer term projections would be purely speculative given the short data set and uncertainties related to the Prairie ecozone's export markets.

Future long-term uncertainties may include environmental factors such as climate change or ozone depletion. The impacts of these trends on production are insufficiently understood. Social issues, such as education and health, could hold significant, yet unknown implications for GDP performance.

Not surprisingly, agriculture is an important sector of the prairie economy. In terms of trade, agriculture is even more important, with a very high and positive net balance of trade. Agriculture is a major contributor to wealth creation in the ecozone and province. Falling per capita food production worldwide could mean increasing export opportunities, providing countries in need of food can afford to import it.

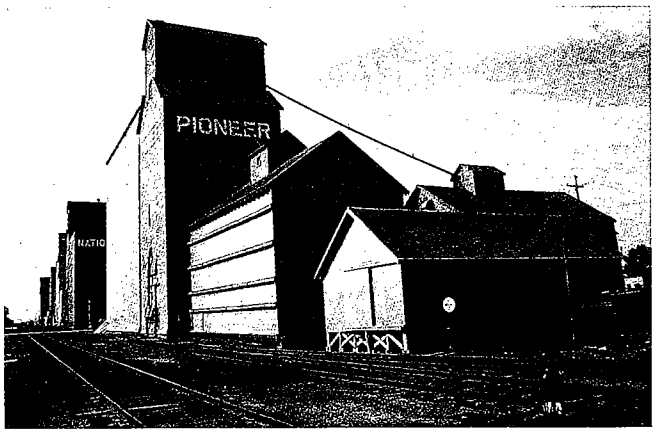
Trade creates mutual interdependence between trading partners. Therefore, it becomes an important consideration for sustainable development in the Prairie ecozone. Given recently signed global (GATT) and regional (NAFTA) trade accords, the implications of trade and sustainable development are expected to grow in importance. The more open the economy is to foreign trade, the more opportunities there are for exports and the greater the need to develop sector competitiveness. At the same time, foreign trade means increased sensitivity to changes in distant markets.

Farming — A Sector in Transition

As the main industry on the Prairies, agriculture has a significant impact on the environment and society. Three issues reviewed in this section on economic trends are agricultural production, farm ownership and farm viability.

The removal of the Crow Rate subsidy is one of the most important factors affecting the future of livestock production in Manitoba. With government support removed, the cost of livestock feed will increase throughout western Canada, as will transportation costs for all grains and oilseeds. This could encourage increased local production in livestock feed. Also, landowners may become more interested in producing livestock than grains and oilseeds, unless more value-added products or facilities are developed.

Substantial amounts of marginal land may be converted to pasture or removed from production entirely. Sustainability of the ecozone would be enhanced through reduced soil erosion and increased wildlife habitat. More value-added livestock processing in the region would provide employment for Manitobans. There are, however, concerns related to increased volumes of livestock wastes.



Values Increase for Livestock and Crops

From 1990-94, the value of livestock increased by 16.8%. During the same period, the value of total crops increased by $405 million, representing a growth rate of 29%. The value of oilseeds doubled. Vegetables increased in value by 51%. Grains and forage seeds decreased in value. On the whole, grain prices have risen, but volumes have declined. Volumes of flax and sunflower seeds have remained stable while their prices have risen. The volume of canola produced has increased considerably.

The most significant changes over the past five years have been the reduction of wheat and the increase in canola grown in the Prairies. To a lesser extent, pulse crops have increased as well. The data suggest that the crop mix is becoming more diversified. Diversity reflects a more sustainable situation for farm production.

Figure 2.29

PRODUCTION VALUE OF LIVESTOCK
In Manitoba - Thousands of dollars

Year	Cattle	Hogs	Lambs and Wool	Dairy	Poultry	Other Livestock	Total
1990	318,500	251,000	1,179	128,459	125,932	2,500	827,570
1991	325,000	248,000	1,168	127,850	118,713	7,400	828,131
1992	349,000	241,000	1,259	123,801	115,072	11,000	841,132
1993	385,000	296,000	1,549	123,787	117,254	15,620	939,210
1994	390,000	303,000	2,049	135,585	119,409	16,580	966,621

Source: Manitoba Agriculture Yearbook 1994.

Figure 2.30

PRODUCTION VALUE SUMMARY
For All Crops - Thousands of dollars

Year	Total Grains	Total Oilseeds	Total Other Crops	Total Horticulture	Forage Seeds	Total Crops
1990	848,380	219,850	235,952	81,813	8,210	1,394,205
1991	689,080	267,720	198,778	88,574	4,800	1,248,952
1992	902,850	321,120	187,549	99,079	3,284	1,513,882
1993	531,380	343,090	244,147	98,578	2,431	1,219,626
1994	773,320	642,010	253,983	123,630	6,248	1,799,191

Source: Manitoba Agriculture Yearbook 1994

Figure 2.31

SIZE AND NUMBER OF FARMS
In the Prairie Ecozone, 1991

Census farms	
Number	17,406
Average Hectares	319
Census farms (sales <$50,000) per farm	
Number	8,686
% of all farms	50
Census farms ($50,000 <sales > $100,00) per farm	
Number	4,055
% of all farms	23
Census farms (sales ≥ $100,000) per farm	
Number	4,665
% of all farms	27

Source: Manitoba Agriculture Yearbook, 1993.

The number of farms in Manitoba has decreased steadily from 1971 to 1991. Meanwhile, farm size has increased (average of 220 ha. in 1971 and 301 ha. in 1991) over the same time period. This trend can be attributed to technological change. Larger farms are necessary to employ modern, capital-intensive machinery effectively. Technology is replacing labour in Western Canada since the wage rate on farms is relatively high.

DOES CONSERVATION PROVIDE ECONOMIC BENEFITS TO THE PRAIRIE ECOZONE?

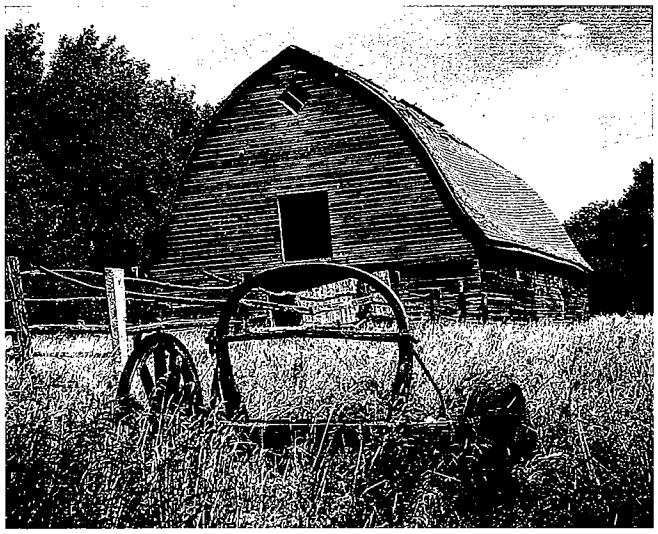
A recent economic evaluation of the North American Waterfowl Management Plan (NAWMP) in Manitoba shows that, aside from the environmental benefits, conservation can be good for the provincial economy as well.[34]

The study was conducted at the University of Manitoba. It looked at the employment, income, and economic returns from NAWMP expenditures for the 1990 to 1994 period. A few of the highlights are included below.

- 340 full-time jobs (direct and indirect) were supported in Manitoba. Each direct job generates 1.36 additional jobs in the province.
- The contribution to Manitoba's GDP was $22.9 million. There were significant economic benefits throughout the economy.
- 86% of all funds were spent in rural areas.
- Farmers gained an estimated $2.46 million in net farm income per year ($24.6 million over 10 years) from land use changes promoted through NAWMP.
- 62% of total NAWMP expenditures of $24.7 million came from US sources.

The study did not attempt to measure the economic gains that arise from the soil, water or biodiversity conservation benefits of NAWMP.

The report states: "When the farm income benefits, rural regional development impacts, and the waterfowl habitat benefits are considered in addition to job benefits, then NAWMP Manitoba is clearly a superior sustainable development project." *(see related story, p.42)*



TREND SYMBOLS
▲ **Improvement** ▼ **Decline** 〓 **Steady** ?? **Trend unclear** ○ **Insufficient data**

FARM OWNERSHIP

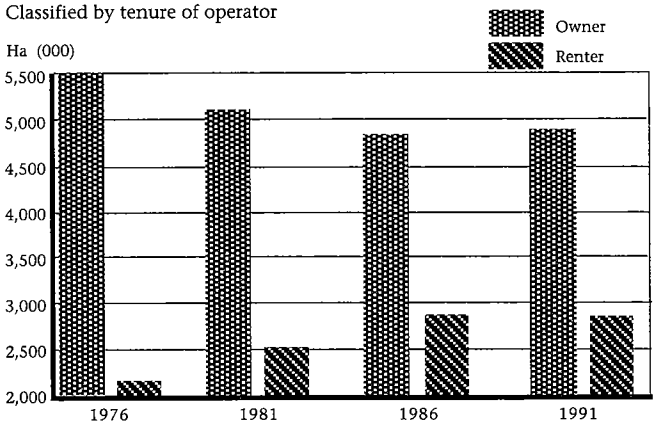
Farm ownership in Manitoba is important from a variety of perspectives. The type of ownership is important. Some family farms are now becoming incorporated because of the ease of transferring title deeds to other family members. Incorporation may also minimize exposure to risk in difficult financial periods. This trend does not change the fact that many farms are still run as family operations.

Of greater concern is whether farms are foreign or locally owned. Returns from locally owned farms are more likely to be reinvested within the local economy. The data in Figure 2.33 are census data. Data for the 1996 census were not available at the time of printing.

Figure 2.32

FARMS

Classified by tenure of operator



Source: Manitoba Agriculture Yearbook 1994

TREND: ??

The trend for farm owndership is unclear. Currently, owners farm about double the hectares of land than renters do. However, the number of renters appears to be on the rise. The importance of recent policy changes, such as the termination of the Western Grain Transportation Act, cannot yet be verified.

Implications For Sustainable Development

It may be that the number of renters managing land is increasing because the cost of land is too high for new farmers who have not inherited farms. Over the period in review, the value of farm land and buildings doubled. If this trend continues, it may have negative environmental consequences for the land depending on the value systems of the renters. The insecurity that renting poses for farmers extends to the rest of the family whose livelihood and lifestyle could be disrupted if they were to leave farming.

FARM BANKRUPTCIES

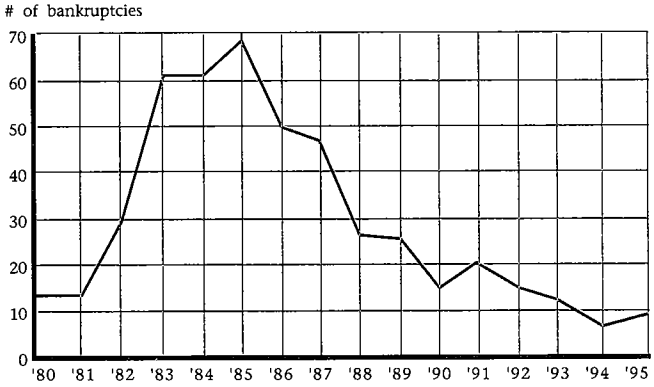
Bankruptcy is an unplanned event that indicates reduced income and an inability to service one's debt. A general increase in farm bankruptcies reflects an unstable farm sector. The increase could result from price fluctuations for commodities and inputs (seed, feed, fertilizers, etc.), increasing costs for debt financing or, in some cases, poor management. A decreasing number of farm bankruptcies indicates a relatively stable farm economy.

The population affected by farm bankruptcies is not restricted to those who are directly dependent on farming for their livelihoods. Farm communities are also affected in a negative way.

Figure 2.33

FARM BANKRUPTCIES

Per year for Manitoba



Source:Economic and Policy Analysis Directorate: Policy Branch. Agriculture and Agri-Food Canada. Farm Income, Financial Conditions and Government Assistance Data Book, February 1996.

TREND: ▲

The trend for farm bankruptcies is showing improvement. Over the past 10 years, farm bankruptcies have decreased dramatically. In 1986, there were 237 bankruptcies, while 165 were recorded in 1991. This is a result of lower debt costs due to decreasing interest rates. It may also indicate relatively stable incomes for farmers. Manitoba Agriculture has speculated that the actual numbers of potentially insolvent operations may be somewhat unclear because of the existence of the Farm Debt Review Board, which subsidizes some farm operations.

Implications For Sustainable Development

A decline in the number of bankruptcies is good news for Manitoba farmers because it shows a certain vitality in farming operations and good management practices.

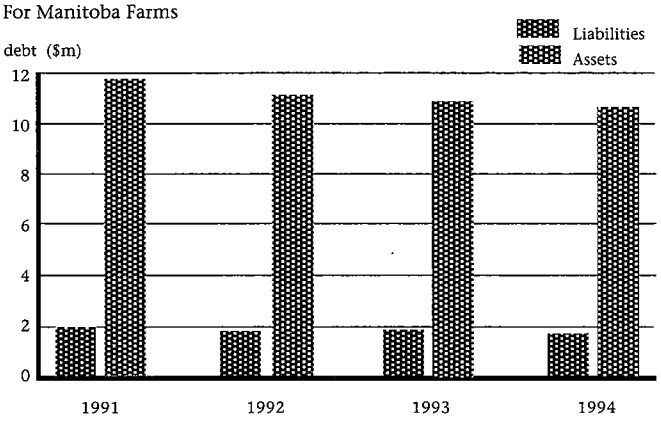
DEBT TO CAPITAL ASSET RATIO

The debt to capital asset ratio for farms is an important indicator of long-term economic viability. Farmers must be able to cover their debt to remain solvent. A maximum ratio of .25 is generally considered reasonable.

An increase in debt while assets remain stable or decrease means a farmer has to produce an increasingly higher return to cover expenses and service the debt. A ratio of less than one, on the other hand, indicates a financially strong operation. Farmers whose assets exceed their liabilities are able to expand their operations when the opportunity presents itself. Also, they can take care of any financial emergency without risking their operation.

Figure 2.34

DEBT TO CAPITAL RATIO
For Manitoba Farms



Sources: Manitoba Agriculture Yearbook 1994.

TREND: =

The trend for debt to capital assets is steady. From 1991 to 1994, the debt-to-capital asset ratio has hovered around 0.169, which means that farm debt only comprises about 17% of the value of assets. This is a strong financial position for any farmer.

In 1993, the average prime lending rate dropped from 7.85% to 6.25%. The lower interest rate was accompanied by lower crop yields and lower commodity prices. Prices and yields climbed back to 1992 levels in 1994.

Implications For Sustainable Development

Increasing debt can be due to a number of factors. Low yields and low crop prices mean lower revenues and less capacity to service debt. When that happens, farmers who already have a debt to capital asset ratio higher than one may have to borrow more money to service existing debt.

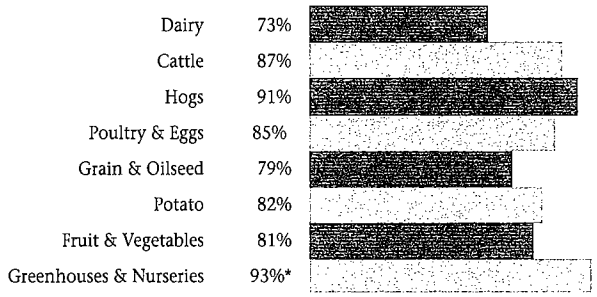
Alternatively, if interest rates are low, farmers are more likely to borrow money for capital improvements. Expectations of future lending rates also have an effect on farmers' willingness to borrow money. If farmers expect the rate to drop lower, they tend to wait until that time to borrow money.

EXPENSES AS A % OF REVENUE

Expenses as a percentage of revenue indicates the profit margin farmers receive on the sale of their produce. A high percentage indicates low profitability. By comparing this percentage across farming activities in Manitoba's Prairie ecozone, it can be determined which activities are more profitable than others. Profitability is an important consideration in choosing what to produce since revenues are influenced by the price for produce on the commodity exchange.

Figure 2.35

EXPENSES AS A % OF REVENUES
Average for all Manitoba farms, 1994



Source: Statistics Canada, estimates of farm revenues and expenses from taxation data and Manitoba Agriculture Yearbook 1994.

** the figure for greenhouses and nurseries is a 1993 figure, the latest figure available.*

TREND: =

Expenses as a percentage of revenue have remained relatively constant from 1991 to 1994. From the data, greenhouses, nurseries and livestock appear to be less profitable (and, therefore, less viable) than grains, vegetables and dairy operations. This information, however, only covers the period to 1994. Since then, the Western Grain Transportation subsidy has been removed. True expenses related to grain production (specifically wheat) will be higher than is reflected in the figures. By diversifying operations, farmers can increase their short-term viability and income stability. Each activity becomes a hedge against the risk of the others failing.

Implications For Sustainable Development

To gain more insight into an individual producer's long-term stability, this indicator can be compared to price fluctuations on commodity exchanges and the mix of farming activities undertaken.

EMPLOYMENT RATES BY INDUSTRY

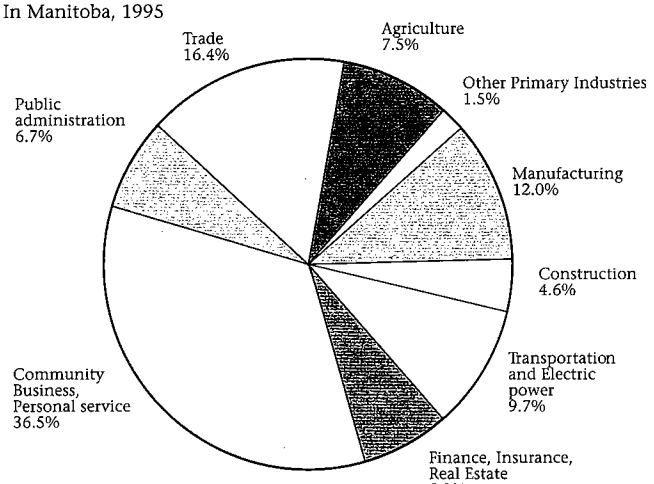
Provincial employment rates and average weekly earnings have been used to assess the status of labour's role within the Prairie ecozone.

Employment rates indicate the percentage of people able to work who are actually working. Employment rates by industry indicate the amount of labour used in each reported industry. A good mix among industries is considered an indication of sustainability because it reveals a diversity of opportunities for workers.

Employment rates are also a good indication of the growth of each sector. As a sector grows, more workers are needed to meet production demands. Growth in employment rates can also be interpreted as growth in the economy.

Figure 2.36

EMPLOYMENT RATES BY INDUSTRY
In Manitoba, 1995



Total # employed as a % of the labour force - 94.7%

Source: Statistics Canada, Catalogue No. 71-001.

Figure 2.37

LABOUR INCOME ($000,000), BY INDUSTRY
In Manitoba, 1990-1995.

Labour Income	1990	1991	1992	1993	1994	1995[1]
Agriculture	153	158	165	179	187	196
Other Primary[2]	30	28	28	28	24	24
Mining	220	220	225	221	212	220
Manufacturing	1,654	1,668	1,707	1,744	1,787	1,851
Construction	570	536	527	517	562	582
Utilities	229	238	245	245	253	262
Transportation & Communication	1,313	1,354	1,377	1,371	1,417	1,468
Storage, Wholesale & Retail trade	1,774	1,750	1,753	1,791	1,913	1,980
Finance	931	991	1,016	1,046	1,039	1,076
Other Commercial services	1,177	1,185	1,254	1,275	1,378	1,426
Education	1,258	1,345	1,387	1,417	1,436	1,487
Hospital & Welfare	1,363	1,436	1,506	1,515	1,569	1,625
Other Institutions	145	152	159	166	173	179
Federal, local and Provincial Government administration.	1,293	1,362	1,425	1,420	1,427	1,478
Total[3]	12,108	12,422	12,774	12,936	13,378	13,854

Source: Manitoba Bureau of Statistics, July, 1996

[1] *The figures for 1995 are preliminary.*
[2] *Other primary includes forestry, fishing, hunting and trapping.*
[3] *Excludes Military pay and allowances.*

TREND: =

Each industry's share of the Manitoba labour force has remained reasonably stable over this reporting period. Between 93% and 95% of Manitoba's population has been employed since 1990. This is a sign of a healthy economy. Manufacturing has increased its labour force slightly while the wholesale and retail trades have decreased theirs slightly.

The data provide a good indication of the employment in each sector. However, these are provincial data and are not broken down by ecozones. The Prairie ecozone is very dependent on primary resources for agriculture and this is not reflected in this data set.

Implications For Sustainable Development

A broad mix of employment sectors and comparatively low unemployment are indications of a healthy economy. Statistics Canada projections for Manitoba seem to confirm this.

AVERAGE WEEKLY EARNINGS

The income earned by workers within the Prairie ecozone contributes to the quality of life of all ecozone residents. Unfortunately, weekly earnings in the agricultural industry are not available since the definition of employees used by Statistics Canada excludes many producers. This is because many people engaged in agricultural activity are self-employed or employed in family operations.

Figure 2.38

AVERAGE WEEKLY EARNINGS, BY INDUSTRY
In Manitoba, 1900-1995 (in actual dollars)

Year	1990	1991	1992	1993	1994	1995
Mining incl. Milling	825.52	861.82	888.92	922.88	910.62	990.33
Manufacturing	485.10	509.41	524.58	528.72	541.00	542.26
Construction	560.78	560.04	575.34	560.88	601.97	613.64
Transportation, Communication and other Utilities	652.11	656.67	668.95	666.21	670.84	687.98
Trade	339.47	346.76	348.33	356.27	373.38	388.70
Finance, Insurance and Real Estate	475.02	504.53	507.88	530.92	548.86	535.52
Service	393.26	411.44	423.70	426.97	429.96	430.00
Industrial Aggregate	459.86	476.54	488.04	492.30	499.27	503.96

Source: Manitoba Bureau of Statistics, July, 1996

TREND: ▲

Generally, labour income has increased from 1990-1995. *(see Fig. 2.37).* Average weekly earnings by industry are presented in Figure 2.38. It appears that workers in the mining, transportation, communications and utility industries earn the most money. Industries that pay the lowest wages are the wholesale and retail trades.

Implications For Sustainable Development

Labour income within the agricultural sector has increased steadily. However, it is difficult to gauge if this is having any significant impact on individual families.

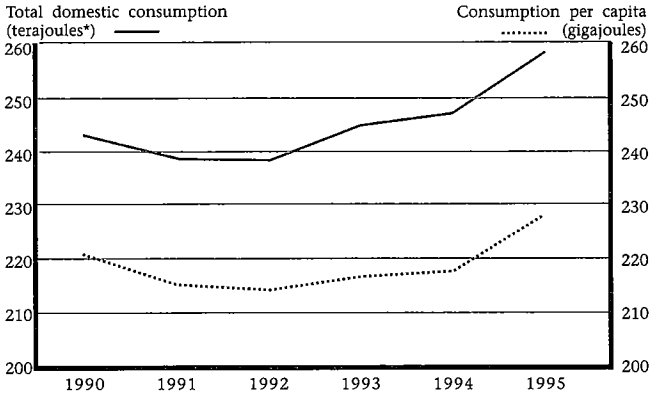
ENERGY CONSUMPTION

Consumption relates to sustainable development because it is one of the driving forces of the economy. Consumption is relevant from a social perspective because it demonstrates a community's standard of living.

However, many aspects of consumption can have negative, long-term effects on the environment. Most production and consumption processes require energy. Therefore, energy consumption is considered a useful proxy for overall industrial consumption in the economy.

Figure 2.39

ENERGY CONSUMPTION PER CAPITA
In Manitoba, 1990-1995



Source: Statistics Canada - Catalogue No. 11-528-XPE, No.3

**A joule is a measurement of energy potential. A terajoule is the amount of energy in 30,000 litres of gasoline or 1,000 gigajoules.*

TREND: ??

Per capita energy consumption has increased slightly. The increase in consumption is due to an increase in population and economic activity. According to Canadian statistics for energy consumption, Manitobans are high energy consumers in relation to other regions of the world.

The majority of Manitoba's energy needs are met through nonrenewable fossil fuels, such as petroleum products, natural gas and coal. About 75% of these are imported. Hydroelectric power produced in Manitoba accounts for almost all the remaining domestic consumption.

Implications For Sustainable Development

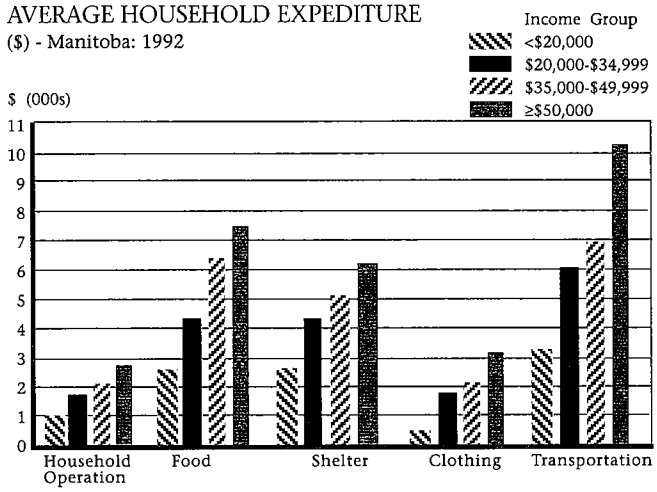
Given the strong influence of climate on energy consumption in Manitoba, it is difficult to determine whether the increase in per capita energy consumption is indicative of a trend. It is known, however, that Canada is among the highest consumers of industrial goods, including energy, in the world. This has implications for resource stocks and the quality of our land, water and air. The burning of nonrenewable fossil fuels, in particular, is a major source of greenhouse gases, such as carbon dioxide, that contribute to climate change.

HOUSEHOLD EXPENDITURES

Household expenditure indicates a community's standard of living and the products its consumers are buying. It is also a reasonable indicator of consumption levels and patterns.

Figure 2.40

AVERAGE HOUSEHOLD EXPEDITURE
($) - Manitoba: 1992



Source: Statistics Canada Catalogue No. 62-555

TREND: =

Statistics Canada reports that transportation is the highest of all household expenditures for all income groups. Expenditures on food and shelter are equal to each other, followed by clothing and household costs. However, the clothing expenses of people earning less than $20,000 are half the cost of their household operations.

Implications For Sustainable Development

Energy has specific production- and consumption-related implications for sustainable development. In terms of production, the main issues are:

- security of supply
- life span of energy reserves and energy-producing infrastructure
- the environmental and social costs of energy production.

In terms of consumption, there are questions related to the impacts of energy use such as pollution emissions. Only 20% of Manitoba's energy needs are supplied by hydroelectricity. The rest is supplied by nonrenewable resources imported in the form of coke and refined petroleum products.

The overall increase in energy consumption could be a concern in the future. Fossil fuels, for instance, contribute to greenhouse gas emissions that are a major factor in climate change. However, due to long distances that must be travelled, a harsh climate and a sparse population, reducing the ecozone's dependence on fossil fuels is a challenging task. It is likely to be achieved through a combination of technological innovations, improved fuel efficiency, alternative fuels and changes in personal lifestyles. *(see p.88-90 for more information on energy consumption)*

COMMUNITY ASSETS

The framework for reporting on sustainable development trends in the Prairie ecozone includes community assets. These assets are services and institutions that may be categorized as "social infrastructure". They fill a range of important, often basic, needs for communities and individuals.

Traditionally, prairie communities have been closely knit. People often work together within families and their community to provide services, such as health care or education, which are fundamental for community support. Other assets include access to adequate transportation and communication networks.

Maintaining these assets and services on a socially desirable level is considered a precondition of social sustainability.

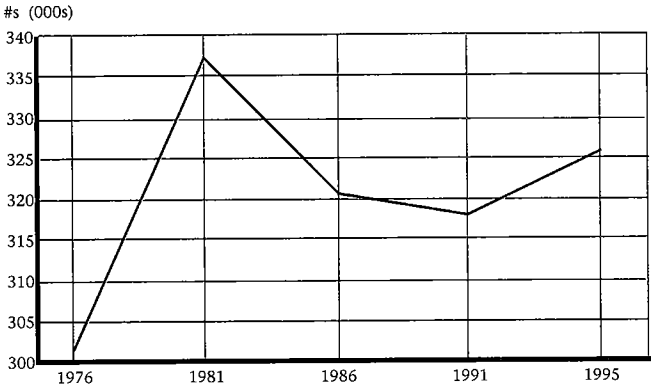
POPULATION TRENDS

Population trends are fundamental to any discussion of social, economic and environmental issues. People and their needs are a major driving force behind the changes occurring today.

Prior to the mid-1800s, the Prairie ecozone was populated by several First Nation groups including the Cree, Ojibwa, Saulteaux, Sioux, and Assiniboine. The influx of European settlers in the last half of the century, and more recent settlement from Asia has resulted in a tremendous regional ethnic mix.

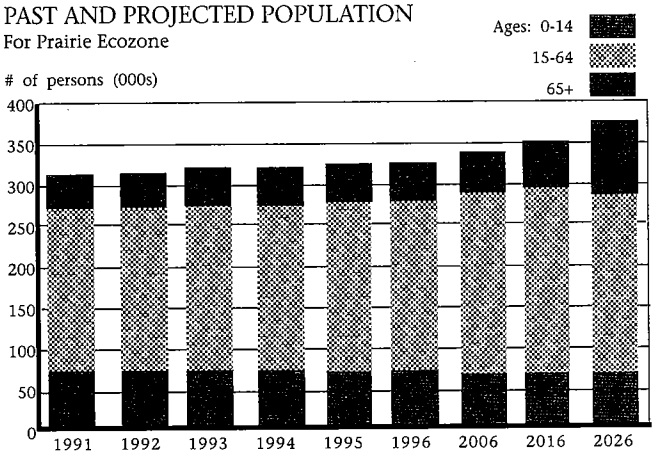
Figure 2.42 indicates a possible scenario of population growth for the Prairie ecozone over the next 30 years, while recent population trends are outlined in Figure 2.41. According to information from the Manitoba Bureau of Statistics, it can be assumed the region will continue to comprise slightly less than 30% of the provincial population. Growth projections for the Prairie ecozone are based on "medium growth scenario" provincial estimates.

Figure 2.41
HISTORICAL POPULATION TRENDS
For Prairie Ecozone 1976 - 1995



Source: Statistics Canada, 1996

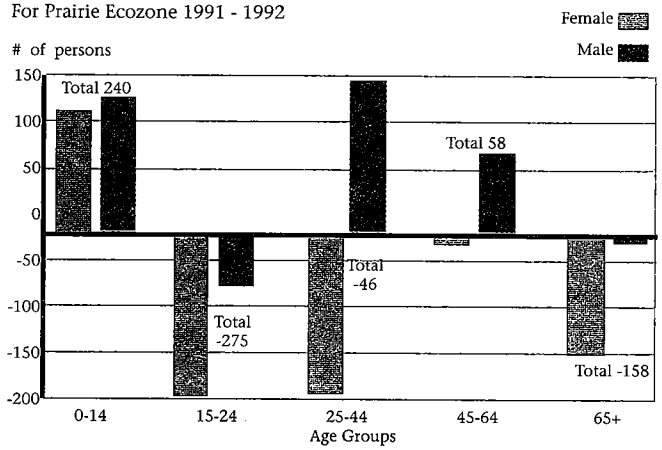
Figure 2.42
PAST AND PROJECTED POPULATION
For Prairie Ecozone



Source: Medium Growth Population Projections, Manitoba Bureau of Statistics, 1996

Figure 2.43

NET MIGRATION
For Prairie Ecozone 1991 - 1992



Total number of females: -440
Total number of males: 259
Combined total: -181

Source: Statistics Canada, 1996

TREND: 〓

After an initial increase in Prairie ecozone population during the 1970s when commodity prices were high, population dropped somewhat and has since stabilized. This is a reflection of some rationalization within the agricultural sector which occurred following a drop in commodity prices in the early 1980s.

In Statistics Canada 1991 census, several trends were evident.

- Most population growth in the Prairie ecozone occurs in urban centres.
- A high percentage of residents were born in Manitoba (93.6%).
- A vast majority are also Canadian-born (81.7%).
- 3.8% of the total population is of aboriginal origin.
- There is a one-to-one ratio of females to males.
- Currently, retirement age population is high relative to Manitoba overall, particularly among females.

The Manitoba Bureau of Statistics reports that the Prairie ecozone will likely see substantial growth within the 65+ age category, as will the province. This trend will focus increasing attention on important issues such as geriatric health and chronic care needs. From 1991 to 2026, this category's percentage of the Manitoba population is expected to increase from 13.3% to 20.3% (15.2% to 22.8% in the prairie region). The 0-14 and 15-24 age categories are expected to experience slight decreases in percentage of total population, both in the Prairie ecozone and the province as a whole. *(see Fig.2.42)*

Implications For Sustainable Development

The retirement-age population is expected to increase substantially in the future, while the proportion of younger people decreases. Fewer children are taking over their parents' farm when they retire. As a result, neighbouring landowners are acquiring larger farms. This trend may continue to have negative economic and social implications for small communities as schools, local governments and businesses strive to remain viable.

Larger, regional service communities are growing with the influx of young professional families. Much of this growth is occurring within the agri-business sector because of massive investments of external capital. The possible lack of suitable employment opportunities for women may be of some concern, although a long-term trend is not available for analysis.

Increased demands on geriatric care and support facilities will have to be addressed, and the retirement needs of women appear to require special attention. Given the departure of this group from the region during 1991/92, it is conceivable that retiring women do not find the current range of home, health, and related services to be adequate in the Prairie ecozone. They also may be moving to be near other members of their families. *(see Fig. 2.43)*

If the net migration (1991/92) figures are indicative of long-term trends, a disturbing fact is emerging. Young males are being attracted to new employment opportunities in the Prairie ecozone, while nearly twice as many young females are leaving, perhaps because of a lack of suitable employment. Assuming that the 1991/92 figures are representative of future trends, substantial numbers of retirement-aged women are also leaving. In absolute terms, these numbers are small and only cover a one-year period. The obvious limitations of the data must be recognized.

ROSSBURN CHOSEN DESTINATION FOR 30 ONTARIANS

Some might say it is presumptuous of a village like Rossburn, Manitoba, population 640, located 300 km northwest of Winnipeg, to expect to attract big city dwellers. But not the residents of Rossburn.

In 1995, the Rossburn town council, the local economic development board, the chamber of commerce and several individuals were approached by a local resident with a novel idea. They agreed to invest $2,080 in an advertisement in the Toronto Sun with the hope of attracting new residents. Selling the virtues of clean air, low crime, wide open spaces, friendly faces, low taxes and affordable prices, the response was overwhelming, according to the mayor of Rossburn.[61]

The advertisement generated media attention worth a good deal more than the initial investment. It also generated requests from 540 people for information kits. And more than 75 families traveled to Rossburn for a first-hand look.

Thirty people have become new Rossburn residents: three families have purchased a local service station, one person was hired as an economic development officer and three families have started new businesses.

Overwhelming Results for a Unique Idea

The results of the Rossburn initiative are still being felt. To date, 10 families have moved to this quiet and safe community on the edge of Riding Mountain National Park. What is just as surprising — and reassuring to local residents — is the way in which the newcomers have adjusted to the local scene.

Initially, fifty people moved to Rossburn. Of the 20 who did not stay, only one moved back East. Several live in nearby towns and two families moved further West.

In the meantime, the ending to this fairy tale is far from being written. The media (22 newspapers at last count) have run the story worldwide and calls to Rossburn are still coming in from as far away as England, Switzerland and Brazil. Rossburn, the little community that could, did.

SERVICES

Several basic social services are available to communities within the Prairie ecozone. They include transportation, communications, water and sewer service, waste management, health care services, family services, police protection, community development and education. Each is a vital component of the region's social infrastructure. Within each component, progress toward sustainable development can be tracked using a combination of indicators.

All cities, towns and villages in the Prairie ecozone have sewer and water facilities. Just over half the rural municipalities in the region also have access to these services.

According to Manitoba Hydro, 100% of the towns in the Manitoba Prairie ecozone have access to electricity.

ACCESS TO WATER AND SEWAGE TREATMENT

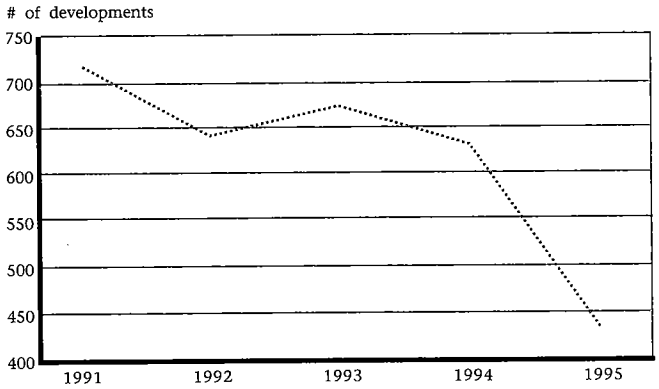
Water is important to agriculture, manufacturing and many other aspects of the prairie economy. Sewers collect wastes for centralized treatment, efficiently eliminating the spread of disease. Most rural households within the ecozone do not have access to centralized water and sewer systems. They make their own provisions for potable water and waste disposal through water well systems, septic fields and holding tanks.

Increasingly, water is needed for diversified economic options involving irrigation or light industry. Two indicators of government assistance were used to measure rural water supply development: regional community water projects and the development of supplies for farmsteads and rural enterprises. It is assumed they indicate areas of need and the level to which those needs are being met. The Prairie Farm Rehabilitation Administration of Agriculture Canada and the Manitoba Water Services Board of Manitoba Rural Development work together in providing several prairie water programs.

An Agricultural Area Water Pipeline project may service a group of farmers, rural residents or community needs. Government assistance is available for cost estimates, engineering design, project management, construction supervision and technical support.

Figure 2.44

TRENDS IN WATER SUPPLY DEVELOPMENT
In the Prairie Ecozone - Farmstead and/or rural enterprise water supply development*



Source: Prairie Farm Rehabilitation Administration

**Includes: dugouts, wells, irrigation, and related projects. These may be new projects or repairs to existing projects.*

TREND: 〓

The trend for water pipeline projects may be characterized as steady. Pipeline projects may be measured in terms of project length in kilometres or number of services (individual connections). These have fluctuated widely since 1991. General program budget levels are stable.

The benchmark year of 1993 was used to indicate the municipal population connected to a community water supply system in towns greater than 1,000 people. The same year was used for the percentage of metered service. In that year, 90.4% of the towns with more than 1,000 people were linked to municipal water systems. Of that number, 71.8% were metered. With increasing attention to domestic water pricing as a conservation strategy, it is likely that volumes delivered on metered service will increase.

A decreasing trend is apparent regarding federal-provincial support of water supplies for farmsteads and rural enterprises. Starting in 1994, funding allocations to individual projects were limited. However, this is a indicator which may not fully reflect the current situation. Cumulatively, this program has provided service to thousands of landowners.

Implications For Sustainable Development

Increasingly, water is becoming one of the most critical prerequisites for development in the ecozone. It is required for agri-food processing and wastewater treatment for many key prairie industries. Future economic growth in the ecozone will need to be integrated with the water supply, both on the side of water availability and effluent treatment.

GIARDIA PROBLEMS IN DAUPHIN AND PARKLANDS REGION

During the first few months of 1996, it became apparent that an outbreak of Giardiasis was occurring in several communities north of Riding Mountain National Park. More than 30 cases had been reported by the end of April 1996.

Giardiasis is a common waterborne disease transmitted by a tiny intestinal parasite called Giardia lamblia. Giardia may infect humans and other animals, commonly beavers, muskrats and dogs.

Although referred to as "beaver fever," the cause of Giardiasis is most often from human sources. Boiling water before use is the only guarantee against infection.[91]

Carrier Populations High in Riding Mountain National Park

Giardia outbreaks occur in times when populations of carrier animals are high. At present, beaver populations are high within Riding Mountain National Park, the source of domestic water for several parkland communities including Dauphin.[71]

Most communities in the parkland region rely on surface water for drinking and other domestic uses. Water quality, as described by Manitoba's water quality index is generally described as "fair". The largest town in the area is Dauphin, population 8,500, which receives water treated by chlorination alone. This form of treatment does not protect the supply from parasites such as Giardia and a related microorganism, cryptosporidia. *(see related story, p. 99).*

After the recent outbreak of Giardia, it became clear that a solution was needed. The town is now working with the Manitoba government's water services board to build a $12 million treatment plant. It is expected to begin operation by 1998.

INVESTMENT IN ROAD TRANSPORTATION

Travel within the Prairie ecozone has changed dramatically over a short period of time. The Aboriginal people and early settlers depended largely on the region's waterways. Later, horses or oxen-driven carts were used to move families and goods. European in-migration was facilitated by the railways and the rail system served as the dominant mode of transport for much of the 20th century. With increased incomes and the need to move goods and people beyond the limits of the rail system, road travel has become the transportation mode of choice in the Prairie ecozone.

Several indicators were used to determine the sustainability of transportation in the Prairie ecozone during the reporting period of 1991 to 1995.

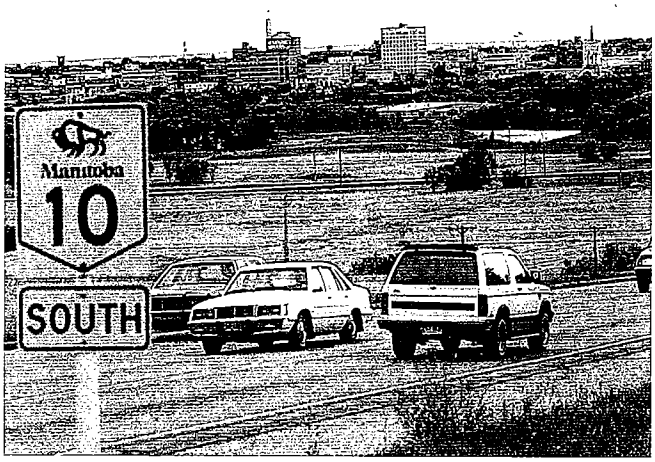


Figure 2.45

EXPENDITURES ON ROAD TRANSPORTATION IN MANITOBA
by Public Sources Per Capita*

Year	Federal Sources[1]	MB Highways[2]	MB Nat. Res.[3]	Municipal[4]	Other[5]
1990/91	12.22	211.78	0.72	61.57	24.96
1991/92	8.58	203.93	0.54	61.42	28.06
1992/93	7.37	202.82	0.99	64.91	25.2
1993/94	19.95	192.90	0.97	61.09	33.31
1994/95	- -	204.04	1.01	- -	30.16

Source: Transport Canada, Manitoba Highways and Transportation, Manitoba Natural Resources, Manitoba Rural Development, Manitoba Northern Affairs and Manitoba Urban Affair.s.

** Amounts are in current dollars, not adjusted for inflation.*

[1] Includes only Federal road transportation expenses in Manitoba.

[2] Includes capital construction and maintenance expenses of Manitoba's primary and secondary road systems (bridges, crossings, winter roads, road information, truck inspections, tendering, design, and engineering). Includes federal contributions.

[3] Includes all water resources-related capital construction costs, but only selected road construction, repair, and maintenance expenses from regional operations. Data are incomplete and understated, although it is a relatively small proportion of overall provincial expenditures.

[4] Includes provincial contributions and rural municipal expenditures for roads, streets, crossings, and salaries.

[5]Includes provincial capital expenditures by Manitoba Northern Affairs, Manitoba Urban Affairs construction expenditures and grants within/to the City of Winnipeg, urban public transit systems grants in the province, and Handi-Transit system grants in Winnipeg and rural Manitoba.

Note: Figures cannot be totaled since federal contributions are included in other categories. Totaling the figures would result in double counting of some contributions.

TREND: =

Prairie ecozone residents, like all Manitobans, have seen a relatively stable proportion of their tax dollars devoted to roads and related infrastructure *(see Fig. 2.45)*. These figures provide only a picture of effort, but do not measure whether the effort is adequate to maintain the functionality of roads.

The number of secondary bus routes on provincial roads within the ecozone has decreased substantially. Grey Goose Bus Lines, which services the secondary rural routes, reports a decrease from 38 routes in 1991 to 27 in 1995.

Implications For Sustainable Development

Federal grain transportation reforms (e.g., elimination of subsidies, relaxation of rail line abandonment rules) will result in increasing stress being placed on the Prairie ecozone's road system. The rationalization of the grain elevator system by the grain companies will further add to the amount of agricultural related traffic on the provincial and municipal road networks. Farmers and grain-handling companies are now using multiple-axle and multiple-unit tractor-trailers to move their products. Recommended load restrictions for roads and crossings are being pressured, causing significant infrastructure stress. This will be a problem in the future, particularly for local governments.

Transportation in the region will be dependent on nonrenewable resources for some time to come. However, Manitobans could reduce their use of fossil fuels by using more ethanol or ethanol-blended gasoline.

NEWSPAPERS AND LIBRARIES

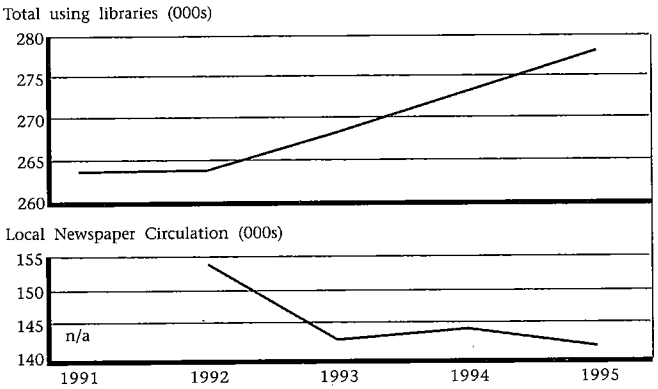
Communications in the Prairie ecozone have changed as much as any other part of the region's social infrastructure. For much of the time, information was dependent on transportation routes including rivers, trails and the railway. The first residents shared information with each other at meeting locations such as The Forks in Winnipeg. Many of these sites were later served by fur trading posts. The flow of information increased and the early mail system began to evolve.

Development of the rail system provided telegraph transmissions and a reliable mail service. With a rapidly expanding population, communications activity also expanded. Local newspapers served towns and villages, advising residents of current events in their regions. Operator-based and, later, "party-line" telephone service followed.

Early in the 20th century, radio stations began to broadcast within the Prairie ecozone. They provided news, weather and commodity reports that were of particular value to farmers. The speed and volume of the information flow increased at unprecedented and irreversible rates. In the 1950s, television made its first appearance, offering yet another communications medium. In the 1990s, electronic communication is becoming a popular method of reaching out.

Figure 2.46

TRENDS IN CONVENTIONAL COMMUNICATIONS
In the Prairie Ecozone



Sources: Manitoba Culture, Heritage, and Recreation, Manitoba Community Newspaper Association.

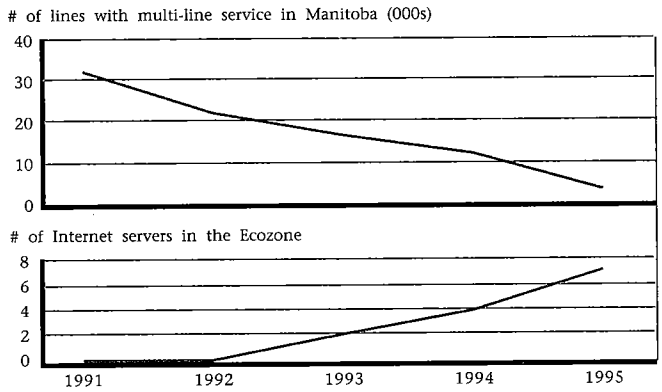
There are 23 libraries in the Prairie Ecozone, an increase of one from 1993. In other conventional communications, the number of electronic broadcasters has remained constant since 1991 at 10 television and three radio stations in the ecozone. However, a new wireless, digital cable system, SkyCable, was launched in late 1996.

EXTENT OF SINGLE LINE TELEPHONE SERVICE AND INTERNET SERVERS

Communications and information access indicate the degree to which Prairie ecozone residents are "connected to the world." A solid range of indicator data is available to assess progress. Several indicators were used to assess the communication issue. Figures 2.46 and 2.47 report some of these trends.

Figure 2.47

TRENDS IN ADVANCED COMMUNICATIONS
In the Prairie Ecozone



Sources: Manitoba Telephone System, Cantel, 1996

98.1% of Manitoba homes have digital line service and all Manitobans have access to community calling service. The number of rural cellular telephone transmission sites has increased from 37 in 1991 to 43 in 1995. This figure includes MTS Cantel services only.

TREND: ▲

In general, the trend for communications is improving. The total circulation of local community newspapers in the Prairie ecozone has declined substantially, although the number of individual publishers is up slightly. Electronic broadcasting systems have not changed since 1991, with 10 radio stations and three television stations in the ecozone. A new digital television service has been launched in southern Manitoba. While the number of libraries has remained stable, the total number of people visiting libraries is apparently increasing.

There is substantial improvement in telephone and Internet services. *(see Fig. 2.47).* Most data in this area are available only on a provincial basis. The provision of digital and individual lines has been expanding gradually over time. These lines offer higher quality service and a full range of telephone-based communications services including faxing, Internet access and numerous calling options such as voice messaging and call forwarding.

"Community Calling" services, offered by MTS in rural areas, enables local residents to make calls to at least one adjacent exchange without incurring long distance charges. Cellular coverage through the Cantel and MTS Mobility net-

works has expanded considerably within the Prairie ecozone. As interest and awareness of the Internet expands, MTS has established local Internet servers on a cost-recovery basis.

Implications For Sustainable Development

The contemporary information era is exposing rural residents to the latest in communications technology and quality. Improved telephone, cable television service and Internet availability are increasing access to information within the Prairie ecozone.

Previously, extensive use of the telephone was either cost prohibitive or difficult because of party lines. Cellular service is of tremendous value to farmers who save time and money by calling for machinery parts or commodity prices without driving into town. Cellular service also provides a higher degree of security for rural families, particularly when driving conditions are dangerous.

These media will link Prairie ecozone residents and communities to the world, offering exposure to the latest information and opportunities. The Internet, in particular, offers instant and affordable participation in the "global village" and marketplace. Expansion in this area offsets the declining trend in community newspaper circulation. Furthermore, it is likely many local papers will begin publishing on-line. This technology is increasing accessibility and reducing the overall cost of communication with little environmental cost because of few physical infrastructure requirements.

FIRST PAPER IN THE CANADIAN WEST TO GO ON-LINE

On April 1, 1996, the Minnedosa Tribune, which has published continuously since 1883, became the first Canadian newspaper to offer an Internet edition to subscribers.[65]

While the Tribune had an initial target of 50 on-line customers, more than 350 had subscribed by the fall of 1996. Many of the subscribers are former residents of the south Riding Mountain region who are scattered around the globe. It is estimated there are as many as 10,000 former residents who may, as they go on-line themselves, want to access their old hometown newspaper.

The Minnedosa Tribune has operated continuously for 113 years. Eventually, all the Tribune's archives will be available through its Internet home page. Other services including genealogy searches will be offered, also. Using the new technology means that Minnedosa's community newspaper can be placed on the same worldwide newsstand as the New York Times and the London tabloids.

The Minnedosa Tribune homepage can be found at http://www.techplus.com/trib/index.htm.

GOVERNMENT EXPENDITURES ON ENVIRONMENTAL SERVICES

Waste in the Prairie ecozone is produced from residential, agricultural and industrial sources. Material consumption produces many streams of solid waste including plastics, metals, paper, glass, organic materials and hazardous waste. In recent years, provincial regulations have tightened considerably in response to public support for environmental programs. As a result, rural municipalities have had to revise their waste management strategies. In many communities, recycling and waste minimization have emerged as important components of comprehensive waste management systems.

"Reducing" or diverting solid waste from the waste stream is the first and most cost-effective step within the "four R's" (reduce, reuse, recycle and recover). Waste reduction avoids expensive processing, separation and treatment of waste products.

Given the evolving nature of the recycling sector, only scattered samples of data are available. An ideal measure of sustainable development would balance the benefits of recycling with the costs of labour and shipping. Increased consumption and increased availability of recycling services are two of the most important factors responsible for higher recycling figures. Considering these data alone, however, it is not possible to determine to what extent these factors are responsible for the changes. A mix of data sources was used to determine a trend for waste management expenditures.

TREND: 〓

Spending on environmental protection has not changed much from year to year. Expenditure data are inconclusive because increased spending does not necessarily mean improved environmental protection. Operational aspects of the issue may be more important. In fact, less spending may be appropriate or desirable in certain cases, especially if service duplication is eliminated.

Implications For Sustainable Development

Environmental protection is one of the foundations of sustainable development. Historically, protection has been viewed as an added cost, not a necessary part of doing business. To ensure sustainability, environmental protection needs to be considered an investment in the future.

Figure 2.48

PROVINCIAL AND LOCAL GOVERNMENT ENVIRONMENTAL PROTECTION EXPENDITURES
In Manitoba[1] 1990-1994 $000

	Sewage Collection & Disposal		Waste collection & disposal		Other environmental services[2]		Total Pollution abatement and control	
Year	Provincial Government[3]	Local Gov.	Provincial Government	Local Gov.	Provincial Government	Local Gov.	Provincial Government	Local Gov.
1990	15,165	52,055	5,415	25,682	9,750	733	15,165	78,470
1991	17,339	55,495	6,493	26,043	10,846	884	17,339	82,422
1992	21,255	89,248	6,659	31,123	14,596	764	21,255	121,135
1993	--	61,193	--	30,220	--	755	--	92,168
1994	--	58,384	--	34,156	--	754	--	93,294

Source: Statistics Canada - Catalogue No. 11-528-XPE, No. 3

[1] Local government expenditures exclude transfers between municipalities. Provincial/territorial government expenditures include intergovernmental transfer payments.
[2] Local, provincial and territorial government expenditures on other environmental services includes expenditures specific to pollution control.
[3] Some provinces and territories report their sewage expenditures under water supply expenditures, which are not considered as environmental protection expenditures.

TREND SYMBOLS
▲ **Improvement** ▼ **Decline** 〓 **Steady** ?? **Trend unclear** ○ **Insufficient data**

WASTE MANAGEMENT

The current recycling trend is very positive in the Prairie ecozone. A number of rural recycling programs were initiated during the early 1990s. However, it was not until 1995, the last year of the last SOE reporting period, that participation by Manitoba's rural and northern municipalities increased to 73%. In that year, 123 municipalities registered with the Manitoba Product Stewardship Program. Similarly, the number of registered communities operating structured programs now provide services for 92% of the rural population.

Figure 2.49

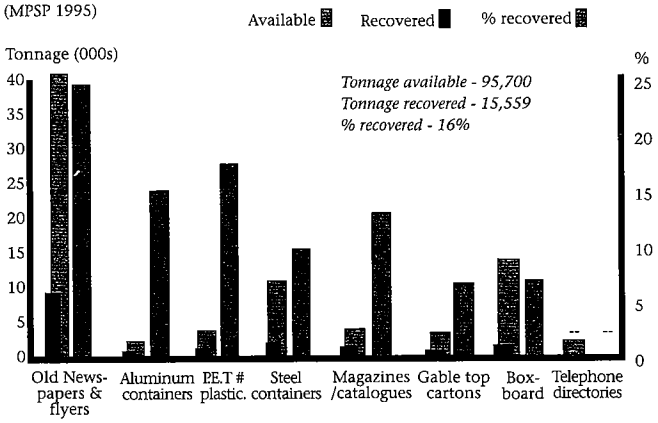
WASTE REDUCTION ACHIEVEMENTS
1988-1994

	1988	1992	1994
Population	1,084,100	1,096,000	1,131,000
Disposal (tonnes)	1,088,436	888,856	893,569
Per Capita (kg)	1,000	810 (19%)	790 (20%)

Source: Manitoba Environment

Figure 2.50

ELIGIBLE MATERIALS AND RECOVERY RATE
(MPSP 1995)



Source: Manitoba Environment

The Manitoba Product Stewardship Program funds the recycling of five mandatory materials including: newspapers and flyers, aluminum, glass, and steel containers and plastic soft drink bottles (#1 PET). In addition, Municipal Recycling Support Payments were made available for the recycling of magazines, milk cartons, boxboard, and telephone books. Figure 2.54 provides information on the available amounts of these items and the tonnage recovered in 1995.

Reported tonnage of all MPSP eligible materials recovered through municipal recycling systems in 1994 was 5,500 tonnes. Total tonnage collected in 1995 more than doubled to 15,500 tonnes. As municipal recycling programs mature, and additional materials are added to the collection systems, recovery rates will increase.

Figure 2.51

HOUSEHOLD HAZARDOUS WASTE COLLECTED

Years	Waste Collected (tonnes)	# of Collection days held
1993	19.6	11
1994	31.9	16
1995	33.7	19

Source: Miller Environmental Corporation

Figure 2.52

MUNICIPAL RECYCLING
1995

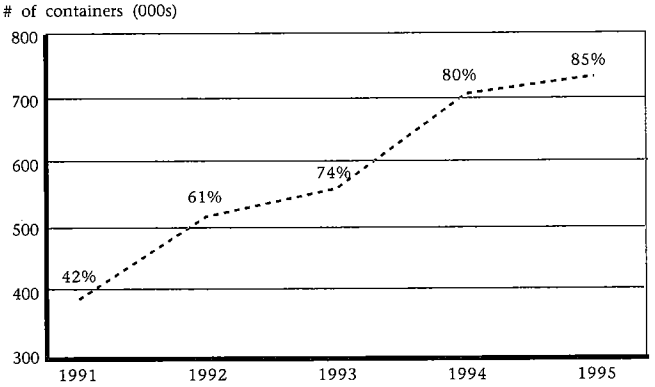
		% of total municipalities
# of municipal recycling programs	114	56
# of curbside systems	46	40
# of depot systems	68	60
# of households with recycling service	306,000	84
# of population with recycling services	976,500	89
# of planned recycling systems	11	

Source: Manitoba Product Stewardship Corporation and Manitoba Environment

In total, 124 municipal corporations, two First Nations communities and the town of Pine Falls have registered with the Manitoba Product Stewardship Program since its establishment in January 1995. Approximately 89% of Manitoba's population of 1.1 million resides in these participating communities. The City of Winnipeg completed the final implementation phase of its curbside recycling system in March 1996 and is now providing service to 170,000 single family households. Expansion to 80,000 multi-family units will continue in 1997.

Figure 2.53

PESTICIDE CONTAINERS COLLECTED
As % of total sales



Source: Manitoba Environment

TREND: ▲

The trend for waste management is showing improvement. Between 1991 and 1995, Manitobans achieved a 20% reduction in waste generated. As well, a strong foundation was put in place for the 50% waste reduction target set by the Canadian Council of Ministers of the Environment (CCME) for the year 2000.

However, pressures that existed in 1991, which resulted in the commitment to minimize waste, remain strong in Manitoba. These include:

- increased public awareness of the benefits of waste reduction
- escalating costs for proper handling and disposal of waste
- a need to review practices for locating regional landfills
- stricter environmental regulations.

Another important success story relates to the Manitoba Tire Stewardship Board (TSB). Since its establishment in 1993, the TSB has diverted thousands of tonnes of tires from Manitoba landfills. As well, a major recycling plant, Tire Recycling Corporation (TRC) of North America in Winkler, is located in the ecozone. TRC was a winner of the 1995 Sustainable Development Award of Excellence, in the small business category.

With the provincial government's sale of the Manitoba Hazardous Waste Management Corporation to Miller Environmental in 1995, the number of household hazardous waste days and the volume of hazardous wastes collected have increased.

A final positive trend relates to the growth of the Association for a Clean Rural Environment (ACRE) program. This management program for pesticide containers is expanding, with a container return rate approaching 90%.

Implications For Sustainable Development

The benefits of recycling include:

- less pressure on the environment
- a decreased need for new materials, both renewable and nonrenewable
- savings for manufacturers and consumers by using recycled instead of new materials
- economic and employment benefits in the recycling industry
- less potential for pollution of water and soil.

Institutional leadership in waste minimization is fundamental for any efforts to be effective. In particular, the Manitoba Tire Stewardship Board and ACRE have generated positive results in the Prairie ecozone. They both offer "closed-loop" solutions for waste. In other words, they deal with the product from its introduction to the waste stream to its final stages of existence. The Manitoba Tire Stewardship Board has played a key role in reducing stockpiles of discarded tires. *(see also, Municipal Waste Management, p. 130-135).*

TREND SYMBOLS

▲ **Improvement** ▼ **Decline** 〓 **Steady** ?? **Trend unclear** ○ **Insufficient data**

CASE STUDY IN SUSTAINABILITY: THE MANITOBA TIRE STEWARDSHIP BOARD

In 1992, the Manitoba government instituted a tire levy of $3.00 for every new tire sold in the province. The levy was collected by tire retailers and by new vehicle dealers.

On April 1, 1995, this process was refined with the establishment of the Manitoba Tire Stewardship Board, a corporation managed by three representatives of industry (Rubber Association of Canada, CAA Manitoba and Western Canadian Tire Dealers and Retreaders Association). Two appointees from the Manitoba Government are also involved.

Under the Tire Stewardship Regulation, the Tire Stewardship Board licenses all tire and vehicle retailers and collects the levy from them. Levies contribute to a fund that pays for the collection, transportation, storage, processing and disposal of scrap tires. In the future, the fund may also support a research and development component on behalf of scrap tire processors.

The program is simple, but very effective. A potential processor may apply to the board for registration. The board will set a product credit based on projected costs for waste treatment and the potential for wealth or job creation to Manitoba.

This credit, up to $2.50 per 20-pound passenger tire equivalent (PTE), is paid upon proof of sale of the new recycled product. Tire derived fuel (TDF) is also included in the program to cover tire waste converted to fuel. The cost of tire pickup, transportation and storage are included in the credit and are not paid directly by the board. Those items are left to industry.

The second important part of the program involves municipalities. They are offered an incentive of 50 cents per tire to divert scrap tires from landfills to registered processors. All Manitoba municipalities are eligible. The program has been a huge success. There are virtually no stockpiles of tires left in Manitoba. As of November 1995:

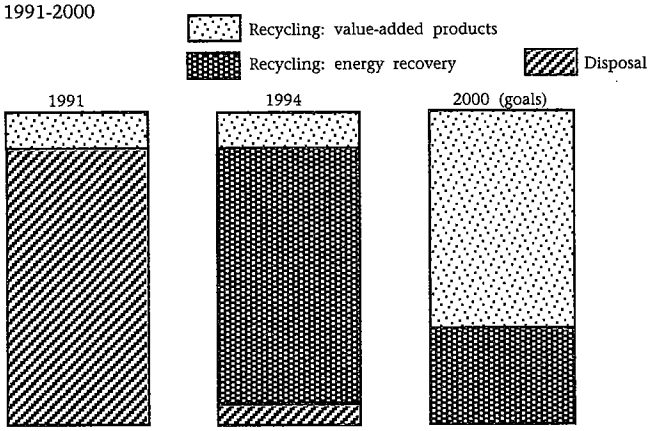
- more than $3.4 million was paid to processors
- more than $250,000 was paid to municipalities
- 1.45 million PTEs have been recycled
- retailers have saved more than $250,000 in transportation charges and tipping fees
- about 70 new jobs and dozens of part-time jobs have been created by processors
- the cost of recycling a passenger tire is currently $2.65, including all program costs.

The Manitoba Tire Stewardship Corporation appears to be a case study in sustainability because it is self-sufficient, the costs of operation are borne by the users, the problem of waste tires has been almost eliminated and economic activity has diversified.

Figure 2.54

WHERE USED TIRES GO

1991-2000

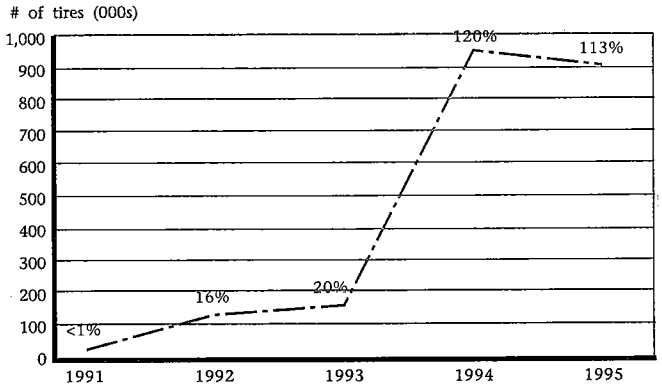


Source:Manitoba Environment

Figure 2.55

TIRES RECYCLED

Number and %



Source:Manitoba Environment

It is estimated that 800,000 used tires are generated annually in Manitoba. Significant progress has been made in increasing the number of tires recycled over the past five years. Recycling levels have increased over 100% since 1991. In addition, Manitoba's inventory of used tire stock piles has been nearly eliminated.

Percentages of annual tire production recycled during 1994 and 1995 exceed 100% due to progress in eliminating stock piles of used tires from previous years.

ACCESS TO HEALTH CARE SERVICES

Basic health care services are a crucial component of sustainability in the Prairie ecozone. Manitoba's health care system attempts to provide general services at the local community level while more specialized treatment is offered within larger centres.

The vast majority of acute care services are concentrated in Winnipeg hospitals. Typically, Prairie ecozone residents visit their community physician on a regular or "as needed" basis. In some emergency cases, or if specialized treatment is required, they are transferred to Winnipeg. The lack of acute care services has always made life in the Prairie ecozone challenging.

The Manitoba Health Services Commission maintains a variety of statistics on the delivery of health care in the province. Some of these data are tracked on a regional basis. Material relevant to the Prairie ecozone can be used to provide viable sustainability indicators.

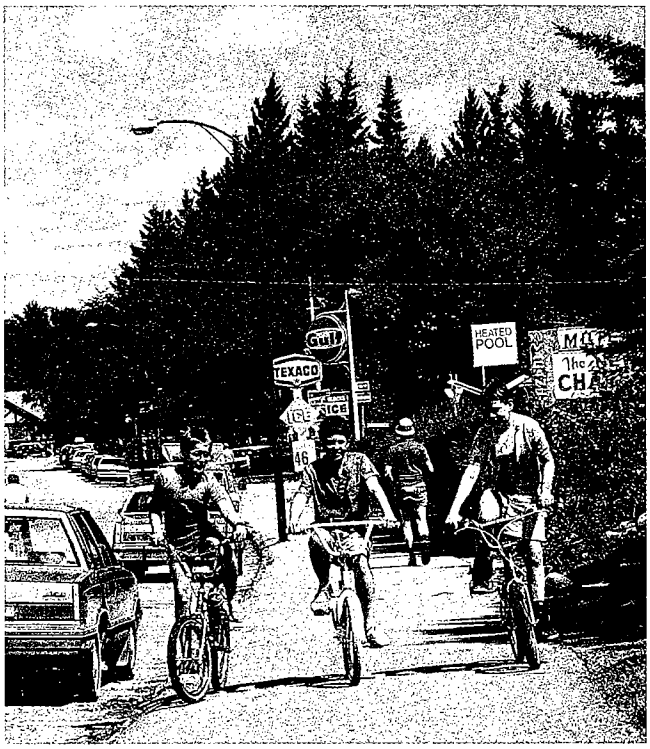


Figure 2.56

PRAIRIE ECOZONE TRENDS IN HEALTH CARE
1991-1995

Year	Beds per 1000 Population	Rural GPs per 1000 Population[1]
1991	6.33	0.77
1992	6.18	0.78
1993	6.44	0.77
1994	5.46	0.72
1995	5.35	0.71

Source: Manitoba Health Services, 1996

1. Includes general practitioners in all areas of rural Manitoba. Reports in later years include regional statistics.

TREND: ▼

The trend for health care services is declining. In recent years, many jurisdictions have tried to address the spiraling cost of health care. Manitoba began restructuring service delivery in the early 1990s and the process continues. Figure 2.60 indicates various trends within the health care sector.

The statistic, "beds per 1,000 population", indicates the number of hospital beds has declined substantially since 1991. General practitioner services have also dropped slightly. The "total number of medical services per 1,000 population" appears steady at approximately 9,135, although the significance of any trend in this area may be difficult to ascertain. Medical services include total visits, consultations, surgeries, laboratory tests and related activities.

The per capita cost of health care delivery has remained stable, at approximately $182.55, although, in real dollar terms (accounting for minor inflation), they have dropped somewhat. This trend can be considered positive from a cost perspective, although the ability of health care staff to maintain service quality may be compromised. The availability of personal care beds per capita has remained steady, at approximately eight per 1,000, despite a gradual increase in need.

Implications For Sustainable Development

The issue of health care delivery has major implications for sustainable development in the Prairie ecozone. To lead productive lives, ecozone residents must maintain a basic level of personal health. This, in turn, requires delivery of a full range of health care services from primary and preventive care to acute treatment.

Prairie residents cite the lack of doctors, nurses, and health care services in smaller towns as a major issue. As well, rapidly increasing costs seriously compromise the ability to provide services in the future. Without additional revenue, the resources required to maintain current levels must be appropriated from other programs. This may have important sustainable development implications for the environment, education, agriculture, natural resources and family services.

EDUCATION AND TRAINING

Until 30 years ago, one-room school houses dotted the Prairies. Often, the resident teacher lived in the rear of the school building or boarded with a nearby family. With the introduction of provincial funding for school bus service in 1967, the centralization process began.

Today, children in the Prairie ecozone may go to three different facilities in three different communities to obtain their primary education. Bus rides of up to one hour are scheduled in some areas. However, rural children receive a comparable education to other children in the province. With the expansion of Internet services, it is likely that educational opportunities will continue to improve.

There are now a variety of training programs available to enhance future employment opportunities. Many of these involve apprenticeship training for skills needed in the Manitoba economy. Sectors requiring skilled labour are affected by the availability of potential employees with appropriate training. Distance education is becoming another popular method of educational achievement.

A range of data are available to assess sustainability with regard to education and training: the number of high school graduates, the number of university graduates and the number of students enrolled in post-secondary colleges. While there are strong data about public schools in the ecozone, there are several weak points, particularly related to post-secondary education. Data on investment by government in training programs are also limited. In recent years, there have been ongoing negotiations between the federal and provincial governments. This has resulted in significant adjustments in funding formulas, making it difficult to define sustainability trends accurately.

ENVIRONMENTAL INDUSTRIES COOPERATIVE EDUCATION PROGRAM A FIRST IN CANADA

The Environmental Industries Cooperative Education Program was created through a partnership with the Triple S Development Corporation, Focus 2000 and the Selkirk School Division. Partial four-year funding was provided by the federal government.

The program, introduced at Lord Selkirk High School in January 1995, offers students a chance to explore some of the more than 200 careers in environmental industries, while receiving high school credit. It also helps students make the transition from school to work.

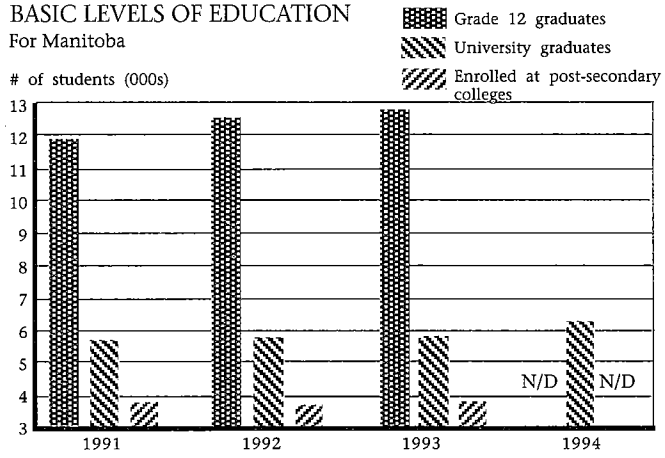
The program is divided into four classes:

- introduction to environmental issues
- introduction to environmental industries, laboratory techniques and theory
- introduction to the Workplace Hazardous Materials Information System (WHMIS) and The Transportation and Handling of Dangerous Goods Act
- technical communications for environmental workers.

All classes help to promote interest in scientific values, sustainable development values, team skills and problem-solving skills. The program allows students to explore the rapidly expanding job field of environmental industries. The aim is to prepare students for the job market, particularly in the environmental field. Forty students have taken the course as of January 1997. This program was a winner of the 1995 Sustainable Development Award of Excellence, in the education category.

Figure 2.57

BASIC LEVELS OF EDUCATION
For Manitoba



Source: Statistics Canada Catalogue No. 81-229

N/D = No Data

Figure 2.58

GOVERNMENT INVESTMENT
In selected Ecozone training programs per trainee, 1995

Federal (HRDC) expences at ACC*	2135
Federal (INAC) expenses at BU & YC**	9629
Provincial funding to BU	8905
Provincial funding to ACC	7244
Provincial funding to 4 selected colleges***	6570
Average measured federal and provincial $	6897

Source: Manitoba Education and Training, 1996

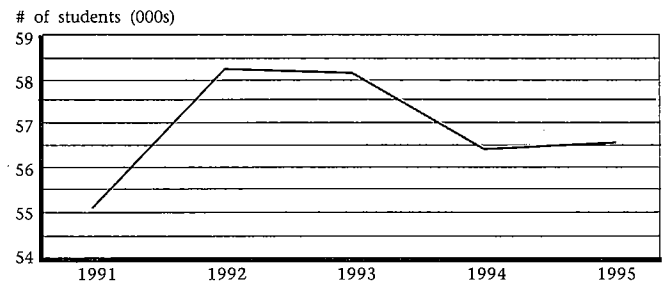
** Includes training services purchased directly from Assiniboine Community College in Brandon by Human Resources Development Canada.*

*** Includes funding to Prairie ecozone First Nations communities provided by the Post Secondary Student Support Program of Indian and Northern Affairs Canada.*

**** Funding included total per trainee costs for the Stevenson Aviation Academy, Manitoba Fire college, and two private religious colleges.*

Figure 2.59

ENROLMENT RATES
For Manitoba



Source: Enrolment & Transported Pupils Report, Schools Finance Board, 1995

TREND: =

The trend for education and training is steady. The number of high school and university graduates is increasing. This is considered healthy and should benefit the province. Enrolment at post-secondary colleges has remained stable for the brief period for which we have data.

Enrolment rates have remained steady since 1991, at approximately 96% of all six- to 18-year-old children. Manitoba Education estimates that this totals approximately 56,000 students. This number is based on provincial enrolment ratios and population estimates. The average distance travelled to school has also remained constant at 1.2 kilometres.

Student-teacher ratios are up slightly, having increased from 18.11 students per teacher in 1991 to 18.80 students per teacher in 1995. The student-teacher ratio is a standard measure used by Manitoba Education and Training. It reflects the average level of professional services delivered within the public school system. It includes teachers of physical education, music, English as a second language, in addition to regular classroom teachers. School-based administration personnel are excluded. This ratio is an average for all Manitoba schools. While there are some schools with lower student-teacher ratios, higher ratios are common in many Manitoba school settings.

Post-secondary attainment and Grade 12 achievement trends are not discernible from the available data. In 1991, 35.9% of the population over 15 years of age had post-secondary training. Further data will not be available until the next census report is released in 1998.

Only a benchmark at 1995 can be set for trends in training investment by government. *(see Fig. 2.58).*

Federal First Nations training expenditures in Manitoba are estimated to have increased by 18% per year for the past decade.[73] However, it is difficult to track this trend given the rate at which First Nations programs are evolving. It is important to note that Brandon University is a major training centre for First Nations students. First Nations students at this university comprise 25% of the student population.

Implications For Sustainable Development

The delivery of effective education and training programs is paramount to sustainable development within the Prairie ecozone. Increased emphasis on monitoring and evaluating progress is required.

TREND SYMBOLS
▲ Improvement **▼ Decline** **= Steady** **?? Trend unclear** **○ Insufficient data**

PROMOTING LITERACY AND HEALTH

In the past, literacy was measured by grade-level achievement. In 1989, Manitoba's Task Force on Literacy defined literacy as the ability to read, write, comprehend and use mathematics adequately to satisfy whatever requirements the learners determine are important for their lives.[4]

The definition of literacy has broadened to recognize its social context as a set of skills changing through life. Reading is more than decoding the alphabet, it is the ability to understand and employ printed information in daily activities. Literacy is a means to achieve one's goals and to develop one's knowledge and potential.

The causes of limited literacy are broad-based and interrelated. Social and economic factors such as inadequate educational opportunities, family background, abuse and poverty have greater significance than personal factors such as perceptual difficulties and learning disabilities.

Limited Literacy Due to Family Background

Children of parents with reading problems are more likely to have problems themselves. One third of children of parents with less than eight years of education go no further than that level themselves. Research suggests that poverty is both a primary cause and a symptom of lower reading levels.

The consequences of low literacy are immense. Self-esteem suffers and access to employment and economic security is severely restricted. Most lower skilled readers are either unemployed or working in low-paying jobs. While the relationship of literacy to health and well-being is understudied, it is known that poor readers are at risk for poor health for a number of reasons.

- Health information is given and received primarily in complex, written formats.
- Poor readers are reluctant to question, and are less likely to understand what health professionals say.
- Poor readers are more likely to be working in unsafe working environments, unable to read safety instructions and overlooked for training.
- The poverty and associated stresses of poor readers lead to higher morbidity and mortality.
- Lower education levels are associated with poor nutrition, smoking, inactivity and higher stress.

Literacy problems affect the entire economy through the cost of income supplements, retraining and health care. The Canadian Business Task Force on Literacy (1987) estimated that literacy problems cost $4 billion per year.

Within the Prairie ecozone there are many success stories. Literacy programs take place within many communities. There are 68 volunteers providing innovative and learner-involved programs to 588 individuals in several Manitoba communities, including Virden, Brandon, Portage la Prairie, Dauphin, Minnedosa, Roblin, Russell, Winkler and Altona.

COMMUNITY INSTITUTIONS AND PARTICIPATION

Institutions in the Prairie ecozone are another important component of the region's social infrastructure. Institutions are the organized and ad hoc networks through which people contribute to their communities. Rural Manitobans have always been noted for their ability to achieve community goals by working together.

From municipal governments and local cooperatives to charitable and recreational events, the Prairie ecozone is a prime example of community activity, representing a critical and often undervalued component of sustainable development.

Figure 2.60

ECOZONE TRENDS IN GOVERNMENT AND LOCAL PLANNING
1991-1995

Year	UMM Meetings* Related to Sustainability	Number of Community Round Table Initiatives
1991	n/a	17
1992	23	25
1993	52	37
1994	38	47
1995	47	50

Source: Manitoba Rural Development

** Includes meetings of the UMM Executive with other levels of government. The vast majority of these meetings would most appropriately be catagorized as economic.*

EXTENSION AND COMMUNITY DEVELOPMENT

Extension and community development programs provide rural communities with practical and economic information as well as other forms of assistance. They offer information on new farming methods, home economics, small business assistance and investment capital to residents in the Prairie ecozone. These programs are offered primarily by the provincial government.

Most of the extension and community development data are not available on a year by year basis. Figures as of 1995 are included as a benchmark for the future. Extensive discussions with relevant institutions and personnel occurred in the hopes of determining suitable indicators for future sustainability assessment. Ideal information would include the range of extension services offered and the various forms of financial advice or funding assistance provided.

Also, an evaluation of usefulness or effectiveness would be helpful. A very significant indicator may involve the role of Manitoba's credit unions/caisse populaires which represent major economic activity in the region.

Figure 2.61
EXTENSION AND COMMUNITY DEVELOPMENT PROGRAM TRENDS
In the Prairie Ecozone, 1995 (#s)

# of regional* agriculture field offices	35
# of agricultural extension reps.	26
# of agricultural credit corporation services	12
# of Manitoba Crop Insurance Corp. agents	15
# of home economist services	11
# of other extension specialists**	65

Source: Manitoba Agriculture, 1996

** Includes all Manitoba Agriculture offices within the Central, Northwest, and Southwest regions (except The Pas and Ashern).*

*** Includes a wide range of specialists in the areas of agricultural Crown lands, soils and crops, 4H/youth programs, pests, and livestock support. Extension staff in regional and central offices are included.*

TREND: 〓

The trend for extension and community development is steady. The number of agriculture extension offices within the Prairie ecozone has remained constant during the reporting period. It is important to note many aspects of Manitoba Agriculture focus on extension services. This support is provided through central or field offices throughout the region.

In terms of community development, Manitoba Rural Development maintains six regional offices within the Prairie ecozone. Technical and funding assistance is provided through the Rural Economic Development Initiative (REDI) as well as through various Community Economic Development (CED) Services. Definite growth trends are evident in both project areas. In 1995, 122 projects were funded through REDI in the Prairie ecozone, at a value of $4.3 million.

Community Economic Development Services (CED) include community round tables and conservation districts. *(see story opposite)*. Other CED projects and funding include downtown revitalization projects and various local Grow Bond issues of investment capital. The number of CED projects in the Prairie ecozone has increased from three in 1991 to 18 in 1995. In dollars, $8 million was spent on these projects in 1995, compared $1.2 million in 1991.

The Community Futures program, a federally supported initiative created in 1986, has seen five of its 14 Manitoba corporations established in the Prairie ecozone. These are:

- Dakota Ojibway
- Heartland
- Parkland
- Wheat Belt
- Central Plains.

The Community Futures model promotes development within local communities as opposed to attracting industry from outside. As of 1994, these corporations had invested more than $40 million into expanding local capabilities and economic growth potential. While a figure from previous years was not available, a clear growth trend has been occurring.

Implications For Sustainable Development

Extension services provide technology and information about improved agriculture techniques. It is important to offer farmers and other prairie residents the latest information. Benefits may include increased efficiency and profitability, more diversification options and environmental enhancement. All these aspects contribute to sustainability.

STRONG PRAIRIE INSTITUTIONS

Since the first rural municipalities and local government districts were established in the Prairie ecozone more than a century ago, grassroots participation in government and planning has been a major facet of life. For 25 years, conservation districts have been developing and now cover approximately 50% of the Prairie ecozone. Community round tables are relatively new forms of local government participation. Both approaches are useful means of community participation and typically spring from the interests of local government.

The number of municipal corporations (including rural municipalities, towns and villages) participating in conservation districts has increased from 38 in 1991 to 61 in 1995. From 1991 to 1995, the total value of all conservation district expenditures, including support from external business and organizations, increased from $2.9 million to $3.7 million. Manitoba's conservation districts receive 75% of their funding from the provincial government and 25% from the local government. Increasingly, additional funds are supplied from external sources.

Community round tables have evolved as a uniquely Canadian method of achieving consensus on interrelated issues. Manitoba's community round tables have focused on developing a community vision. Once there is agreement, the groups serve as a medium for addressing other important issues.

Community round tables and conservation districts contribute toward sustainability in the Prairie ecozone because they serve as forums for discussion of environmental, economic and social issues. They are solution-oriented approaches that consider all relevant aspects of sustainable development.

CULTURE, HERITAGE AND RECREATION TRENDS

Cultural, historical and recreational activities are fundamental to a healthy, thriving community. Historically, they have been central aspects of life within the Manitoba Prairie ecozone.

In 1995, there were:

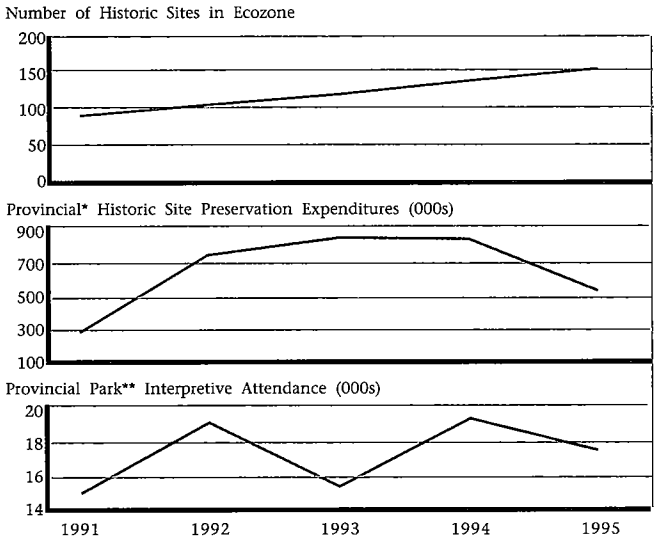
- 21 French immersion schools
- 33 schools offering courses in German
- 10 schools offering Native language instruction
- 231 recreation facilities in the Prairie ecozone, including pools, arenas and curling rinks
- 235 community festivals
- 151 historic sites.

Seventy per cent of the ecozone's municipal corporations were served by a recreation director.

A limited range of indicators was available for assessing the sustainability implications of culture, heritage and recreation within the Prairie ecozone. While they provide some insight into this aspect of life in the ecozone, they are not exhaustive. Significant efforts will be required to monitor these and related indicators in greater detail.

Figure 2.62

CULTURE AND HERITAGE TRENDS
In the Prairie Ecozone



Sources: Manitoba Culture, Heritage, and Citizenship and Manitoba Natural Resources, 1996

**Expenditures may vary on an annual basis in accordance with projects undertaken.*
***Includes actual attendance at Interpretation Programs offered via the Spruce Woods Provincial Park Interpretive Centre and the St. Norbert Reception Centre*

TREND: =

The trend for culture, heritage and recreation is steady. The number of historic sites in the region has increased substantially, from 94 in 1991 to 151 in 1995. Expenditures on provincial historic sites have also grown, from $2.6 million in 1991 to $5 million in 1995.

Many community festivals are held in the Prairie ecozone each year, but only benchmark data are available. The Prairie ecozone is well served by an extensive network of recreational facilities and, often, professional staff support. These figures are reported to be stable.[37] While the reported number of recreational facilities in the ecozone seems small, it should be noted that nearly every community in the region, regardless of size, has at least one facility.

The number of schools in the Prairie ecozone offering Native language instruction has declined by two, from 12 to 10. The reasons for this are unclear and they appear to be offset by expansion in Winnipeg.

Implications For Sustainable Development

Culture, heritage and recreation are important aspects of life for Prairie ecozone communities. These activities provide opportunities for learning, participation and fellowship for ecozone residents. E ach of these opportunities may improve an individual's desire or ability to work and be creative. Recreation, in particular, can contribute to one's health and energy levels, further enhancing productivity and quality of life.

The availability of Native language instruction and other cultural activities is particularly relevant to sustainable development in the Prairie ecozone. Fostering an enhanced cultural identity within any community contributes to general well-being.

FIRST NATIONS' SPIRITUALITY AND CULTURAL CONTINUITY

In an age when there is much effort devoted to preserving the productive capacity of the land on the Prairies, it is also important to remember the traditions and spiritual values that help people connect to their environment and use its assets with respect and care. Treasuring our traditions, sites and objects of the past help us make this connection. Although often overlooked, the Prairie ecozone is rich in spiritual sites and traditions.

One of these is the Nahastewin Site located on a high point of land at the west end of Rock Lake, just west of Pilot Mound in southern Manitoba. The obvious features at this site are a complex series of burial mounds. Less obvious are the archaeological materials left behind in associated campsites near these earthworks.

Intriguing Artifacts Found at Site

The earliest known feature at this site is a limestone slab platform which may have served as an altar. A projectile point from an arrow or spear was recovered from the western edge of the feature and there is a small amount of charcoal and charred animal bone associated with it. The site may be as much as 2,500 years old.

Campsites scattered around burial mounds, indicate ongoing use of the site until possibly as late as A.D. 1600—over 2000 years of ceremonial and spiritual communion.

With its magnificent, panoramic view, the site would have been a suitable resting place for loved ones as they began their spirit journey to join their ancestors.

There are other such sites throughout southwestern Manitoba. They form a focus of continuity for First Nations spirituality.

AN ENVIRONMENTAL INITIATIVE THAT WORKS FOR CANADA'S FIRST PEOPLES

The Centre for Indigenous Environmental Resources (CIER) was founded in 1994 by a board of 10 First Nation leaders from across Canada. Together, they established a mandate aimed at increasing First Nations participation in environmental decision making.

At the heart of this initiative is a commitment to create and implement First Nation environmental capacity at the community level. This includes design and delivery of a post-secondary environmental education and training program, assisting First Nations with a broad range of environmental services and undertaking indigenous environmental research and policy development.

Education and Training Program Meets Broad Objectives

CIER's 27-month environmental education and training program is based on meeting a broad range of environmental, social and economic objectives from a First Nation perspective. The program provides First Nation youth with viable community development options in addition to the necessary capacity to engage in environmental protection initiatives in a manner that is consistent with the underlying principles of natural law. In many senses, this approach is similar to what many groups refer to as sustainable development.

Training First Nation youth in environmental applications not only serves to help communities understand and deal with their environmental issues, but also facilitates a community's move toward greater self-sufficiency by providing employment opportunities. Many students plan to take the knowledge and skills learned through the program back to their communities to assist in finding solutions to common environmental issues, such as inadequate water and sewage treatment and contamination of water supplies.

HUMAN LIFE ON THE PRAIRIES

Sustainable development extends beyond the level of the community to the well-being of the individual. The framework for assessing sustainable development in the Manitoba Prairie ecozone includes trends that affect the average resident. These issues encompass the areas of well-being and satisfaction. While some of these issues are nearly impossible to measure accurately, they may be some of the most important.

Society is changing its view of how health and well-being are defined. The definition of health has changed from "the absence of disease or physical problems" to "physical, mental and social well-being".[4]

The way individual and community health are measured is also changing. Traditional measures of longevity, rates of disease and death, and measures of physical health are now being supplemented. Information on quality of health and well-being, the impact of health problems on everyday life and measures of mental and emotional health have been added.

Sustainable development indicators in this area include individual health; equity, empowerment and wealth distribution; personal safety; and quality of life.

Similar to issues covered in the health services section, individual health and welfare may be affected by the availability of support services relative to urban centres such as Winnipeg.

Security and accident-free living help to ensure the productivity of individuals who contribute to society. Like many other occupations, farming has pressures that take their toll. Addictive habits can become problematic. As well, chronic social problems exist in the ecozone, as they do in all other areas of the province.

INDIVIDUAL HEALTH TRENDS

Several conventional health indicators were used to evaluate sustainability for this issue. Ideally, a wide range of information relating various health concerns to environmental risk factors would be included. It is important to note there are many problems associated with environmental health indicators.

For example, lung cancer rates could be associated with a radon gas risk or with smoking. Greater efforts could be devoted to monitoring these issues in the future. All health indicators were taken from the 1996 benchmark, *Report on the Health of Canadians*, prepared by the Federal, Provincial, and Territorial Advisory Committee on Population Health.[26] The data cover the entire province, not just the Prairie ecozone.

Figure 2.63

INDIVIDUAL HEALTH TRENDS
In the Prairie Ecozone, 1995

Disability-free life expectancy (years)	69.4
% of Manitobans with high blood pressure	22
% of Manitobans overweight	36
% of Manitobans with high blood cholestoral	15
Manitoba teen pregnancy rate per 1000	60
Low birthweight rate (5)	5.4
New male cancer incidence per 100,000	456
New female cancer incidence per 100,000	343

Source: Federal, Provincial, and Territorial Advisory Committee on Population Health, 1996

Figure 2.64

INDIVIDUAL HEALTH TRENDS
In the Prairie Ecozone, 1995

% of Manitobans smoking	29
Smoking attributable deaths(%) on prairies (F/M)	13.6/22.9
% of Manitobans who drink heavily on a regular basis	19
% of Manitobans drinking and driving	18
% of Manitobans reporting 2+ sex partners	10
Gonorrhea rate per 100,000	84
Chlamydia rate per 100,000	292
AIDS rate per 100,000	1.2
Infant mortalilty per 1,000	6.8

Source: Federal, Provincial, and Territorial Advisory Committee on Population Health, 1996

TREND: ??

The trend for individual health is unclear. For the most part, Manitobans experience similar health patterns to the national average. However, some differences are important to note. More Manitobans are overweight compared to other Canadians. Manitoba also has a significantly lower rate of AIDS infection. However, other sexually transmitted diseases (such as chlamydia and gonorrhea) occur at substantially higher rates in Manitoba than in other provinces. From 1991 to 1993, infant mortality has remained constant at 6.8 per 1,000 live births.

Implications For Sustainable Development

Income, education and employment are all indicators of living and working conditions. These factors affect health, but also interact with each other. The combined factors of chronic unemployment, inadequate education, inadequate nutrition and poor housing contribute to the poor levels of health experienced by many disadvantaged groups. Like many other issues within the ecozone, efficient service delivery and availability are predominant factors affecting the lives of prairie people as compared to residents of larger urban centres.

TREND SYMBOLS
▲ **Improvement** ▼ **Decline** = **Steady** ?? **Trend unclear** ○ **Insufficient data**

EQUITY AND POVERTY

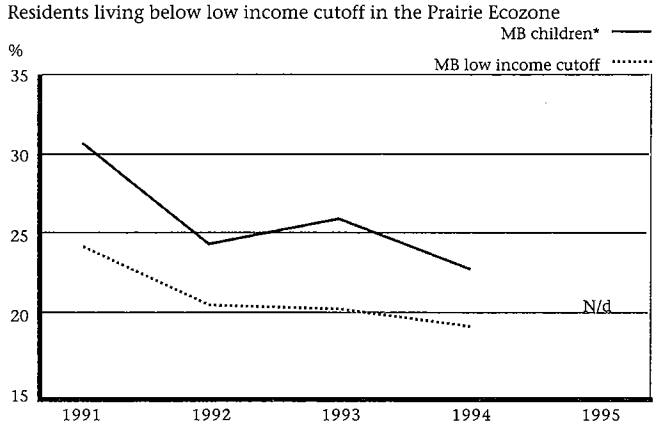
One of the fundamental tenets of sustainable development involves the interrelated issues of equity, empowerment and wealth distribution and these issues remain high on the social agenda. From the Manitoba Prairie ecozone to the developing world, individuals with few advantages face the challenges of daily life without the same opportunities as many others in society.

Poverty Levels

A range of benchmark and time-series data are available to assess this issue. Aspects under consideration include poverty levels, income disparity and unemployment equity. The status of First Nation reserves and land claim settlements are very significant issues and are also considered in detail.

Figure 2.65

EQUITY, EMPOWERMENT, AND WEALTH DISTRIBUTION
Residents living below low income cutoff in the Prairie Ecozone

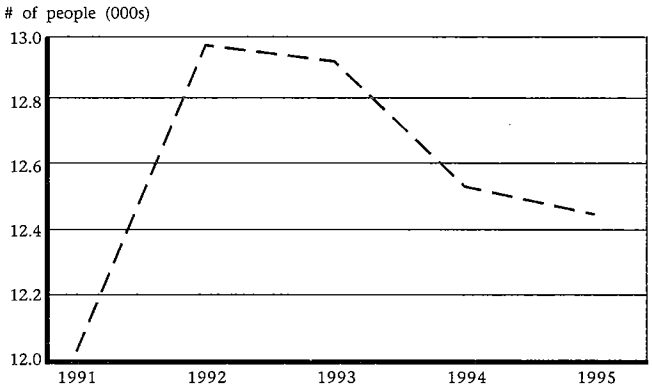


Sources: Statistics Canada, Low Income Persons 1991-1995

** Determined by the percentage of children living in families where more than 56% of family income was spent on basic necessities, according to the 1992 low income cutoff base established by Statistics Canada.*

Figure 2.66

NUMBER OF PEOPLE ON SOCIAL ASSISTANCE*
In the Prairie Ecozone

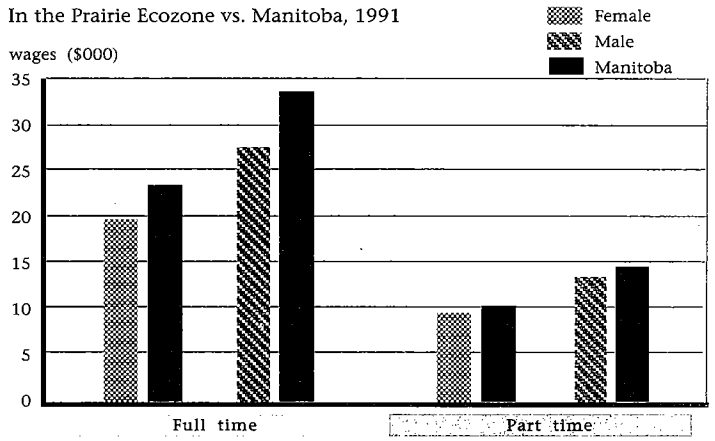


Sources: Manitoba Family Services, Annual Reports

**This includes the Income Assistance District Office of Brandon, Dauphin, Morden, Portage la Prairie and Selkirk.*

Figure 2.67

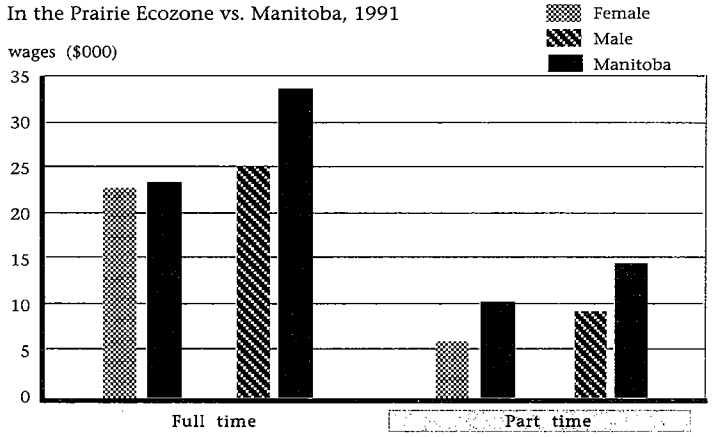
AVERAGE WAGES
In the Prairie Ecozone vs. Manitoba, 1991



Source: Statistics Canada, 1996.

Figure 2.68

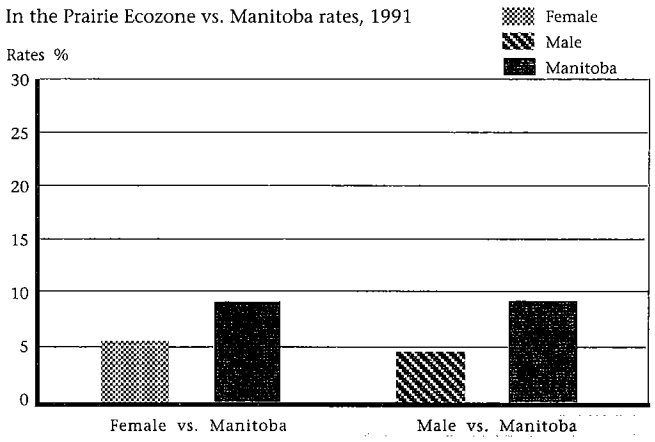
FIRST NATIONS' AVERAGE WAGES
In the Prairie Ecozone vs. Manitoba, 1991



Source: Statistics Canada, 1996.

Figure 2.69

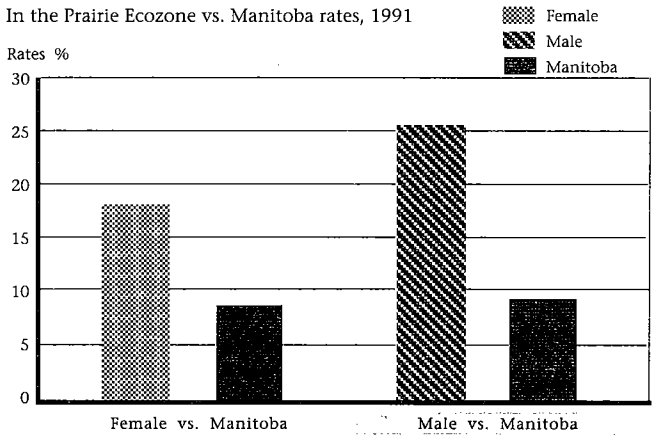
UNEMPLOYMENT RATES
In the Prairie Ecozone vs. Manitoba rates, 1991



Source: Statistics Canada.

Figure 2.70

FIRST NATIONS' UNEMPLOYMENT RATES
In the Prairie Ecozone vs. Manitoba rates, 1991



Source: Statistics Canada.

TREND: ??

The trend related to equity and poverty levels is unclear. The challenge of addressing poverty in Manitoba has been an ongoing concern. Child poverty and the number of people on social assistance show a definite downward trend. There may be many reasons for this trend, including the migration of disadvantaged people out of the province.

Also, using the poverty line as an accurate measure is open to debate. Although Statistics Canada's low income cutoffs are commonly referred to as official poverty lines, they have no officially recognized status nor does Statistics Canada promote their use as poverty lines.

Statistics from 1992 were used as a benchmark for households in the low and high income categories. They were also used for the expenditures of these groups on basic needs (food, clothing and shelter). In that year, 37,745 households in the Prairie ecozone had incomes of less than $20,000, while 32,105 households had incomes of more than $50,000.

Wage Disparity Continues

Substantial wage disparity exists between females and males who work full-time within the ecozone and within Manitoba overall. A similar trend is apparent regarding part-time employment. Statistics Canada reports that women still earn an average of 73¢ to every $1 earned by men. This is a slowly improving trend.

While female unemployment is slightly lower than that of males in Manitoba overall, the reverse is true within the ecozone. This is likely indicative of the prevalence of farm families in which males are the predominant income earners. The issue also relates to concerns such as a lack of day care and off-farm job opportunities for women.

It is important to recognize, however, that this kind of traditional indicator uses men's experience as the norm for all adults and thus, can leave important aspects of women's experience invisible to decision makers. Gender analysis needs to go beyond comparing averages between men and women so that the presence of children is taken into account, along with educational choices and occupations.

Some progress on the resolution of outstanding land claims was made within the ecozone during the period of this report. Treaty Land Entitlement Claims include lands that should have been provided by the Crown at the time reserves were established. From 1991 to 1995, settlements occurred with three First Nations. Two more are outstanding. These agreements included the original reserve entitlement plus an opportunity to purchase additional amounts of land. These agreements involved 13,386 hectares in 1994, worth approximately $17.4 million, and 15,912 hectares in 1995, worth $24.4 million.

However, it will take a long time to execute these agreements, because of the difficulties in acquiring land within settled regions of the ecozone. No progress has been made since 1991 regarding outstanding claims. Five First Nations groups are awaiting the results of a federal review of their claims.

Implications For Sustainable Development

Equity, empowerment, and wealth distribution are fundamental to sustainable development within the Prairie ecozone. As described in the 1987 Report of the World Commission on Environment and Development, without concentrated efforts to address inequality, disadvantaged groups will continue to be denied the same opportunities as other Manitobans and true sustainability will be impossible.

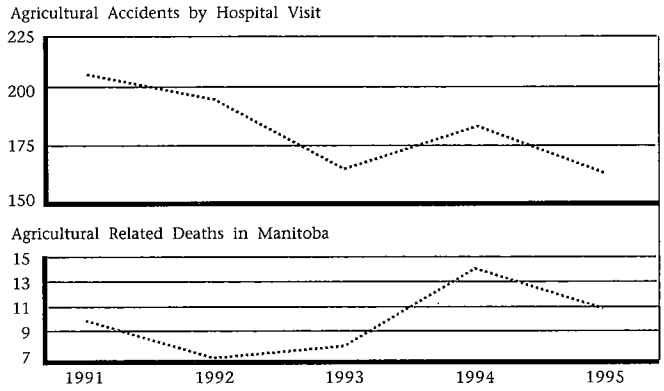
TREND SYMBOLS

▲ **Improvement** ▼ **Decline** = **Steady** ?? **Trend unclear** ○ **Insufficient data**

PERSONAL SAFETY

Several data sources were used to assess personal safety in the Prairie ecozone. Information from Manitoba government departments, the RCMP, and the report by the Federal/ Provincial/Territorial Advisory Committee on Population Health contributed to this overview of the safety issue.

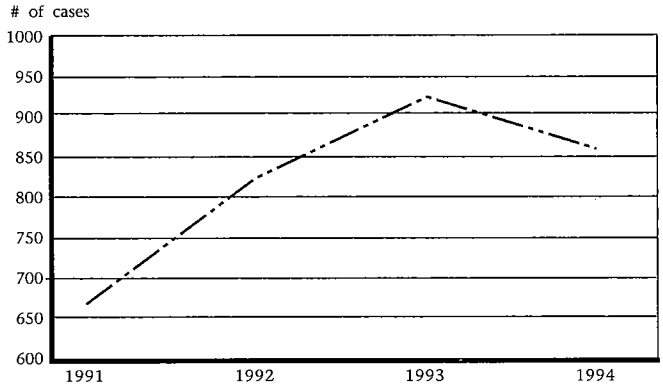
Figure 2.71
PERSONAL SAFETY-AGRICULTURAL
In the Prairie Ecozone*



Source: Manitoba Labour

**Accidents/hospitalizations and death statistics are Province-wide.*

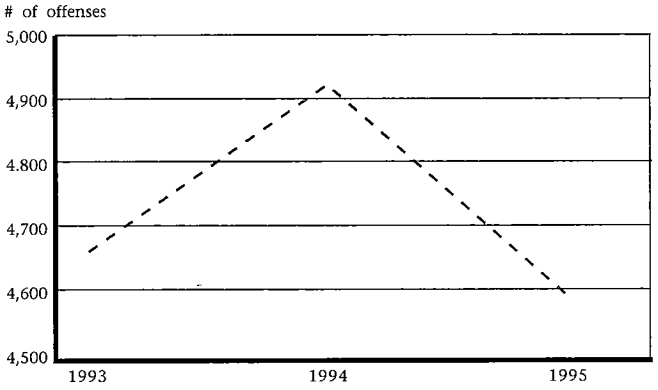
Figure 2.72
REPORTED CHILD ABUSE*
In the Prairie Ecozone



Source: Manitoba Family Services, Annual Reports

** As reported by the following agencies: Child and Family Services of Central and Western Manitoba, Interlake and Parklands and the Dakota and Ojibway and West Region Child and Family Services.*

Figure 2.73
CRIMINAL OFFENCES
In the Prairie Ecozone*



Source: RCMP, 1996

** Includes the total actual number of offences after initial reporting and subsequent investigation.*

TREND: ??

The trend for personal safety is unclear. The number of agricultural accidents is decreasing, although this may be due to a declining farm population. Clear trends are not evident regarding child abuse, criminal offences. The number of reported child abuse cases has increased over time. However, this may not indicate an actual increase in cases, but rather society's growing awareness and reporting of abuse. An accurate trend is very difficult to determine.

Another indicator is women reporting physical or sexual violence. A 1993 Statistics Canada survey found that 49% of Manitoba women over the age of 18 had experienced violence ranging from unwanted sexual touching to physical attack resulting in injury.[26]

Implications For Sustainable Development

While the assurance of personal safety facilitates progress in other areas of sustainable development, the absence of a clear trend in this area makes future projections difficult. One trend is certain: increased awareness and sensitivity to safety issues is occurring. The availability of adequate victim assistance facilities and programs is an important sustainable development issue.

QUALITY OF LIFE BENCHMARKS

Perhaps the most intangible measure of sustainable development relates to quality of life. A person's quality of life influences his or her happiness and ability to contribute to society. Several indicators comprise this issue area including physical health, mental health and job satisfaction.

As well, some Prairie ecozone residents now view landscape conservation and diversity as important contributions to quality of life in the region. *(see story, opposite).*

A comprehensive benchmark study prepared by the Federal, Provincial and Territorial Advisory Committee on Population Health (1996) serves as the source of information for this indicator. It provides province-wide data only. Information on the Prairie ecozone is not identified separately.

Figure 2.74

QUALITY OF LIFE TRENDS
In the Prairie Ecozone, 1995

% of Manitoba residents rating their health as "Excellent"	24
% of MB residents rating their psychological well-being as "High"	10
% of Manitoba residents "Very Satisfied" with their jobs	51
Probable risk of clinical depression in Manitoba (%)	8
% of Manitobas experiencing high chronic stress	29
Average Manitoba work stress index (maxiumum score = 45)	20.4
Manitoba suicide rate per 100,000	11

Source: Federal, Provincial, and Territorial Advisory Committee on Population Health, 1996

TREND: ??

A range of indicators is available to monitor quality of life indicators in Canada. However, data are only available as a benchmark at the provincial level. No clear trends are evident. Manitoba rates similarly to the other Prairie provinces for most indicators. However, Manitoba's rates of depression, high chronic stress and work stress indices are significantly higher.

Implications For Sustainable Development

Quality of life is largely intangible, but it is a fundamental component of sustainable development. How people feel about themselves and their situations dictates how they function on a daily basis. This, in turn, reflects on their contributions to sustainability in the Manitoba Prairie ecozone.

A LINK BETWEEN QUALITY OF LIFE AND LANDSCAPE CONSERVATION

In 1992, the Manitoba Habitat Heritage Corporation (MHHC) commissioned a survey by Western Opinion Research on the importance of wildlife habitat conservation to people in southwestern Manitoba. This region generally corresponds to the Manitoba Prairie ecozone. The poll found that quality-of-life concerns are connected to environmental issues.

The survey of 403 people generated several conclusions.

- More than 75% of those surveyed said they believe programs designed to enhance wildlife habitat also benefit farmers. A similar number support the use of public funds for cost-shared conservation programs.
- The great majority supported initiatives such as conservation tillage and planting grass or trees on sandy or hilly land.
- Over 90% felt that maintaining bush, sloughs and grassland was important to their quality of life. They said these areas maintain quality in lakes and streams, provide homes for plants and animals and contribute to the natural beauty of the landscape.

The survey indicates that many rural residents gave conservation issues equal importance to economic development issues. These results in southwestern Manitoba suggest that wetland and wildlife restoration projects may find wide public appeal across the Prairies.

TREND SYMBOLS
▲ **Improvement** ▼ **Decline** 〓 **Steady** ?? **Trend unclear** ○ **Insufficient data**

CONCLUSIONS FOR THE PRAIRIE ECOZONE

Evaluating progress toward sustainable development is a challenging, but as demonstrated by the focus chapter, a possible and worthwhile exercise. In many ways, this chapter needed to transcend conventional State of the Environment reporting practices. This was necessary because only by looking into a mirror of social, environmental and economic realities *together* can we gain the full insight to realize the threats and opportunities for the future.

All of the indicators reported are Prairie-ecozone specific, some of them with little relevance in other regions of Canada or the world. This is unavoidable, given that many sustainable development issues identified in the consultative process leading to the focus chapter are important only in the Manitoba context. Other sustainable development indicator sets in the world are also expected to contain a mix of locally relevant and universal measures.

Despite significant research efforts, some indicators could not be appropriately reported. Availability of adequate data is one of the most common impediments. In cases like surface water availability or stratospheric ozone levels, monitoring efforts would need to be stepped up in order to gather basic information necessary to calculate a meaningful indicator. The same is true for population trends of wildlife species or biodiversity. Hard numbers obtained through serious monitoring efforts are necessary to shed light on these areas of concern, either supporting or correcting broadly held public perceptions. Gaps like these can be identified only in a process that looks at the full range of sustainable development issues, like the consultative process used during the preparation of this chapter.

Is Manitoba Sustainable?

Is Manitoba's Prairie ecozone progressing toward sustainable development? For readers who glanced through the main section of the focus chapter it should be immensely clear that finding an answer to this question, even based on the presented indicators is anything but simple. Even if we knew the desirable targets for water quality, debt ratio, medical services and so on, how would better performance for some and poorer performance for others balance out for the big picture?

In order to demonstrate the possibilities and challenges of this task for future reporting, a subset of the indicators reported in the focus chapter were chosen for aggregated analysis. In the first step, a decision had to be made about what indicators to put in the same basket. A representative sample of economic, environmental, community and human life indicators were selected based on their relevance and the quality of available data. In the second step, both best and worst possible performance was identified separately for every single indicator chosen.

Given the limited involvement of prairie stakeholders and the lack of clear scientific guidance in these two steps, both are strongly influenced by the best, but still subjective judgment of analysts. Keeping in mind this important qualification, the analysis is a first and - even internationally - one of the pioneering attempts to express progress toward sustainable development in a highly condensed, aggregated way. The method of using different indicators, often as different as apples and oranges, together is found in a recently developed index called the *Barometer of Sustainability*.[72]

Explaining the Barometer of Sustainability

The barometer organizes and combines indicators to draw conclusions about people and ecosystems, and the effects of their interactions. It is an engaging and visually appealing tool to provide an immediate picture of human and ecosystem well-being together.

The barometer is a performance scale with two axes, one for human well-being, which includes economic, community and human life indicators and the other for ecosystem well-being, which includes indicators for the natural environment. Both axes range from 0, the worst possible performance for any given indicator, to 100, the best possible. Indicators are expressed between 0 and 100 as points on their respective axes. The averages of ecosystem and human well-being are calculated separately.

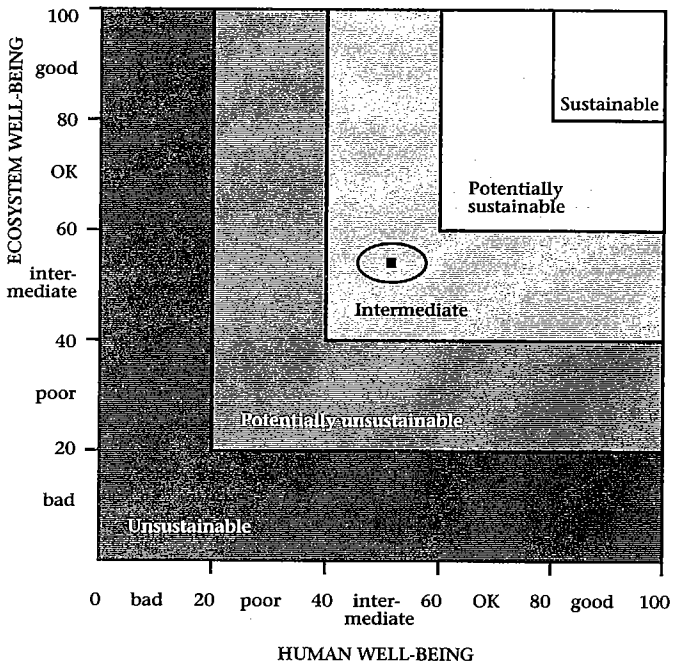
The intersection of these points - one on the human well-being and one on the ecosystem well-being scale - defines a single dot on the barometer, the overall well-being and progress toward sustainable development.

This ensures that an improvement in one index does not mask a decline in the other. Also, a low score on one axis overrides a high score: well-being is based on the worst condition. For instance, excellent economic performance that is paid for through lax environmental standards does not appear as particularly good performance. On the other hand, low achievers on the human well-being front would also rank low even if the environment did very well.

In order to demonstrate the use of the barometer, scales for human and ecosystem well-being were created by selecting indicators and converting their value to a performance scale of 0-100. Indicators were selected if their desirable, acceptable and unacceptable ranges could be defined. National and international statistics as well as available standards were consulted to give an approximate professional judgment for the endpoints of these ranges to make the demonstration possible. Because of the mentioned constraints, many indicators that may be truly important for sustainable development had to be excluded from the barometer.

Figure 2.75

BAROMETER OF SUSTAINABILITY
For Manitoba's Prairie Ecozone



Barometer Scale

The scale is divided into five sectors as shown in Figure 2.75. An ecosystem well-being of 54 and human well-being of 51 defines overall ranking for the Prairie ecozone's Barometer of Sustainability in the "intermediate" range. The ellipse around the dot represents the uncertainty with the calculations. Keeping the constraints of barometer calculation in mind, this position provides information about the status and opportunities for sustainable development. *(see Appendices, beginning on p. 147 for more detailed information).*

Six indicators were used to assess ecosystem well-being. Indicators that negatively influenced the score in this category are related to soil erosion and water quality. Twenty-eight social and economic indicators were used to assess human well-being. Indicators that had the strongest negative impact on the score in this category are related to poverty, waste management and energy use.

TREND SYMBOLS

▲ **Improvement** ▼ **Decline** 〓 **Steady** ?? **Trend unclear** ○ **Insufficient data**

APPENDICES

PROCESS AND CRITERIA FOR INDICATOR SELECTION

The selection and refinement of indicators for Manitoba's Prairie ecozone took place using a consultative process with a group of regional stakeholders and government experts. The objective of this approach was to help focus the indicators on real issues that concern people and organizations in the ecozone.

A Focus Group of stakeholders was formed in the early stage of the project to help guide indicator selection. Focus Group members were selected to ensure broad representation of environment and economic sectors, main social interest groups and organizations. Over time, the initial focus group expanded as additional organizations and individuals expressed interest in taking part in meetings.

In addition to the Focus Group, a Technical Advisory Committee (TAC) with representatives from Manitoba government departments and agencies was set up to help track down and compile information on the selected indicators.

Altogether, four focus group meetings were held. The objective of the first meeting in December 1995 was to compile a list of key sustainable development issues for the Prairie ecozone. The meeting was set up to allow all participants equal access and say in the process using a modified version of the nominal group method. It included individual brainstorming of issues followed by a ranking exercise in which participants assigned ranks to the selected issues based on their importance. The meeting resulted in a list of more than 150 partially overlapping issues.

Following an analysis of results from the first meeting, a second focus group session was called in February 1996 to further refine the list of key economic issues that were not adequately represented in the results of the first meeting. Methods of this meeting were similar to those of the first focus group session.

Based on the results of the first two meetings, preliminary indicators were assigned to every issue. The list of issues was narrowed down by eliminating duplication and using a set of indicator selection criteria, as follows:

- **Policy relevance**

Is the indicator linked to one or several issues around which key policies are formulated? Indicators of sustainable development are intended to improve the outcome of decision-making on levels ranging from individuals and communities to the province, country or world. Unless users can see the connection between the indicator and critical decisions and policies, it is unlikely to motivate action. It is for this reason that appropriate explanations of the implications for sustainable development and linkages to other prairie issues are included in the discussion of indicators.

- **Simplicity**

Can the information be presented in an easily understandable, appealing way to the target audience? Even complex issues and calculations should eventually yield clearly presentable information that the general public understands.

- **Validity**

Is the indicator a true reflection of the facts? Were the data collected using scientifically defensible measurement techniques? Will one arrive at the same result if two or more measurements of the indicator are made? Methodological rigor is needed to make the data easily understood by all audiences.

- **Time series data**

Time series data provide information on the trend of change over time. One or two data points do not provide a clear picture of the direction the community may be going .

- **Availability of affordable data**

Are good quality data available at a reasonable cost or is it feasible to initiate a monitoring process that will make the information available in the future? Information tends to cost money, or at least time and effort from many volunteers.

- **Ability to aggregate information**

Is the indicator about a very narrow or broader sustainability issue of sustainable development? The list of potential indicators is endless. For practical reasons, indicators that combine information on a range of issues should be preferred. For example, organic matter in soil is a useful indicator of soil health and is preferable to having to measure many other potential indicators to come to the same conclusions.

- **Sensitivity**

Can a small change in the system be picked up by the indicator? It is necessary to determine in advance how large or small changes are relevant for monitoring purposes.

The third focus group session was held in June 1996 to introduce the draft list of indicators and ask for the comment of participants. By this time, partial data were available from provincial agencies, using the help of TAC members. Following the completion of data collection and analysis of individual indicators, a small set of measures was selected for inclusion in the Barometer of Sustainability, an experimental tool to aggregate various indicators in the categories of ecosystem and human well-being.

A fourth focus group meeting took place in February 1997 to review final indicator selection and interpretation. The group also discussed and confirmed the inclusion of the Barometer of Sustainability in Chapter 2 as an experimental tool and method.

BAROMETER OF SUSTAINABILITY

Chapter 2 uses an experimental method, the Barometer of Sustainability, adapted from Prescott-Allen[72] for assessing the Prairie ecozone's progress toward sustainability. This appendix presents a brief description of the barometer, the method for calculating scores, and the performance scales used in the assessment.

Application of the barometer involves three steps:

1. establishing performance scales for ecosystem and socioeconomic indicators based on existing targets, comparisons or judgments;
2. calculating barometer scores and placing them on the scale; and
3. illustrating the index of progress within a range of five categories between sustainable to unsustainable.

The barometer scores for Manitoba's human and ecosystem well-being are 51 and 54 respectively, clearly in the intermediate sector of the barometer. Arriving at these values required a number of comparisons and assumptions with varying degrees of uncertainty that collectively influence the final result. They also illustrate the complexity of summary statements about sustainable development.

PERFORMANCE SCALE
for the Barometer of Sustainability

PERFORMANCE SCALE	INTERPRETATION
100-81	good - sustainable
80-61	OK - potentially sustainable
60-41	intermediate
40-21	poor - potentially unsustainable
20-0	bad - unsustainable

Barometer Combines Range of Social, Economic and Environmental Information

The barometer provides a very broad or holistic approach. Its main strength is its ability to combine a wide range of social, economic and environmental information. It makes direct links between maintaining or improving human and ecosystem well-being. It requires stating explicit performance goals or value judgments and offers a transparent assessment process. The barometer provides a visually engaging way of communicating the assessment.

Three examples for calculating indicator barometer scores are described here. Scaling is used to distinguish the range of values in the barometer sectors from bad (unsustainable) to good (sustainable) performance.

When the scale is fully controlled, all sectors on the barometer scale are defined; good performance between 100-81, OK between 80-61, intermediate performance between 60-41, poor between 40-21, and bad between 20-0.

The calculation is completed in six steps:

1. the actual value is subtracted from the minimum value in the sector range,
2. the value of the range is calculated (maximum minus minimum),
3. the ratio of the differences is calculated (result from 1 divided by result from 2,
4. 1 minus the ratio determines a numerator,
5. a sector value of 20, the range between each sector, is multiplied with the result from 4, and
6. the result is added to the base of each sector, 0, 20, 40, 60 or 80.

For example, a proposed biodiversity indicator used in British Columbia is the number of threatened ecosystems as a percentage of all ecosystems.[5] (Data for Manitoba are not readily available, so this indicator was not included in this application.) The explicit performance standard for this indicator defined good as 0% - 4.9% threatened, OK as 5% - 9.9% threatened, intermediate as 10% - 19.9% threatened, poor as 20% - 39.9% threatened, and bad as 40% - 100% threatened. In BC, 32% of all the ecosystems are threatened so the barometer score is in the poor sector. The score was calculated as follows:

A. 32 (actual) - 20 (minimum) = 12
B. 39.9 (maximum) - 20 (minimum) = 19.9
C. 12 (A) ÷ 19.9 (B) = 0.603
D. 1 - 0.603 = 0.397
E. 0.397 x 20 = 7.9
F. 20 + 7.9 = 28 (rounded)

If the best is the maximum value and worst the minimum value, the barometer score is calculated by (actual minus minimum) divided by (maximum minus minimum) multiplied by 100. This method was often used in this application. For example, an agricultural indicator used in this assessment is the average total operating revenue (1990-92) of farms. The Canadian value, equal or more than $100,500, is judged good. The poor sector is judged to be the lowest provincial average, $70,970. Manitoba's average operating revenue was $90,585. The barometer score is calculated :

A. $90,585 (actual) - $70,970 (minimum) = $19,615
B. $100,500 (maximum) - $70,970 (minimum) = $29,530
C. $19,615 (A) ÷ $29,530 (B) = 0.664
D. 100 x 0.664 = 66

A partially controlled scale, defining the end points of what is good (81-100) or bad (20-0) was often used in this application. If the best is the minimum value and worst the maximum the barometer score is calculated by 1 minus (actual minus minimum) divided by (maximum minus minimum) multiplied by 100. Since there is a range in the upper and lower sectors a multiplier of 60 instead of 100 is used and the result is added to 20, the starting point in the range. For example, water quality data for surface water in rivers are compared to the Canadian Water Quality guidelines. Good water quality has an index rating of 0 - 3, and poor is 60 - 100. The long term water quality average in Manitoba rivers is 34, or in the fair to OK range.

Calculating the value for water quality:
A. 34 (actual) - 4 (minimum) = 30
B. 59 (maximum) - 4 (minimum) = 55
C. 30 (A) ÷ 55 (B) = 0.54
D. 1 - 0.54 = 0.46
E. 0.46 x 60 = 28
F. 28 + 20 = 48

Barometer Value for Prairie Ecozone

The barometer value for the Prairie ecozone ecosystem well-being index is calculated from an aggregation of indicators for soil erosion, water quality, air quality, soil conservation and habitat protection.

Soil erosion indicators are the % of cultivated land susceptible to moderate, high and severe wind and water erosion. In the Prairie ecozone wind erosion risk is moderate to high on 54%, and water erosion on 24% of the cultivated land. For this evaluation, 25% exposure to moderate and high risk of erosion was considered bad, and less than 5% was considered good. The barometer values for wind and water erosion are 8 and 21. The two indicators are treated equally and so are added and averaged to provide an indicator of soil erosion: 15.

Water quality data for surface water in rivers are compared to the Canadian Water Quality guidelines. Good water quality has an index rating of 0 - 3, and poor is 60 - 100. The long term water quality average in these rivers is 34, or in the fair to OK range. The barometer value is 48.

Air quality indicators are air quality index data for Winnipeg and total suspended particulate (TSP) in Brandon. These are compared to Canadian indices, and similar scaling values used for British Columbia. For the air quality index good is a value between 0 - 25, bad is greater than 100. Winnipeg's average index is 12.13, or a barometer value of 90. TSP are assumed to have the same significant relationships to health as small particulate matter (PM10) discussed in BC. Good is valued between 0 and 20 micrograms per cubic metre, and bad greater than 200. (This is assumed by the writer and judgment is not recognised by air quality objectives. See BC Commission on Resources And Environment p. 4-62). The long term annual average TSP levels in Brandon is 33, and has a barometer value of 71. The air quality index for Manitoba's Prairie ecozone is the average of these two indicators, 80.

An indicator for land conservation in the Prairie ecozone is the ratio of the area of land in summerfallow to that in crops, and is compared to values for western Canada. The Canadian ratio is 0.27:1, so that is good. A ratio greater than 0.35:1 is considered bad. Manitoba's ratio is 0.10:1 and a barometer value of 72.

The barometer score for the Prairie ecozone's well-being is the average of these values: 54 - intermediate. Ecozone well-being is influenced by low performance achievement in soil erosion and water quality.

The barometer value for the Prairie ecozone human well-being index is calculated from an aggregation of agricultural, community asset, economic and individual health indicators.

Agricultural Index

An agricultural index was developed by collecting available published data from Statistics Canada. These are additional to the indicators discussed in the report. One selected indicator is the average total income of farm families after capital cost allowance, 1990-91. The Canadian average of $38,880 or more is set as the standard for good. The lowest provincial average , Manitoba of $31,754 would be the start of the poor sector on the scale. This is by default a barometer score of 20.

Another selected agricultural indicator is off-farm income as a percent of total income 1991. The Canadian value of 67.4 or less is good. The low end of the scale is 79.3. The value for Manitoba is 62.5. The resulting barometer score is 85.

A third selected agricultural indicator is the percentage of farms with negative or zero net operating revenue. The Canadian score is 27% so that or less is good. The poor score is 30.7% or more. Manitoba had only 21% of its farms in 1992 in a negative or zero net operating income position. This converts to a barometer score of 89.

A fourth selected agricultural indicator is the average total operating revenue (1990-92). The Canadian value, equal or more than $100, 500, is good. The poor sector would be the lowest provincial average, $70,970. Manitoba's average operating revenue was $90,585. This converts to a barometer score of 66.

The fifth selected agricultural indicator is the average total operating expenditures as a % of total operating revenues (1990-92). The highest provincial average is poor, 91.2%, and the lowest is good, 77.7%. Manitoba's average is 82.1%. This results in a barometer score of 66.

The average of these indicators gives the agricultural index a barometer value of (20+85+89+66+66) 65.

Health Index

A health index was developed by collecting available published data from Manitoba Health and Health Canada. These are additional to the indicators discussed in the report. One selected health indicator is the ratio of population to health practitioners (physicians, chiropractors and optometrists). The Prairie Ecozone has a calculated ratio of 1032 person per health practitioner. The provincial ratio is 704 or good, and the highest observed ratio in a health region, 2948, is poor. The barometer value for this indicator is 71.

A second selected indicator is the ratio of population to general practitioners for Canada and provinces (1995). The 1995 Canadian average of 542 people per GP is considered good. The lowest provincial ratio, 1049 per GP, is judged bad. Manitoba's ratio is 575, so it is somewhere between 21 and 79 on the barometer. The calculated barometer score is 79.

A third selected health indicator is the number of approved hospital bed per 1000 population for Canada and the provinces (1995). The 1995 Canadian ratio of approved beds per 1000 people is 6.1 and considered good. The worst provincial ratio, 4.5 is considered bad. Manitoba's ratio of 5.8 is between 21 and 79 on the barometer scale. The calculated value is 78.

Averaging these four indicators gives the health index a barometer score of [71+79+78] 76.

Other Information Used to Calculate Barometer for Prairie Ecozone

Canada is recognised as having one of the highest energy consumption per capita patterns in the world, averaging 307 gigajoules (GJ) per capita. Comparatively 50 - 99 gigajoules (GJ) per capita is judged to be good and over 300 GJ per capita is considered poor. The highest per capita energy use in Canada averages about 800 GJ. Manitoba's is 232 GJ per capita. The barometer value for this indicator is 27.

Average waste disposal per capita in Manitoba in 1988 was 1000 kg, and to meet CCME targets of a 50% reduction by 2000 determines a benchmark of 500 kg per capita or less as good, and 1000 kg or more bad. Manitobans currently dispose 790 kg per capita. This relates to a barometer score of 42.

Additional data not included in the report were obtained to fill gaps in information about students. A pupil to teacher index is calculated from assessing pupil to educator and pupil to regular instructor ratios in Manitoba. The Prairie ecozone ratios are 15.7 and 18.8 respectively. Good is judged to be 13:1 and 14.6:1 based on the lowest ratios in the province, and bad to be 18 and 21 based on the highest ratios in the province. The ecozone barometer values are 66 and 21, or an index of 43.

Three more indicators suitable for comparison to the rest of Canada are: the percentage of Manitobans with less than a high school education; the percentage with a university degree; and the percentage who are literate. The Manitoba percentages for these indicators are 32%, 12% and 65% reflecting respective barometer values of 50, 50 and 84. This level of education and literacy index is 61.

Human Life Index

A human life index is calculated from averaging disease free life expectancy, infant mortality rates and percent of women experiencing violence in Manitoba compared to the rest of Canada. Additional information on violence not included in the report was obtained. For disease free life expectancy the lowest value in Canada, 68 is good, and the lowest observed value in the world, 30 is bad. Manitobans can expect a disease free life of 69.4, related to a barometer value of 84. Compared to Canadian provinces an infant mortality rate less than 6.3 per 1000 births is judged good and more than 10 bad. Manitoba's infant mortality rate is 6.8 per 1000 births, or a barometer value of 70. Compared to the rest of Canada less than 33% of women experiencing violence is good and more than 59% bad. Data for Manitoba indicate 49% of women experience violence. This corresponds to a barometer value of 36. Aggregating these indicators produces a human life index for the ecozone of 63.

Additional information on poverty not discussed in the report was collected. A poverty index is calculated from averaging the percent of children under 18 living under poverty, the percent of children in single parent families living under poverty and the percent of people over the age of 65 living under poverty. Compared to Canada Manitoba record the highest percent for children under 18 and in single parent families living under poverty. The barometer score for each of these indicators is 20. Compared to the rest of Canada less than 11% of aged people living under poverty is judged good, and more than 28 bad. Manitoba's percent is 23, corresponding to a barometer score of 36. The poverty index for Manitoba is 25.

The unemployment rate in Manitoba compared to Canada is another socioeconomic indicator for the barometer. The Canadian average is 10.6%, and anything greater is considered bad. The best provincial unemployment rate is 7% so that is considered good. Manitoba's unemployment rate is 8.5% and computes to a barometer value of 47.

A quality of life index is composed of six indicators on various satisfaction with work and life situations for Manitobans compared to Canada. Assigning the Canadian average as the upper or lower end point for scaling results in the following Manitoba barometer values: rating health excellent: 70; rating psychological well-being as high: 84; very satisfied with their jobs: 82; probable risk of chronic depression: 20; experiencing high chronic stress: 20; and suicide rate per 100,000: 95. The quality if life index calculated as the average of these indicators is 62.

The barometer score for human well-being in the Prairie ecozone is the average of these values: 51 - intermediate. This value is influenced by low performance achievement for the following five indicators: energy efficiency, waste generation, pupil teacher ratios, poverty and unemployment.

ECOSYSTEM WELL-BEING INDICATORS

Indicator	Canadian or Standard Value Value	Prairie Ecozone or Manitoba Good	Limit of Assumed Bad	Limit of Assumed	Barometer Score
1. a. wind erosion (% of land where wind erosion is moderate to severe)	n/a	54%	assume less than 5%	assume more than 25%	8
b. water erosion (% of land where water erosion is moderate to severe)	n/a	34%	assume less than 5%	assume more than 25%	21
2 surface water quality in PEZ rivers (water quality index scores)	Canadian Water Quality Guidelines	34	3-0	60-100	48
3. a. Winnipeg air quality index	Canadian Air Quality Index	estimated at 12.3	0-25	greater than 100	90
b. Brandon (total suspended particulate) PM10	British Columbia application to	estimated at 33	0-20	greater than 200	71
4. ratio of land in summerfallow compared to area in crops	western Canada average 0.27:1	0.10	0-0.05	0.36-.50	72

Source: IISD

HUMAN WELL-BEING INDICATORS							
Indicator			Canadian or standard value	Prairie Ecozone or Manitoba value	Limit of assumed good	Limit of assumed bad	Barometer score
1.	a.	average total income of farm families after capital cost allowance	$38,880	$31,754	$38,880	$31,754	20
	b.	off-farm income as a % of total income	67.4%	62.5%	67.4%	79.3%	85
	c.	percentage of farms with negative or zero net operating revenue	27%	21%	275	30.7%	89
	d.	average total operating revenue	$100,500	$90,585	$100,500	$70,970	66
	e.	average total operating expenditures as a % of total operating revenues		82.1%	lowest provincial average 77.7%	highest provincial average 91.2%	66
2.		energy consumption per capita	307 GJ/capita	232 GJ/capita	99-50 GJ/capita	more than 300 GJ/capita	27
3.		waste disposal per capita	CCME target of 50% reduction of 1988 levels by the year 2000	1988=1,000 kg/capita current 1994=790 kg/capita	500 kg/capita or less	1,000 kg/ capita	42
4.	a.	ratio of population to health practitioners (physicians, chiropractors and optometrists)		Prairie ecozone has a calculated ratio of 1,032	provincial ratio is 704, or "good"	the highest observed ratio in a health region, 2,948, is "poor"	71
	b.	ratio of population to general practitioners for Canada and provinces (1995)	the 1995 Canadian average of 542 people/GP is considered good	575	542 people per GP is considered good	lowest provincial ratio, 1049 per GP, is judged bad	79
	c.	number of approved hospital beds per 1,000 population for Canada and the provinces (1995)	1995 Canadian ratio of approved beds per 1,000 people is 6.1	5.8	6.1	the worst provincial ratio, 4.5 is considered bad	78
5.	a.	ratio: pupil-educator	n/a	15.7	13.1 or less	18 or more	66
	b.	ratio: pupil-regular instructor	n/a	18.8	14.6	21	21

Indicator			Canadian or standard value	Prairie Ecozone or Manitoba value	Limit of assumed good	Limit of assumed bad	Barometer score
6.	a.	% of residents with less than high school education	26%	32%	less than 26%	more than 40%	50
	b.	% of residents with university degrees	15%	12%	more than 15%	less than 9%	50
	c.	% of residents who are literate	63%	65%	more than 63%	less than 39%	84
7.	a.	disease-free life expectancy	69 years	69.4 years	69 years or more	less than 30	84
	b.	infant mortality rate	6.3/1,000 live births	6.8/1,000	less than 6.3/1,000	more than 10/1,000	70
	c.	% of women experiencing violence	lowest % in Canadian provinces is 33%, highest is 59%	49%	less than 33%	more than 59%	36
8.	a.	% of children under 18 living in poverty	Canadian average is 20 and range is 13% to 23%	23%	less than 13%	more than 23%	20
	b.	% of children in single parent families living in poverty	Canadian average is 60%, range is a low of 56% to a high of 70%	70% 23%	less than 56% less than	more than 70% more than	20 36
	c.	persons 65 and older living in poverty	Canadian average is 19%, low 12% high 28%		11%	28%	
9.		unemployment rate	Canadian average=10.6%; range 7%-19.6%	8.5%	6% or less	more than 10.6%	47
10.	a.	% rating health as excellent	26%, range= 18%-29%	24%	265 or more	18% or less	70
	b.	% rating psychological well-being as high	9%, range= 7% to 15%	10%	9% or more	7% or less	84
	c.	% satisfied with job	50%, range= 47%-58%	51%	50%-58%	less than 47%	82
	d.	% probable risk of clinical depression	6%, range= 4%-8%	8%	6%-4%	8% or more	20
	e.	% experiencing high chronic stress	26%, range 16%-29%	29%	16-26%	29% or more	20
	f.	suicide rate/1,000	12, range 8-17	11	12 or less	17 or more	95

Source: IISD

LITERATURE CITED

1. Agriculture and Agri-Food Canada, 1996. News Notes: Brandon Research Centre, Brandon, Manitoba. 3 pp.
2. Beattie, B. and K. Keddy, 1995. Pre-1980 Ultraviolet Index Climatology for Canadian Locations. Environment Canada, Atmospheric Environment Services, Scientific Services, Bedford, Nova Scotia. 20 pp.
3. Bowering, R., 1997. Background Information on Assiniboine River Flows. Manitoba Natural Resources, Water Resources Branch (unpublished), Winnipeg, Manitoba. 10 pp.
4. Breen, M.J., 1996. What Determines Health? National Forum on Health, 2nd Edition, September 1996. Ministry of Public Works and Government Services, Canada Cat. No. H21-126/3 1996E. Ottawa, Ontario.
5. British Columbia Commission on Resources and Environment, 1996. Report on British Columbia's Progress Toward Sustainability: Interim Draft: March 1996 (unpublished). Pages 4-62, 4-63.
6. British Columbia Ministry of Environment, Lands and Parks, 1995. The British Columbia Water Quality Index. BC Environment, Lands and Parks, Water Quality Branch, Victoria, B.C.
7. Brown, Lester R., Hal Kane, David Malin Roodman, Linda Starke, editor, et al, 1994. Vital Signs 1994: The Trends That are Shaping our Future. Worldwatch Institute, New York, NY. 160 pp.
8. Burrows, W.R. et al, 1992. Climatology of Daily Total Ozone and UVB Radiation Levels: Report #92-005. Environment Canada, Atmospheric Environment Services. 200 pp.
9. Canada Soil Inventory, 1989. Soil Landscapes of Canada - Manitoba. Agriculture Canada Publication 5242/B. 22 pp. 1:1 000 000 scale map compiled by Canada-Manitoba Soil Survey. Agriculture Canada, Research Branch, Land Resources Research Centre, Ottawa, Ontario.
10. Canadian Council of Forest Ministers (CCFM), 1992. Sustainable Forests: A Canadian Commitment. National Forest Strategy Coalition, Ottawa, Ontario.
11. Canadian Council of Forest Ministers (CCFM), 1995. Defining Sustainable Forest Management: A Canadian Approach to Criteria and Indicators. Cat. no. Fo75-3/4-1995E. Natural Resources Canada, Canadian Forest Service, Ottawa, Ontario. 22 pp.
12. Carpenter, C., Kira Schmidt, Jeffrey Turner and Gary Dunning, 1996. Highlights: North American Public Hearing, World Commission on Forests and Sustainable Development, Winnipeg, Canada, September 30 - October 2, 1996. International Institute for Sustainable Development, Winnipeg, Manitoba. 23 pp.
13. Delaney, J. and A. Grauman, 1991. The Forest Regeneration Report: Five-Year Analysis. Manitoba Natural Resources, Winnipeg, Manitoba.
14. Department of the Environment, 1996. Indicators of Sustainable Development for the United Kingdom: A set of indicators produced for discussion and consultation by an interdepartmental working group, following a commitment in the UK's Sustainable Development strategy of 1994. Environmental Protection Statistics and Information Management Division, Indicators Working Group Secretariat, London, England. 196 pp.
15. Dovetail Consulting in association with SALASAN Associates, 1995. State of the Environment Reporting Guidelines for CCME Member Jurisdictions. Prepared for Canadian Council of Ministers of the Environment, State of the Environment Reporting Task Group, December 1995. 67 pp.
16. Dumanski, J., L.J. Gregorich, V. Kirkwood, M.A. Cann, J.L.B. Culley and D.R. Coote, 1994. The Status of Land Management Practices on Agricultural Land in Canada, Technical Bulletin 1994-3E. Agriculture and Agri-Food Canada, Centre for land and Biological Resources Research, Central Experimental Farm, Ottawa, Ontario. 46 pp.
17. Ecological Stratification Working Group, 1995. A National Ecological Framework for Canada. Agriculture and Agri-Food Canada, Research Branch, Centre for Land and Biological Resources Research and Environment Canada, State of the Environment Directorate, Ecozone Analysis Branch, Ottawa/Hull. Report and national map at 1:7 500 000 scale. 125 pp.
18. Eilers, R.G., 1987. Soil Salinity — Manitoba. Folder including a 10-page booklet with a map at a 1:1,000,000 scale. Publication No. 5261/B., Canada-Manitoba soil Survey. Agriculture Canada, Research Branch, Land Resource Research Centre, Contribution No. 87-15.
19. Eilers, R.G., W.D. Eilers, W.W. Pettapiece, and G. Lelyk. 1995. Salinization of Soil. Pages 77-86 in D.F. Acton and L.J. Gregorich (eds.) The health of our soils—toward sustainable agriculture in Canada. Agriculture and Agri-Food Canada, Research Branch, Centre for Land and Biological Resources Research, Ottawa, Ontario.
20. Environment Canada, 1990. Water Works! Fact Sheet. Cat. No. En 37-81/4-1990E. Minister of Supply and Services, Canada, Ottawa, Ontario.
21. Environment Canada, 1995. National Environmental Indicator Series: Canadian Passenger Transportation, SOE Bulletin No. 95-3, Spring 1995. Environment Canada, Environmental Conservation Service, Environmental Conservation Directorate, Indicators and Assessment Office, Ottawa, Ontario.

22. Environment Canada, 1996. National Environmental Indicator Series: Energy Consumption. SOE Bulletin No. 96-3, Spring 1996, Catalogue No. EN 1-19/96-3. Environment Canada, Environmental Conservation Service, Environmental Conservation Directorate, Indicators and Assessment Office, Ottawa, Ontario.
23. Environment Canada, 1996. National Environmental Indicator Series: Climate Change, SOE Bulletin No. 96-4, Spring 1996, Catalogue No. EN 1-1996-4. Environment Canada, Environmental Conservation Service, Environmental Conservation Directorate, Indicators and Assessment Office, Ottawa, Ontario.
24. Environment Canada, 1996. National Environmental Indicator Series: Urban Water Indicator Bulletin, 1996 update. Catalogue No. EN-1-19-96-X. Environment Canada, Environmental Conservation Service, State of the Environment Directorate, Ottawa, Ontario.
25. Environment Canada, Indicators Task Force, 1991. A Report on Canada's Progress Towards a National Set of Environmental Indicators. SOE Report No. 91-1. Environment Canada, State of the Environment Reporting, Ottawa, Ontario. 98 pp.
26. Federal, Provincial, and Territorial Advisory Committee on Population Health, 1996. Report on the Health of Canadians. Toronto, Ontario. 107 pp.
27. Federal/Provincial Research and Monitoring Coordinating Committee (RMCC), 1990. Canadian Long-Range Transport of Air Pollutants and Acid Deposition Assessment Report, Part 5: Terrestrial Effects. Health and Welfare Canada, Environmental Health Directorate.
28. Ferguson, J., 1994. Managing Waste Management, in Urban Scene/Winter 1994 (periodical).
29. Government of Canada, 1991. The State of Canada's Environment - 1991. DSS cat. no. EN21-54/1991E. Minister of Supply and Services, Canada, Ottawa, Ontario.
30. Government of Canada, 1997. State of the Environment Report for Canada 1996. Minister of Supply and Services, Canada, Ottawa, Ontario. (CD-ROM)
31. Gregorich, E.G., D.A. Angers, C.A. Campbell, M.R. Carter, C.F. Drury, B.H. Ellert, P.H. Groenevelt, D.A. Holmstrum, C.M. Monreal, H.W. Rees, R.P. Vorney, and T.J. Vyn, 1995. Changes in Soil Organic Matter. Pages 41-50 in D.F. Acton and L.J. Gregorich (eds.). The health of our soils—toward sustainable agriculture in Canada. Agriculture and Agri-Food Canada, Research Branch, Centre for Land and Biological Resources Research, Ottawa, Ontario.
32. Harasymec, D., 1997. Background on Education Enrollment (unpublished). Manitoba Education and Training, Policy and Planning Branch, Winnipeg, Manitoba. 10 pp.
33. KPMG Management Consulting, 1995. Manitoba's Forest Plan: Toward Ecosystems Based Management, Report to Manitoba Natural Resources. Canada-Manitoba Partnership in Forestry. Manitoba Natural Resources, Winnipeg, Manitoba.
34. MacMillan, J. A., 1996. Economic Evaluation of Manitoba Sustainable Development Activities: NAWMP. University of Manitoba, Department of Agricultural Economics. Winnipeg, Manitoba. 24 pp.
35. Manitoba Association for Native Languages, 1996. Manitoba Schools with Native language Instruction: 1992-92 (with unpublished update). Manitoba Association for Native Languages, Winnipeg, Manitoba. 14 pp.
36. Manitoba Association of School Trustees (MAST), 1997. Background on Student/Educator Ratios. MAST, Winnipeg, Manitoba. 6 pp.
37. Manitoba Culture, Heritage, and Citizenship, 1996. Background Information on Recreation Facilities (unpublished). Manitoba Culture, Heritage and Citizenship, Winnipeg, Manitoba. 8 pp.
38. Manitoba Environment, 1993. State of the Environment Report for Manitoba 1993. Manitoba Environment, Winnipeg, Manitoba. 167 pp.
39. Manitoba Environment, 1995. State of the Environment Report for Manitoba, 1995, Manitoba Environment, Winnipeg, Manitoba. 184 pp.
40. Manitoba Environment, 1995. Winnipeg Air Quality Index (pamphlet). Manitoba Environment, Air Quality Standards, Winnipeg, Manitoba.
41. Manitoba Environment, n.d. Petroleum Storage Tanks Operation and Maintenance. (poster). Manitoba Environment, Winnipeg, Manitoba.
42. Manitoba Environment, 1995. Petroleum Storage Tank News, Special Issue, May 1995. Manitoba Environment, Winnipeg, Manitoba. 4 pp.
43. Manitoba Environment, 1996. Manitoba Water Use Efficiency Program: How to use Water Efficiently in the Household. Information Bulletin No. 96-11E, September 1996. Manitoba Environment, Pollution Prevention Branch, Winnipeg, Manitoba.
44. Manitoba Environment, 1996. Manitoba Water Use Efficiency Program: Community Actions to Consider. Information Bulletin No. 96-12E, September 1996. Manitoba Environment, Pollution Prevention Branch, Winnipeg, Manitoba.
45. Manitoba Environment, 1996. Waste Reduction and Prevention (WRAP) Strategy Report 1996. Report No: 96-13, November 1996. Manitoba Environment, Pollution Prevention Branch. 32 pp.
46. Manitoba Government, 1996. Elie Becomes Strawboard Capital of the World, November 8 News Release, Winnipeg, Manitoba. 4 pp.

47. Manitoba Government, 1996. Manitoba Pork Initiative to Promote Pork Industry, November 19 News Release, Winnipeg, Manitoba. 2 pp.
48. Manitoba Health, Manitoba Environment and City of Winnipeg, Facts from the Health files, Cryptosporidiosis: The Facts, based on information from the Centers for Disease Control and Prevention (CDC) and Health Canada. Manitoba Health, Winnipeg, Manitoba.
49. Manitoba Health Services Commission, 1991-95. Annual Statistics. Manitoba Health Services Commission, Winnipeg, Manitoba.
50. Manitoba Hydro, 1993. Waste Minimization (pamphlet). Manitoba Hydro, Winnipeg, Manitoba.
51. Manitoba Hydro, 1994. Sustainable Development Report, First Edition. Manitoba Hydro, Winnipeg, Manitoba. 59 pp.
52. Manitoba Hydro, 1996. Hydro Lines, September 1996, Vol. 36, No. 6, (monthly publication). Manitoba Hydro, Winnipeg, Manitoba.
53. Manitoba Hydro, 1996. Sustainable Development Report, Second Edition 1994 & 1995. Manitoba Hydro, Winnipeg, Manitoba. 48 pp.
54. Manitoba Natural Resources, 1997. An Action Plan for Manitoba's Network of Protected Areas (1996-1998). Manitoba Natural Resources, Parks and Natural Areas Branch, Winnipeg, Manitoba. 10 pp.
55. Manitoba Pork Est., 1997. Background Information on Hog Farming (unpublished), Winnipeg, Manitoba. 3 pp.
56. Manitoba Product Stewardship Corporation, 1996. Manitoba Product Stewardship Program Annual Report, April 1, 1995 - March 31, 1996. Manitoba Product Stewardship Corporation, Winnipeg, Manitoba. 18 pp. & appendices.
57. Manitoba Round Table on Environment and Economy, (MRTEE), n.d. Towards a Sustainable Development Strategy for Manitobans. Sustainable Development Coordination Unit, Winnipeg, Manitoba.
58. Manitoba Round Table on Environment & Economy (MRTEE), n.d. Workbook on Energy Strategy. Sustainable Development Coordination Unit, Winnipeg, Manitoba. 34 pp.
59. Manitoba Tire Stewardship Board, 1996. Background Information on Tire Recycling. Manitoba Tire Stewardship Board, Winnipeg, Manitoba. 6 pp.
60. McGarry, P. 1997. Background Information on Soil Conservation Programs. Prairie Farm Rehabilitation Administration, Winnipeg, Manitoba. 8 pp.
61. McGuiness, F., n.d. Manitoba's Economic Innovation and Technology Council and Bootstrap Three: Enterprise Stories from Rural Manitoba. Manitoba Rural Development.
62. Meadows, D. Editor. 1996. Sustainable Development Indicators from a Systems Perspective. Draft report of the Balaton Group Workshop on Sustainable Development Indicators. Bilthoven, the Netherlands. 59 pp.
63. Minister of Supply and Services, Canada. The Importance of Wildlife to Canadians: The Economic Significance of Wildlife-Related Recreational Activities in 1991. Cat. No. CW66-103/2-1994E. Minister of Supply and Services, Ottawa, Ontario.
64. Morrison, I.N. and D.F. Kraft (eds.), 1994. Sustainability of Canada's Agri-Food System - A Prairie Perspective. International Institute for Sustainable Development, Winnipeg, 168 p.
65. Mummery, B., 1996. Publisher, Minnedosa Tribune, Personal Communication.
66. National Round Table on the Environment and the Economy (NRTEE), 1996. State of the Debate on the Environment and Economy: Water and Wastewater Services in Canada. NRTEE, Ottawa, Ontario. 39 pp.
67. National Task Force on Environment and Economy, 1987. Report. Canadian Council of Resource and Environment Ministers, Ottawa, Ontario.
68. Nordin, V.J., 1996. Criteria and Indicators and Forest Certification — Canadian Initiatives Paper presented at the Fourth International Symposium on Forest Ecosystems, Brazil, August 14, 1996. Nordin, J and Associates Ltd., Bulletin, Vol. 2, No. 3, August, 1996. Ottawa, Ontario.
69. Parks Canada and Manitoba Natural Resources, 1996. A Proposal for a National Park in the Manitoba Lowlands. Manitoba Lowlands Study Steering Committee, Winnipeg, Manitoba. 8 pp.
70. Pinter, L., 1996. Whitemud Watershed Conservation District, Province of Manitoba, Canada: Project Summary and Preliminary Evaluation. Prepared for the Sustainable Development of Cities and Regions Project of STENUM GmvH, Graz, Austria, September, 1996. International Institute for Sustainable Development, Winnipeg, Manitoba. 17 pp.
71. Popplaw, J., 1996. Background information on Dauphin's Giardia outbreak. Manitoba Health, Winnipeg, Manitoba. 12 pp.
72. Prescott-Allen, Robert. 1996. The Wellbeing of Nations, and BC Commission on Resources and Environment, Report on British Columbia's Progress Toward Sustainability: Interim Draft: March 1996 (unpublished).
73. Proctor, B., 1996. Personal Communication. Manitoba Education and Training, Training and Advanced Education, Winnipeg, Manitoba.

74. Province of Manitoba, 1994. Applying Manitoba's Forest Policies. Sustainable Development Coordination Unit, Winnipeg, Manitoba. 80 pp.
75. Province of Manitoba, 1994. Applying Manitoba's Water Policies. Sustainable Development Coordination Unit, Winnipeg, Manitoba. 83 pp.
76. Province of Manitoba, 1995. Applying Manitoba's Natural Lands and Special Places Policies. Sustainable Development Coordination Unit, Winnipeg, Manitoba. 44 pp.
77. Report of the Railway Safety Act Review Committee, n.d. On Track, p. 15, Table 2.2.
78. Sustainable Development Coordination Unit, 1996. White Paper on the Sustainable Development Act. Province of Manitoba, Winnipeg, Manitoba. 144 pp.
79. Tarasick, D., 1995. Ozone Climatology and Trends at Canadian Stations, Environment Canada, Atmospheric Environment Services, Downsview, Ontario. 47 pp.
80. Task Force on Water Quality Guidelines, Canadian Council of Ministers of the Environment. 1995 (and subsequent updates). Inland Waters Directorate, Environmental Quality Guidelines Division, Water Quality Branch, Ottawa, Ontario.
81. Treloar, N., 1997. Background Information on Ozone Depletion. Environment Canada, Atmospheric Environment Service, Winnipeg, Manitoba. 3 pp.
82. Wall, G.J., E.A. Pringle, G.A. Padbury, H.W. Rees, J. Tajek, L.J.P. van Vliet, C.T. Stushnoff, R.G. Eilers, and J.M. Cossette, 1995. Erosion. Pages 61-76 in D.F. Acton and L.J. Gregorich (eds.) The health of our soils—toward sustainable agriculture in Canada. Agriculture and Agri-Food Canada, Research Branch, Centre for Land and Biological Resources Research, Ottawa, Ontario.
83. Wardrop Engineering Inc., 1996. Capital Region Waste Management Inventory, Report to Manitoba Environment, September 5, 1996, Volume 1 of 2. 22 pp. & appendices.
84. Westarc Group, 1994. Demographic Trends in Southwestern Manitoba. Brandon, Manitoba. 24 pp.
85. Westland Resource Group, 1996. An Assessment of Data Quality and Availability for Environmental Reporting in Canada: Volume II. Prepared for the Canadian Council of Ministers of the Environment (CCME), May 16, 1996.
86. Williamson, D.A., 1988. Manitoba Surface Water Quality Objectives. Manitoba Environment, Water Quality Management. 40 pp.
87. Wilson, F., 1997. Background Information on Soil Conservation Programs. Prairie Farm Rehabilitation Administration, Winnipeg, Manitoba. 4 pp.
88. Wonneck, R., 1997. Background Information on Manitoba Population: 1971-91. Statistics Canada, Advisory Services, (unpublished), Winnipeg, Manitoba. 7 pp.
89. World Ozone and UV Radiation Data Centre, 1996. WOUDC Volume 1: August, Environment Canada, North York, Ontario. (CD-ROM)
90. World Commission on Environment and Development, (WCED), 1987. Our Common Future. Oxford University Press, Oxford, Great Britain.
91. Yukon Conservation Society, 1993. Giardia Fact Sheet. Whitehorse, Yukon. 2 pp.

GLOSSARY

abiotic: nonbiological; occurring neither within living cells nor under their influence.

acid deposition (also known as acid rain, acidic precipitation): rain, snow or fog with a pH of less than 5.6. Acid deposition is often caused by air-borne sulphur (SO_2) and nitrogen oxides (NO_x) reacting with moisture, to eventually form sulphuric and nitric acids. These acid causing compounds may fall as rain, snow, or fog or they may be deposited in the dry form. Acid deposition can harm aquatic ecosystems and kill freshwater fish. As well, it can damage trees and plants, and gradually erode stone, metal and other surfaces.

acidifying potential: the relationship between concentrations of sulphate, calcium and magnesium ions in precipitation.

alkaline: having a basic pH of more than 7.0.

algal bloom: a relatively high concentration of phytoplankton that is readily visible in a body of water as a result of proliferation during favourable growing conditions generated by nutrient or sunlight availability.

anode: the positive pole or electrode of an electrolytic cell, vacuum, tube, etc.

AQI (air quality index): an index compiled of measurements from common air contaminants. Developed jointly by federal and provincial governments to report air quality in a manner that can be easily understood by the general public.

bacteria: one-celled organisms. Some transmit diseases, most act as decomposers that break down dead organic matter into substances that dissolve in water and are used as nutrients by plants.

biochemical oxygen demand (BOD): the amount of dissolved oxygen required for the bacterial decomposition of organic waste in water.

biodegradable: capable of being broken down by living organisms into inorganic compounds.

biological diversity (biodiversity): a broad term referring to the variety of life in an area from small areas such as a pond to the whole biosphere. Biodiversity encompasses four main considerations: landscape diversity, ecosystem diversity, species diversity and genetic diversity. It also involves the countless, complex ways in which living things function and interact.

biomass: the amount of living matter in an area — most of it is plant material and a small quantity is animal matter. In general, biomass (wood, vegetation and crop residue) is burned either for disposal or to produce energy or it is left on the site to decompose.

biotic: having to do with living organisms.

bituminous: having the qualities of, impregnated or compounded with, or containing bitumen — a natural substance consisting mainly of hydrocarbons.

BOD: see biochemical oxygen demand.

carbon dioxide (CO_2): an odourless, nontoxic gas normally present in the ambient air and also produced when any substance containing carbon (such as fossil fuels and wood) is burned in the presence of adequate oxygen. Carbon dioxide is the most important greenhouse gas. Human caused emissions of CO_2 are largely responsible for the enhanced greenhouse effect.

carbon monoxide (CO): an odourless, colourless, toxic gas produced as a result of the incomplete combustion of fuels containing carbon. Carbon monoxide is a common air pollutant, mainly released by motor vehicles. At low concentrations, CO can impair vision, cause dizziness and trigger angina. It is lethal at high concentrations.

carbon sinks: carbon is found in the air, vegetation, the oceans, sedimentary rocks and fossil fuels. Anything that stores carbon naturally is referred to as a carbon reservoir. A reservoir that absorbs carbon is known as a carbon "sink". Forests are carbon sinks as they normally use more carbon dioxide in the photosynthetic process than they release when they respire.

catch per unit of effort (CUE): an indicator of the relative abundance and trend of a particular fish species over time.

cathode: the negative pole or electrode of an electrolytic cell, vacuum, tube, etc.

CFCs (chlorofluorocarbons): gaseous synthetic substances composed of chlorine, fluorine, and carbon. They have been used as refrigerants, as aerosol propellants, as cleaning solvents, and in the manufacture of plastic foam. CFCs are suspected of causing ozone depletion in the stratosphere.

chlorinated organic compounds (also known as organochlorines or chlorinated organics): chlorine-containing organic compounds, in some cases containing oxygen and other elements such as phosphorus. Includes many pesticides and industrial chemicals. Examples are dioxins, furans, PCBs, DDT, dieldrin, HCB and HCH.

coliform: a group of bacteria used as an indicator of sanitary quality of water. The total coliform group is an indicator of sanitary significance because the organisms are usually present in the intestinal tracts of humans and other warm-blooded animals, and exposure to them in drinking water causes diseases such as cholera.

commodities: anything that is bought and sold; an article of trade or commerce.

compost: a mixture of decayed vegetable or animal matter such as leaves or manure, used to fertilize and condition soil.

contamination: the introduction of any foreign, undesirable physical, chemical, or biological substance into the environment. Does not imply an effect (see pollution). Usually refers to introduction of human-made substances.

cryptosporidium parvum (also known as crypto): a very small organism that is found as a hard-shelled oocyst (or shell) in the environment. The oocyst contains very small, worm-like parasites. When swallowed, the oocyst releases the parasites into the digestive tract. The parasites invade the cells lining the intestines and cause an illness called cryptosporidiosis.

DDT (dichlorodiphenyltrichloroethane): a synthetic insecticide introduced for widespread used just after World War II. Because this chlorinated organic compound is persistent and tends to accumulate in living tissue, most uses of DDT were banned in 1974. Registration of all DDT products was discontinued in 1985. However, the use and sale of existing stocks of DDT products were allowed until December 31, 1990.

DNA (deoxyribonucleic acid): the genetic material or organisms and of many viruses.

ecosystem: organisms of a natural community together with their physical, chemical and biological environment ("ecological" + "system").

ecozone: large, terrestrial ecosystem unit that contains distinctive sets of nonliving and living resources that are ecologically related as a system.

effluent: a liquid waste material that is a by-product of human activity (e.g., liquid industrial discharge or sewage), which may be discharged into the environment.

endangered species: refers to an official designation assigned by the Committee on the Status of Endangered Wildlife in Canada. The designation is assigned to any indigenous species of subspecies or geographically separate population of fauna or flora that is threatened with imminent extinction or extirpation throughout all or a significant portion of its Canadian range. See also extinct, extirpated, threatened, and vulnerable.

eutrophication (also known as nutrient enrichment): the process by which bodies of water become better nourished by fertilization. This process is often accelerated by nutrient-rich discharges from agriculture or sewage, leading to a rapid and excessive growth of algae and water plants and undesirable changes in water quality.

extirpated species: refers to an official designation assigned by the Committee on the Status of Endangered Wildlife in Canada. The designation is assigned to any indigenous species or subspecies or geographically separate population of fauna or flora no longer known to exist in the wild in Manitoba, but existing in other parts of Canada or the world.

exotic species: species that are not native and have been intentionally introduced or have inadvertently infiltrated an area.

fauna: animal life of an area.

fecal coliforms: a group of bacteria that originate in the digestive tracts of warm-blooded animals and humans. They do not cause disease themselves, but when present in sufficient numbers, are often accompanied by other, more harmful disease-causing organisms.

flora: plant life of an area.

galvanic: producing a direct current of electricity, especially by chemical action.

geographic information system (GIS): automated systems for the capture, storage, retrieval, analysis and display of spatial data.

gigawatt-hours: the actual amount of electricity produced.

gillnets: a type of commercial fishing net that has rather large mesh so that a fish will swim into the net and be caught by its gills in the mesh.

global positioning satellite (GPS): system involving 18 geostationary satellites in orbit around the earth. Signals received from the satellites can be used to fix locations on Earth very precisely.

global warming: the warming of the earth and its atmosphere by the enhanced greenhouse effect. Global warming is expected to lead to global climate change. The Intergovernmental Panel on Climate Change predicts by 2025, the planet will be about one degree C. warmer than it is now, and three degrees C. higher by the end of the 21st century. To put these figures into perspective, the earth's average temperature during the last ice age was only five degrees C. colder than at present.

greenhouse effect: the heating effect of the atmosphere upon the earth. Light waves from the sun pass through the atmosphere and are absorbed by the earth. The earth then reradiates this energy as heat waves which are absorbed by greenhouse gases in the lower atmosphere. Thus the atmosphere behaves like the glass in a greenhouse, allowing the passage of light, but not of heat. The greenhouse effect has been a property of earth's atmosphere for millions of years. Today, because humans are affecting the proportion of greenhouse gases in the atmosphere, an enhanced greenhouse effect (see global warming) is believed to be causing a rise in average global temperatures.

greenhouse gases: gases in the earth's atmosphere that cause the greenhouse effect. Examples are carbon dioxide (the most important greenhouse gas), chlorofluorcarbons, ozone, methane, and nitrous oxide.

ground-level ozone (also known as tropospheric ozone): ozone (O_3), found near the earth's surface, as opposed to the ozone found in the upper atmosphere (the ozone layer). Some ground-level ozone occurs naturally. However, concentrations are increased by human activities. Ground-level ozone is formed by the reaction of volatile organic compounds (VOCs) and nitrogen oxides (NO_x) in the presence of sunlight and warm temperatures. A stagnant air mass keeps the pollution from being dispersed. Motor vehicles are the major human made source of VOC and NO_x emissions.

groundwater: water occurring below the ground surface that may supply water to wells and springs. Groundwater occupies pores, cavities, cracks and other spaces in bedrock and unconsolidated surface materials.

habitat: the place in which an animal or plant species lives. The concept of habitat includes not only the place where a species is found, but also the particular characteristics of that place, such as climate or the availability of suitable food and shelter, which make it especially well-suited to meet the life-cycle needs of that species.

hazardous waste: waste that poses a risk to human health or the environment and requires special disposal techniques to make it harmless or less dangerous.

herbicide: a chemical that kills a plant or inhibits its growth.

impressed current: a type of cathodic protection for underground petroleum storage tanks. The anodes are connected to an external power source. The current is "impressed" into the soil through the semi-inert anodes made of graphite, high silicon-content cast iron or platinum. Electrons then move from the metal anodes to the tank and the tank is protected.

indicators of sustainable development: measurements of the key vital signs of the environment, economy, human health and society.

indicator species: an organism that indicates the presence or absence of any particular factor, e.g. fecal coliforms are used as an indicator species for the presence of disease causing organisms in drinking water.

inorganic: matter other than plant or animal, and not containing a combination of carbon/hydrogen/oxygen as in living things.

ion: an electrically charged atom or group of atoms.

invertebrate: an animal that lacks a backbone; e.g. earthworm, snail.

kilowatt-hour (kW-h): a unit used to measure electrical energy, and defined as the number of kilowatts of electrical power used per hour. One kilowatt-hour is equivalent to 3.6 megajoules.

leachate: solution containing dissolved or suspended materials in water that has percolated through solids such as soils, solid wastes and rock layers.

leaching: washing out of soluble substances by water passing down through soil. Leaching occurs when more water falls on the soil than is lost by evaporation from the surface. Rainwater running through the soil dissolves mineral nutrients and other substances and carries them via groundwater into water bodies. The leaching of mercury and other heavy metals into water supplies is believed to be a serious consequence of acidic deposition.

least lifetime costing: refers to the lowest cost for construction, maintenance and rehabilitation that may be incurred over the lifetime of a roadway or facility.

metal hydroxides: an effective buffering agent at low pH levels.

metallurgical smelters: mining operations such as INCO Ltd., a nickel smelter in Thompson or Hudson Bay Mining and Smelting Co. Ltd. (HBMS), a zinc and copper smelter in Flin Flon.

methane: a colourless, odourless, inflammable gas, the simplest of the hydrocarbons. Methane comes from livestock, poultry, manure, marshes, petroleum wells, volcanoes and coal mines.

mitigate: make or become less severe, painful, or harsh; make or become mild or milder; soften or moderate.

niche: the way of life of a species; includes the habitat, food, nest sites, etc. that it needs in order to survive.

nitrogen dioxide (NO_2): a reddish-brown gas with a pungent, irritating odour when its concentration exceeds more than 10 parts per million (ppm). NO_2 exerts its most adverse effects on the lungs and can contribute to a worsening of existing respiratory conditions. It may also result in a loss of elasticity in the lungs. NO_2 suppresses vegetation growth, causes corrosion, reduces visibility and helps form harmful ground-level ozone. All combustion processes are sources for NO_2, including vehicles, power plants, heating systems and incinerators.

nitrogen oxide (NO_x): a gas formed when nitrogen combines with oxygen. NO_x consists of nitric oxide (NO), nitrous oxide (N_2O) and nitrogen dioxide ($NO_{2)}$. At low concentrations, NO_x can trigger bronchial congestion in asthmatics and children. At higher concentrations, they can cause fluid buildup in the lungs and other changes. NO_x contributes to ground-level ozone, acid rain, the enhanced greenhouse effect and stratospheric ozone depletion.

nonpoint source: a source of pollution in which pollutants are discharged over a widespread area or from a number of small sources rather than from distinct, identifiable sources. See also point source.

nonrenewable: natural resources that can be used up completely or else used up to such a degree that it is economically impractical to obtain any more of them (e.g., coal, crude oil, metal ores).

nutrient: any element or compound that an organism must take in from its environment because it cannot produce it or cannot produce it as fast as it needs it. As pollutants, any element or compound, such as phosphorus or nitrogen, that fuels abnormally high organic growth in aquatic ecosystems (e.g., eutrophication of a lake).

old-growth forest: after a natural disturbance, such as a fire, or after being harvested, forests develop through a series of stages in a process called "succession". The last stage in forest succession is called old-growth. Depending on the type of forest, it may take anywhere from 100 to 250 years for a forest to enter the old-growth stage of development. Old-growth forests are characterized by a large variety of tree sizes and ages, a great diversity in species of plants and animals, the presence of standing and fallen dead trees (which provide habitat for plants and animals), and an uneven canopy which allows light to penetrate to the forest floor in small openings.

organic: describes compounds based on carbon, and also containing hydrogen, with or without oxygen, nitrogen, or other elements. Organic originally meant "of plant or animal origin", and it is still sometimes used in this way. For example, "organic waste" can mean food scraps, manure, sewage, leaves, etc.; "organic fertilizer" can mean manure; "organic deposits" can mean peat or other plant material in soil; "organic nutrients" can mean nutrients derived from decayed plant material. However, now that organic compounds are routinely created by people, the word "organic" is also used to refer to synthetic organic compounds, as in "organic pollution" (which can include toxic human-made organic compounds). See chlorinated organic compounds.

ozone (O_3): a poisonous gas, a common pollutant in smog; also formed by the action of sunlight on oxygen in the ozone layer of the atmosphere.

ozone layer: a fragile band of gases ranging from about 15 to 40 kilometres above the earth, in the stratosphere. The ozone layer acts as the planet's natural sunscreen: it shields life on earth from much of the sun's potentially damaging ultraviolet radiation.

particulates: solid and liquid particles capable of being suspended for long periods in the atmosphere.

PCBs (polychlorinated biphenyls): A group of chemical compounds, a small number of which are toxic, that are widely used as fire retardants in insulating and heat exchange fluids in electrical transformers and capacitors, as plasticisers, as waterproofing agents, and in inking processes to produce carbonless copy paper. PCBs resist biodegradation, accumulate in the food chain and are suspected carcinogens.

pesticide: substances, usually chemicals, used to kill unwanted plants and animals. Includes herbicides, insecticides, algaecides and fungicides.

pesticide residue: refers to pesticides that remain in food, soil and water after application.

pH: a numerical expression of the concentration of hydrogen ions in solution — pH 0 is acidic, pH 7 is neutral, and pH 14 is basic or alkaline.

point source: a source of pollution that is distinct and identifiable. Includes smokestacks and outfall pipes from industrial plants and municipal sewage treatment plants.

pollution: the release of substances or energy into the environment, which results in deleterious effects: i.e., causing harm to living resources and life, being hazardous to human health, hindering human activities, or impairing the quality of the environmental resources.

ppm (parts per million): number of parts of a chemical found in one million parts of a particular gas, liquid, or solid.

pre-wetting: in road de-icing, involves adding liquid chemical de-icer to the salt and sand mix as it leaves the spreader truck. Research has shown that increased retention of the dampened material reduces the need for de-icing material by 30%. The de-icer also acts as a catalyst, providing heat and moisture to dissolve the salt and speed thawing.

primary level sewage treatment: first step in sewage treatment to remove large solid objects by screens (filters) and sediment and organic matter in settling chambers; a mechanical process.

renewable resources: natural resources whose supply can essentially never be exhausted, usually because they are continuously produced (e.g. trees, fish). Overuse, however, can result in complete or near complete exhaustion of a renewable resource.

riffles: a shoal or other object in a stream causing a ripple or a stretch of choppy water.

second growth: a second forest that develops after harvest of the original forest.

secondary level sewage treatment: after primary treatment, removal of biodegradable organic matter from sewage using bacteria and other microorganisms, in activated sludge, or trickle filters. Also removes some of the phosphorus and nitrate; a biological process.

shelterbelt: a row of trees, shrubs, or other vegetation planted in rows, perpendicular to prevailing winds, specifically to minimize soil erosion in agricultural areas.

soiling index (or coefficient of haze - COH): an indication of the soiling or darkening potential of fine particulates in the atmosphere. Usually, these types of particles are generated by combustion. The particles may remain suspended in the air as dust, smoke, fumes, aerosols, soot or mist. These particulates, from 0.1 to 1 micron in solid or liquid form, can become trapped in the lungs during breathing. They can also soil surfaces, decrease visibility, aggravate respiratory problems and cause long-term damage to the lungs.

species: a group of related plants or animals that share certain identical physical characteristics and are capable of producing fertile offspring.

sulphur dioxide (SO_2): a colourless gas formed primarily by the combustion of fossil fuels that is one of the major contributors to acid rain. Sulphur dioxide and its atmospheric by-products can also cause respiratory ailments and cardiac problems. Sources of SO_2 include pulp mills, smelters, natural gas processing plants and the combustion of high-sulphur fuels, such as coal and petroleum.

summerfallow: agricultural land left unsown, usually for a season, to conserve moisture in the soil and to allow accumulation of nitrogen.

sustainable development: development that meets the needs of the present without compromising the ability of future generations to meet their own needs.

sustainable use: use of an organism or ecosystem at a rate within its capacity for renewal or regeneration.

sustained yield: the yield that a forest, cropland, water body, or other resource base can produce continuously at a given intensity of management.

tall-grass prairie: the native prairie habitat in Manitoba. Most of Manitoba's tall-grass prairie has been brought under cultivation.

tailings: material rejected from a mill after most of the recoverable valuable minerals have been extracted. Tailings are generally finely ground rock particles that are transported as a water slurry to a storage area, known as a tailings pond, at the mine site. Usually, the tailings composition is similar to that of the parent ore body and may therefore contain metals, sulphides, salts, or radioactive minerals.

terajoules: a joule is a measure of energy potential. A terajoule is equal to 1,000 gigajoules or the amount of energy in approximately 30,000 litres of gasoline.

tertiary level sewage treatment: removal of nitrates, phosphates, chlorinated compounds, salts, acids, metals and toxic organic compounds after secondary treatment; a chemical process.

threatened species: an official designation assigned by the Committee on the Status of Endangered Wildlife in Canada. The term describes any indigenous species or subspecies or geographically separate population of fauna or flora that is likely to become endangered in Canada if the factors affecting its vulnerability do not become reversed. See also extinct, extirpated.

volatile organic compounds (VOCs): chemicals which contain hydrogen and carbon, and which evaporate easily. Hundreds of these compounds are present in the atmosphere and may come from natural sources (e.g. volcanoes, trees, vegetation, bacteria and fossil fuel deposits). The main human sources of VOCs are the fossil fuels burned in motor vehicles, as well as solvents and oil-based paints.

wetland: land that has the water table at, near, or above the land surface or that is saturated for a long enough time to promote wetland or aquatic processes and various kinds of biological activity that are adapted to the wet environment. Includes fen, bog, swamp, marsh, and shallow open water.

ACRONYMS

BFI (Browning Ferris Industries)

CCFM (Canadian Council of Forest Ministers)

CCME (Canadian Council of Ministers of the Environment)

CEC (Clean Environment Commission

CETAC (Canadian Environmental Technology Advancement Corporation)

CMEC (Council of Ministers of Education, Canada)

COH (coefficient of haze)

CWHP (Critical Wildlife Habitat Program)

DSWMA (Deerwood Soil and Water Management Association)

EIDI (Environmental Industries Development Initiative)

ESIC (Environmentally Sensitive Initiative Committee)

EYC (Environmental Youth Corps)

FFMC (Freshwater Fish Marketing Corporation)

GATT (General Agreement on Tariffs and Trade)

HBMS (Hudson Bay Mining and Smelting)

HELP (Habitat Enhancement Land Use Program)

ICLEI (International Council for Local Environmental Initiatives)

LMCFA (Lake Manitoba Commercial Fishermen's Association)

MAL (Maximum acceptable level)

MAUM (Manitoba Association of Urban Municipalities)

MPI (Manitoba Public Insurance)

MPSP (Manitoba Product Stewardship Program)

NAFTA (North American Free Trade Agreement)

NAPCC (National Action Program on Climate Change)

NAPS (National Air Pollution Surveillance)

NAWMP (North American Waterfowl Management Plan)

NGLs (natural gas liquids)

PERD (Program of Energy Research and Development)

PFRA (Prairie Farm Rehabilitation Administration)

PHJV (Prairie Habitat Joint Venture)

PRP (Park and Ride Program)

RWMAF (Regional Waste Management Assistance Fund)

SDIF (Sustainable Development Innovations Fund)

UMM (Union of Manitoba Municipalities)

WCFSD (World Commission on Forests and Sustainable Development)

WQI (Water Quality Index)

WRAP (Waste Reduction and Prevention)

WWCD (Whitemud Watershed Conservation District)

SOURCES FOR DEFINITIONS:

Arms and Camp, 1991. Journey into Life, second edition. Saunders College Publishing, U.S.A.

Avis, Drysdale, Gregg, Neufeldt, and Scargill, 1983. Gage Canadian Dictionary. Gage Publishing, Toronto, Ontario.

Bishop, Lewis and Sutherland, 1976. The Atmosphere and Hydrosphere. Bell and Howell, Toronto, Ontario.

British Columbia Ministry of Environment, Lands and Parks and Environment Canada, 1993. State of the Environment Report for British Columbia. B.C. Environment, Lands and Parks, Victoria, B.C.

Clarke, Keith C. 1990. Analytical and Computer Cartography. Prentice Hall Inc., New Jersey.

Davis, Richard A., Jr., 1991. Oceanography, second edition. Wm. C. Brown Publishers, Dubuque, Iowa.

Manitoba Environment, 1995. State of the Environment Report for Manitoba 1995. Manitoba Environment, Winnipeg, Manitoba.

Miller, 1990. Living in the Environment, 6th edition. Wadsworth, Inc., Belmont California.

Rubenstein, James M., 1989. The Cultural Landscape, second edition. Bell and Howell, Columbus, Ohio.