CHAPTER 6

The Canadian Prairies: biophysical and socio-economic context

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The MA (Millennium Ecosystem Assessment) – a four-year study by 1360 scientists from 95 countries – provides a useful lens for examining agriculture and water resource policy and practice in an internationally significant and vulnerable agro-ecosystem—the Canadian prairies.

The key innovation of the MA – as compared to other global environmental assessments – was its framework: human well-being is ultimately dependent on ecosystem services, variously categorized as provisioning, regulatory, and cultural services. The MA identified the acute vulnerability of dryland agro-ecosystems, arising from the loss of ecosystem services, as one of the 'outstanding' global environmental problems—particularly in the context of climate change.[2] This paper contextualizes the general observations of the MA, with a detailed examination as regards the Canadian prairies.

In November 2003, the Canadian Senate Committee on Agriculture and Forestry published a report titled *Climate Change: we are at risk*, which concluded that Canadian agriculture will be affected by climate change, and noted that more frequent and widespread drought on the prairies was expected. The prairies produce well over half of the total value of Canadian agri-food exports, but are frequently affected by climate-related disasters. The prospect of more frequent and larger droughts afflicting the prairies only compounds the multitude of physical and economic shocks and stressors with which prairie socio-ecological systems – including the following – have had to cope.

- Stagnant commodity prices and input price shocks (particularly energy)
- Closure of the American border to beef exports
- Further threats to export markets from the introduction of genetically modified wheat
- Increasing nutrient loads on prairie water bodies

Past adaptations to the cumulative stresses in the dust-bowl years of the 1930s included distress out-migration; they also, however, included federal policy innovations like the PFRA (Prairie Farm Rehabilitation Administration) and the CWB (Canadian Wheat Board). The PFRA was established to assist prairie farmers in recovering ecological resilience that had been lost through poor land

[1] International Institute for Sustainable Development, Canada
[2] http://www.millenniumassessment.org//proxy/document.356.aspx

management practices, which left the prairies extremely vulnerable to wind and water erosion during the droughts of the 1930s. The CWB was established to buffer prairie farmers from the vagary of international commodity prices by aggregating and then marketing all prairie wheat and barley production in global markets.

Our basic hypothesis is that, in the face of recent evidence, the prairies' agriculture is not sustainable and is in need of policy innovation on a similar scale to the advent of the PFRA and the CWB. We believe that existing, nascent market forces that value ecological goods and services, such as organic agriculture and carbon trading, harnessed through focused policy, constitute such innovation. First, we review the climatologic, hydrologic, and economic shocks afflicting prairie agriculture; and, second, we examine federal and provincial agri-water policies that pertain to watershed management and the use of economic instruments to value ecological goods and services—both areas of innovation deemed critical by the MA to reducing agro-ecological vulnerabilities.

6.1 Overview of agriculture on the Canadian prairies

Agricultural exports from the Canadian Prairies are an important source of food and fibre for the global market, and make a significant contribution to the nation's wealth and balance of payments. In 2001, the agriculture and agri-food sector contributed 8.3 % to the GDP (gross domestic product), accounting for CAD (Canadian dollar) 100 billion in annual retail and food service sales, and about CAD 20 billion in exports.[3] The three Prairie Provinces – Manitoba, Saskatchewan, and Alberta – generally contribute well over half of these totals. The CWB markets wheat, durum wheat, and barley grown on the prairies. With annual sales revenue between CAD 4 and CAD 6 billion, the CWB is one of Canada's biggest exporters (and foreign exchange earners). The CWB annually markets about 20 million tonnes of wheat and barley to over 70 countries, and controls about 20 per cent of the international wheat trade.[4]

Prairie agriculture takes place in a physiographic region known as the Western Interior Basin that comprises the northern portion of the Great Plains eco-zone, which essentially comprises the northwestern extreme of cultivable land in North America (see the box in Figure 6.1).

Figure 6.1 Cultivated systems

Source MA (2005)

[3] http://www.cbcglobelink.org/cbcglobelink/country/Canada/cr.htm

[4] http://www.cwb.ca/en/about/index.jsp

The natural vegetation of this region is primarily grassland, extending southward from the Boreal Forest into a transition zone of Aspen Grove to Mixed-grass Prairie and Short-grass Prairie, with the northern tip of the True Prairie grassland extending into south-eastern Manitoba. The soils of the interior plains are quite fertile, made up of Brown Chernozemic, Dark Brown Chernozemic, and Black Chernozemic soils (AAFC–PFRA 2000).

The climatic regimes of the Prairie Provinces are classified as cold temperate and sub-Arctic. They range from dry continental type conditions in the south-west to near-Arctic conditions in the north-east along the Hudson Bay coastline. Most areas of the Prairie Provinces receive their heaviest precipitation from storms fed by moisture flowing northward from the mid-west US. Average yearly temperatures are warmest in the south and coldest in the north-eastern areas of the prairies. The western mountain ranges have a pronounced effect on precipitation patterns across the region and on winter temperatures (Herrington, Johnston, and Hunter 1997).

While the region enjoys predominately sunny skies throughout the year, considerable fall and spring cloudiness occurs due to the oscillation of the migratory storm track across the region. The agricultural regions experience relatively long winters, short summers, and low precipitation. Clear skies and warm temperatures generate sufficient growing degree-days for agriculture during summer. During the period of instrumental record, the available growing degree-days averages about 1700–1800 in Manitoba, with Saskatchewan and Alberta receiving, on average, 100–300 less.

Annual precipitation during the period of instrumental record has ranged from 400 mm to 600 mm for Manitoba, whereas Saskatchewan (300 mm–500 mm) and Alberta (300 mm–500 mm) tend to receive relatively less precipitation. Although this level of precipitation is marginal for agriculture, most of the precipitation falls during the growing season, and typically during the month of June when crops can best use the moisture. Moisture deficits, however, tend to exist in most agricultural regions, ranging from 150 to 400 mm. Extreme weather events such as drought, tornadoes, floods, and hails are also common occurrences throughout the prairies, although the frequency and severity of these events tend to be regionally variable.

The combination of good soils and – on average – adequate precipitation, results in large and diverse agricultural production. The prairies produce well over half of the total value of Canadian agri-food exports (Tyrchniewicz and Chiotti 1997). Although grain production has historically been associated with prairie agriculture and continues to account for the majority of production, in recent years, many farmers have begun to diversify into specialty crops (such as mustard seed, dry peas, and lentils). In areas subject to extreme moisture deficits, extensive irrigation systems have also been developed. According to AAFC–PFRA (2000), 630 000 hectares of agricultural land on the prairies currently rely on irrigation; almost 500 000 hectares of which are in southern Alberta, producing a wide variety of crops including grains, pulse crops, corn, sugar beets, and vegetables.

In summary, the coincidence of favourable soils and a marginal hydro-climatological regime has given rise to large and diverse agricultural economy on the Canadian prairies during the period of European settlement. The appearance of climate change as a major public policy issue motivates a retrospective of the historic prairie climate as a potential proxy for the future climate, as well as a survey of the existing research on the projected impacts of climate change.

6.2 Prairie hydrology, hydrologic variability, and drought

Canada is widely regarded as a water-abundant country—a notion reinforced by maps like the national water poverty index recently published in *Scientific American*.[5] However, this very coarse generalization belies the relative water stress on prairie agriculture. Global precipitation maps, such as that produced by the International Water Management Institute (Figure 6.2), reveal that although the Canadian prairies are not as arid as central Asia or Australia, they are one of the major agricultural zones with the least precipitation—viable because the relatively cool temperatures reduce potential evapo-transpiration.

[5] *Scientific American* **293** (3): 87

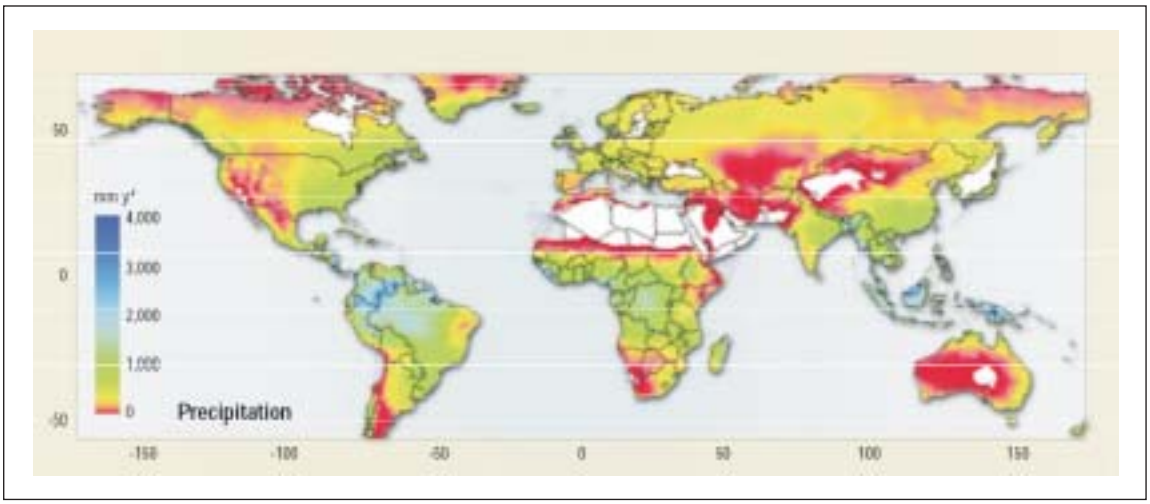

Figure 6.2 Global precipitation map
Source IWMI (2005)

6.2.1 Palliser's expedition, drought, and historic climate variability

The earliest scientific assessment of the prairies produced a foreboding assessment of the viability of prairie agriculture. From 1857 to 1860, Captain John Palliser led a group of scientists into what was then the virtually unknown (to European explorers) territory lying west of what is now Manitoba. Palliser's group, known as the British North American Exploring Expedition, was commissioned by the government of the day with exploring, studying, and mapping the plains between the North Saskatchewan River and the current American border. They identified a triangular region bounded by the lines adjoining Cartwright, Manitoba; Lloydminster, Saskatchewan; and Calgary, Alberta (now known as Palliser's Triangle) as arid and unsuitable for settled cultivation. Palliser warned that disaster would befall those who tried to settle in the region. A subsequent expedition by Henry Yule Hind reached different conclusions from Palliser's, probably because of a different geographic focus.

Government policy followed Hind's recommendations, and the early settlement of the prairies coincided with an unusual sustained run of moist years from the late 1890s to the early 1900s, with 12 years of average or above-average precipitation. Increased soil moisture reserves provided for good crop yields and led to bumper harvests in 1905 and 1915. The success of harvests in the early years of settlement encouraged further agricultural expansion and population growth. Despite the early promise, the 20th century has been punctuated by droughts, such as those in 1906, 1936–38, 1961, 1976–77, 1980, 1984–85, 1988, and 2001–2003 (Goodwin 1986; Gan 2000; Wheaton, Wittrock, Kulshreshtha *et al.* 2005).

Precipitation is the major factor controlling the onset and duration of drought. Inter-annual variability of precipitation and temperature, to a lesser extent, determine the frequency and intensity of drought. Precipitation variability can be a useful indicator of the extent to which an area is prone to drought, with the coefficient of variation (the ratio of the standard deviation to the mean) being the most stable measure of precipitation variability (Longley 1953). Figure 6.3 depicts the coefficient of variation of growing season precipitation over the Canadian prairies, and is noteworthy for the following two reasons.

1 The regions of highest precipitation variability that coincide quite closely with the extent of Palliser's Triangle
2 The magnitude of precipitation variability in this area (30–40 per cent)

6.2.2 Paleo-climatic research

Recent paleo-climatic research also indicates that the Canadian prairies have been subject to high historic climate variability. Current research suggests a sequence of long-term, broad-scale climatic trends, roughly synchronous over wide areas, and their associated ecological responses. Much of the knowledge of post-glacial environments in the Prairies Provinces has been derived from the study of pollen records recovered from lakes and wetlands. There are about 100 paleo-environmental records available, with more from Alberta than from the other Prairie Provinces.

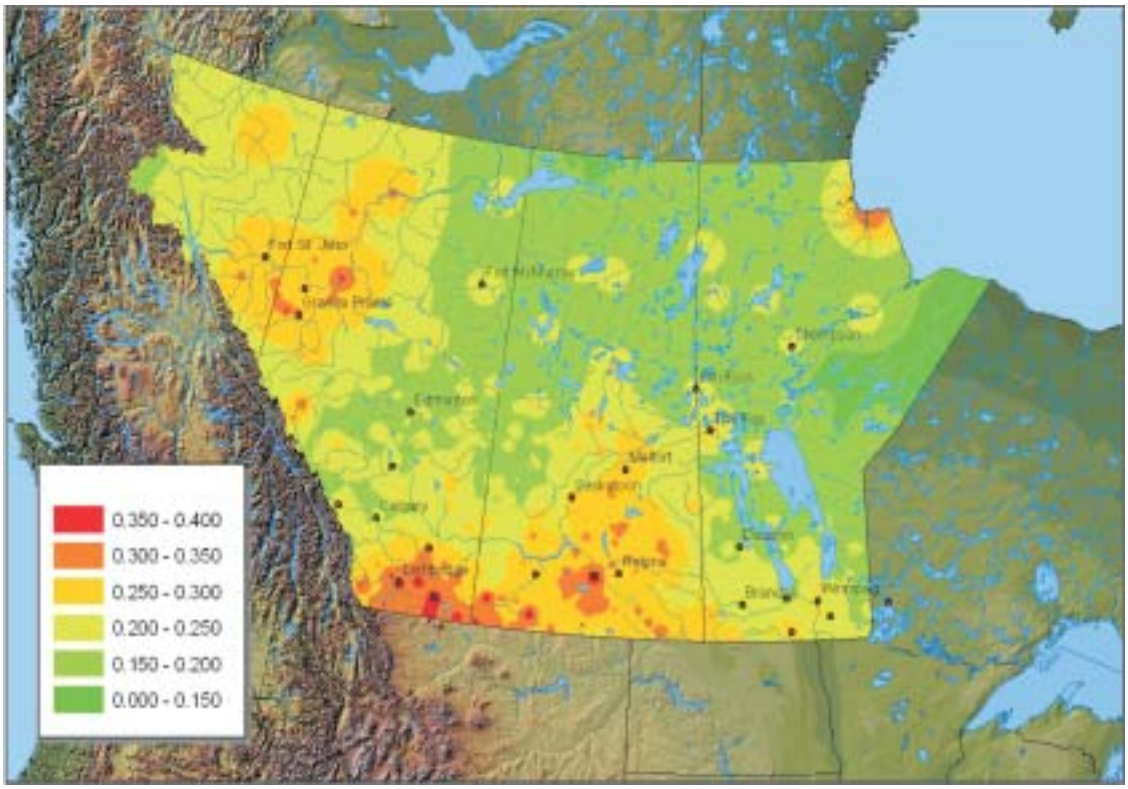

Figure 6.3 Precipitation variability map: coefficients of variability calculated from average precipitation data (1960–2002)

At a very generalized level, paleo-environmental records for the prairies concur in showing a broad three-part division of the post-glacial period. The early part (prior to about 9000 years BP [Before the Present, specifically before 1950]), for which there are comparatively few records, shows a sequence of rapid vegetation changes that reflect post-glacial migration of plants into the region and soil development and landscape response to post-glacial conditions—all of which tend to blur the climate signal. Between around 9000 and about 6000 year BP, most records show evidence of aridity, increased salinity and higher than present temperatures, with the prairie grasslands probably extending up to about 80 km farther north than their present range. After about 6000 year BP, increased moisture and probably cooler temperatures are inferred from rising lake levels, decreased salinity, and southward advance of the boreal forest margin. This cooler, wetter interval resulted in renewed ice accumulation in the Canadian Rockies and led to the first well-marked Neoglacial advance around 4000 year BP. A series of ice advances have occurred in the last 4000 years, although most glaciers show their maximum advances in the last few centuries.

These general climate changes include considerably smaller scale variability. For example, within the last millennium there were two broad climate phases: the Medieval Warm Period, ending around the 12th century, followed by the Little Ice Age.[6] The paleo-climatic record for the past 1000 years indicates that periodic and severe drought episodes are common, and that drought conditions prior to Euro-Canadian settlement far exceed anything experienced in the last century (Sauchyn and Beaudoin 1998). The most severe drought of the past 500 years is thought to have occurred between approximately 1791 and 1800 (Harrington, Johnston, and Hunter 1997). Historically, drought has been found to occur every 30 to 50 years, a pattern repeated in the 20th century.

[6] A cold period lasted from about 1550 AD to about 1850 AD in Europe, North America, and Asia. This period was marked by rapid expansion of mountain glaciers, especially in the Alps, Norway, Ireland, and Alaska. There were three maxima, beginning about 1650 AD, 1770 AD, and 1850 AD, each separated by slight warming interval.

6.2.3 Implications of future climate change

The potential for climate change as the result of global warming is now part of the modern scientific canon, and potential threats to agriculture are also widely understood. A study by the IIASA (International Institute for Applied Systems Analysis) – titled *A Global Agro-ecological Assessment for Agriculture in the 21st Century* – suggests that climate change will create significant but highly varied impacts on crop production. Developed countries will gain substantial potential, with developing countries losing potential (Fischer, Shah, van Velthuizen *et al.* 2001). This coarse generalization, however, requires region-specific contextualization. Conventional approaches to estimating agriculture vulnerability to climate change generally use a top-down approach starting with scenarios derived from GCMs (global circulation models), which are, in turn, used to estimate changes in agro-climatic properties, crop yield impacts and regional economic impacts, and to suggest possible adaptation responses. To date, two relevant GCM impact studies have been conducted for the prairies. Sauchyn, Barrow, Hopkinson *et al.* (2002) used results from three different GCM modelling scenarios – HadCM3, CGCM2, and CSIROMk2b – to estimate future aridity on the Canadian prairies. The CGCM1 model was used by Nyirfa and Harron (2001) to estimate the impact of climate change on land suitability for agriculture as it had been applied in previous agricultural adaptation studies in Canada (Bootsma, Gameda, and McKenney 2000), and is considered to be performing well in reproducing present baseline climate characteristics (Hengeveld 2000). The two studies produced broadly similar results.

Although precipitation increases in all the GCM scenarios, this gain is offset by higher temperatures, which increase the potential evapo-transpiration, thus increasing moisture deficits. The moisture deficit – defined by Nyirfa and Harron (2001) as precipitation minus potential evapo-transpiration – for the nominal 'normal' period (1961–1990) is shown in Figure 6.4. The projected moisture deficit for the 2040–2069 period (Figure 6.5) reveals an increase in the overall extent of regions affected by moisture stress—regions of highest moisture deficit correspond quite closely to that of the Palliser's Triangle.

Sauchyn, Barrow, Hopkinson *et al.* (2002) investigated a broader range of climate scenarios, but had similar results. The HadCM3 model used by Sauchyn, Barrow, Hopkinson *et al.* (2002) is cooler and wetter than the CGCM1 scenario used by Nyirfa and Harron (2001); the CSIROMk2b is similar to CGCM1; and the CGCM2 hotter and dryer than CGCM1. Sauchyn, Barrow, Hopkinson *et al.* (2002) concluded that the climate projections suggest a general increase in dry conditions; the cooler, wetter scenario (HadCM3) merely delays the onset of increasing aridity, whereas the hotter, dryer scenario (CGCM2) reveals a possible desertification risk.

Even in the absence of climate change, based on the proxy-historical record, the prairies are expected to return to drier conditions in the coming decades. Thus, a natural cyclical drying combined with climate change potentially leaves the prairies extremely vulnerable to transient climatic variability and extreme weather events in the coming century.

The demonstrated adaptive capacity to historic climatic stress is not heartening in light of projected future climate change adaptation requirements.

6.2.4 Evidence of the current adaptive capacity to climate variability

Although the history of prairie agriculture is characterized by adaptations to climate variability, including the development of drought- and frost-tolerant crops and farming practices that conserve soil moisture, there is considerable evidence of more aggressive policies being required to increase adaptive capacity. The drought of the Great Depression provides a classic example of mal-adaptation; drought in the 1930s affected 7.3 million acres and forced distress migration of a quarter of a million people (Goodwin 1986). This mass exodus did catalyse a major institutional response, that being the formation of the PFRA and the CWB. The impacts of subsequent droughts have largely been simply absorbed by a much larger national economy, less dependent on agriculture.[7] The 1984–85 drought affected most of the southern prairies, and cost Canada at least a billion dollars of GDP (Ripley 1988).

[7] In 1999, about two per cent of Canada's GDP was derived directly from agriculture. http://www.wd.gc.ca/rpts/audit/wdp/3_e.asp

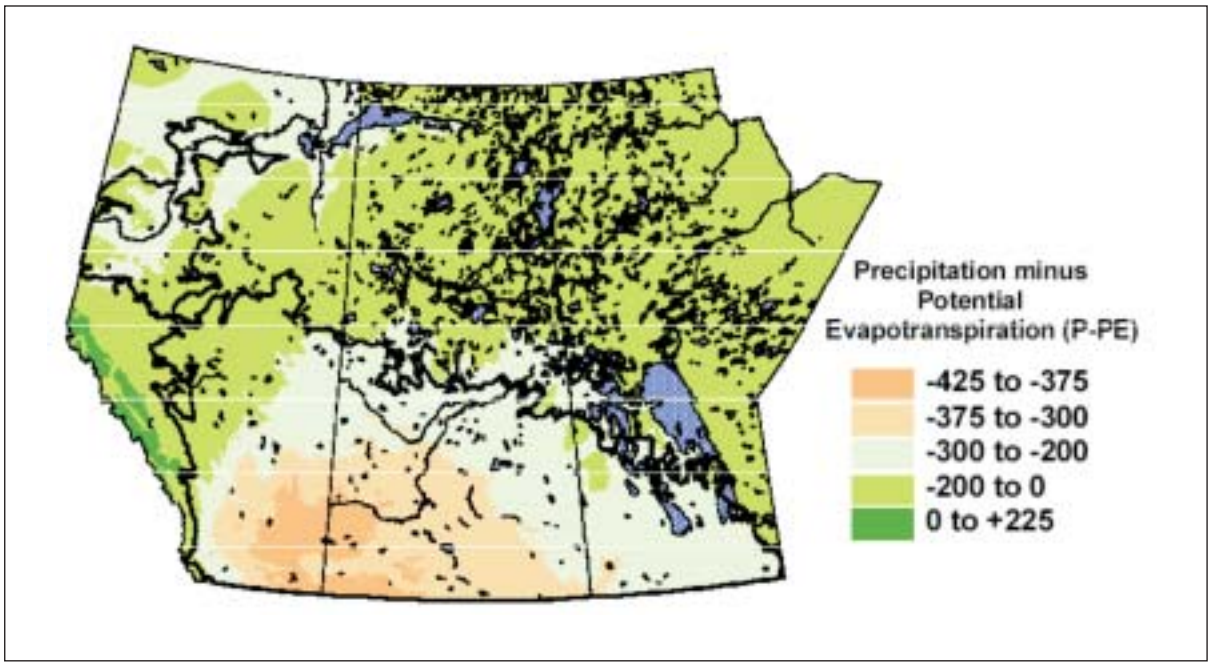

Figure 6.4 Moisture deficit 1961–90
Source Nyirfa and Harron (2001)

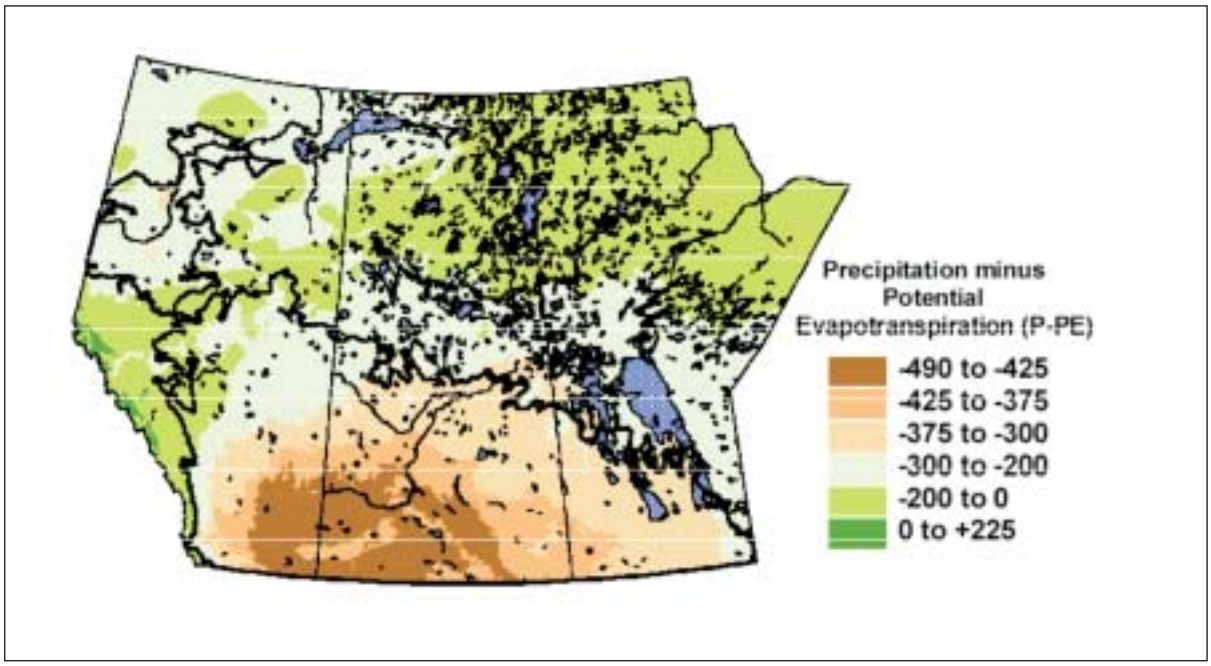

Figure 6.4 Projected moisture deficit 2040–69 (scenario CGCM 1)
Source Nyirfa and Harron (2001)

In the severe drought year of 1988, agricultural export losses topped CAD 4 billion. Despite assistance payments of over CAD 1.3 billion, Manitoba showed net farm income losses of 50 per cent and Saskatchewan 78 per cent, and an estimated 10 per cent of farmers and farm workers left the agricultural sector that year alone (Arthur and Chorney 1989; Herrington, Johnston, and Hunter 1997). Even in 1991 – a year of record-high wheat production – emergency payments (that is, above regular assistance and insurance programmes) were still in excess of CAD 700 million (Sauchyn and Beaudoin 1998). Recent analysis of the 2001–03 drought (Wheaton, Wittrock, Kulshreshtha *et al.* 2005) indicates losses of CAD 3.6 billion and CAD 5.8 billion, in agricultural productivity and GDP respectively, and manifest as the loss of 41 000 jobs in the agricultural sector. Most recently, floods in the late spring of 2005 in Manitoba have devastated yields. Continuous rain through July forced

farmers to abandon seeding on some fields, while losing other newly germinated fields to drowning. About one-third of Manitoba's normally cultivated agricultural land was lost in 2005.[8]

Dave Sauchyn, paleo-climatologist of the University of Regina, makes some rather succinct observations regarding the sustainability of prairie agriculture given probable historic and possible future climate hazards. They include the following.

- The sustainability of prairie agriculture depends on adaptation to the amplitudes of climate change and variability. (Sauchyn and Beaudoin 1998, p.337)
- The prairie eco-zone is the only major region (in Canada) where drought is a landscape hazard… management of prairie ecosystems and soil landscapes requires an understanding of past and future trends and variability. (Sauchyn, Barrow, Hopkinson *et al.* 2002, p.247).
- A policy framework to minimize the adverse impacts of drought and increasing aridity must support adaptation of soil and water management practices to climatic variability. (Sauchyn, Barrow, Hopkinson *et al.* 2003, p.11).

6.2.5 Prairie water and soil quality

In addition to the severe risk to dryland agriculture posed by climate change, the MA also identified nutrient over-enrichment as a critical global environmental issue. Since 1960, flows of biologically available nitrogen in terrestrial ecosystems have doubled, and flows of phosphorus have tripled, primarily due to applications of synthetic fertilizers.

The current eutrophication (oxygen deprivation) of Lake Winnipeg is a useful integrative indicator of nutrient stresses on the prairies. Lake Winnipeg is the 10th largest permanent freshwater lake, in area, in the world, and supports the largest freshwater fishery in North America. Rivers flowing into Lake Winnipeg drain a vast swath of the Great Plains encompassing parts of four Canadian provinces (about 80 per cent of the cultivable land on the prairies), as well as parts of four American states, as shown in Figure 6.6.

Figure 6.6 The Lake Winnipeg Watershed
Source LWSB (2005)

[8] http://www.hpj.com/dtnnewstable.cfm?type=story&sid=15105

Like many lakes in human-dominated ecosystems elsewhere in the world, Lake Winnipeg is currently under increasing ecological stress due to a number of factors including invasive species, erosion, and an inverted discharge regime owing to regulation for hydropower. Nutrient pollution is, however, currently regarded as the most severe threat to Lake Winnipeg water quality. Algal blooms – a typical ecosystem response to excessive nutrient enrichment, usually nitrogen and phosphorus – were significant in the lake's north basin in 2001 and 2005. Stewart, Stern, Salki *et al.* (2000) suggest that on the basis of inflow phosphorus concentration and water renewal time, Lake Winnipeg is significantly more stressed than Lake Erie prior to remediation efforts.

The cumulative toll on prairie land resources from agricultural stresses is also telling. In 2000, the PFRA released a report, titled *Prairie Agricultural Landscapes: A Land Resource Review* (AAFC–PFRA 2000), which concluded that the following.

- Fifty per cent of lands under annual cropped lands are threatened by erosion and require intensified use of crop residues and permanent cover to maintain soil health.
- Fourteen to forty per cent of soil organic matter (the vital component of the soil fabric, responsible for improving soil structure, fertility, and health) has been lost from prairie soils since cultivation began.

Prominent Canadian ecologist David Schindler (2001) argues that the interaction of climate change and nutrient loadings from intensive agriculture will have multiple negative impacts on prairie water resources, including increased risks to human health from pathogenic bacteria and toxic algal blooms. Schindler (2001, p. 21) argues that 'only comprehensive approaches to the conservation and management of the catchments, which supply drinking water, can prevent major water problems.'

6.3 Agricultural policy drivers and socio-economic conditions

Heightened concern about soil quality, water quality, and climate change on the prairies is concurrent with, and to some degree a function of, liberalization trends reshaping prairie agriculture. The restructuring of agriculture in Canada by the federal government since the 1980s is similar to that accomplished by the International Monetary Fund / World Bank in the structural adjustment of developing world economies. The key instruments in domestic structural adjustment have been WTO (World Trade Organization) compliance efforts, and the NAFTA (North American Free Trade Agreement). Policies reminiscent of structural adjustment adopted in Canada and applied to the agricultural sector include a focus on production for export; dramatic cuts in government spending; deregulation; measures to attract foreign investment; privatization of government industries and utilities; removal of farm subsidies, price controls, and other supports; and implementation of a freely-floating currency.

Between 1991–92 and 1999–2000, government spending on agriculture dropped by 52 per cent from the peak of over CAD 6.1 billion in 1991–92 to approximately CAD 2.9 billion for 1999–2000.[9] According to the NFU (National Farmers' Union), however, no other policy decision has had a greater negative impact on western farmers' income than the cancellation of the Crow Benefit, which subsidized shipping costs (see Chapter 7).

Some of the diversification anticipated through the elimination of the Crow Rate did take place—not through a return to relatively low input classical mixed farming, but rather through new forms of specialized production as farmers adjusted to new economic realities. Pork and beef production are prominent examples of intensified specialized production. Between 1991 and 2001 Canadian beef exports increased almost fivefold (de Loe 2005), much of it concentrated in southern Alberta. This unfettered growth came to an abrupt end in May 2003, when the US closed its border to Canadian beef following the discovery of a single case of BSE (bovine spongiform encephalopathy) or 'mad cow' disease in northern Alberta. Even if the BSE crisis had not dramatically curtailed beef production and

[9] AAFC, Farm Income, Financial Conditions, and Government Assistance data Book, various releases, Table C.I.

export, climate change and water resource limitations may have placed hard constraints on the industry (de Loe 2005). Sixty per cent of Alberta's beef production takes place in the irrigated areas of Alberta, where moisture deficit is the highest and is projected to increase with climate change (de Loe 2005; Wall, Smit, and Wandel 2004). The economic impacts of the BSE crisis have been exacerbated by the consolidation and closure of slaughtering capacity in Canada throughout the 1980s and 1990s—a trend concurrent with the liberalization forces that reshaped the meat packing industry.

Trends and drivers in the pork industry are broadly similar. For example, in Manitoba, between 1990 and 2000, the number of hog farms has declined by more than 50 per cent from 3150 to 1450, while the average number of hogs per farm has more than tripled—increasing from 388 heads to 1290 heads. Overall hog production has increased rapidly, exceeding 4.8 million in 1999—89 per cent of which is exported. The rapid growth in intensive hog operations is attributed to

- changes in world grain trade resulting in relatively static volumes of grains being sold at ever declining prices (constant dollars) due to technology improvements;
- loss of the Crow Benefit on export grain resulting in farmers facing the full freight bill and lower (at least initially) feed grain prices; and
- growth in world demand for meat due to rising incomes.

This heavy intensification in the hog sector, along with its concentration in certain locations within the province, has heightened public concerns regarding the environment, particularly regarding air and water quality, and public health. A broad-based coalition of environmental NGOs complain that hog ILOs (intensive livestock operations) threaten both water supplies and water quality,[10] and are particularly opposed to the practice of field application of liquid hog manure, which is very high in nitrates and phosphorus. Noted University of Alberta Ecologist David Schindler warns that the combination of declining stream flows due to climate change and the concentration of nitrates, phosphates, and pathogens from ILOs (some of which produce as much waste as medium-sized cities) will seriously imperil freshwater resources on the prairies. Recently a citizens' coalition in Manitoba[11] has opposed plans to liberalize regulations governing liquid manure applications, charging that they are in direct conflict with efforts to reduce the volume of pollutants (particularly phosphorus) that enter Lake Winnipeg that are believed to be responsible for the appearance of large oxygen-depleting algae blooms, and the lake's high risk of further eutrophication (LWSB 2005).

How is the family farm on the prairies coping with these agro-ecological stresses and, equally important, with severe concurrent economic stress? In short, the answer is with grim determination to hang on. Ninety-eight per cent of farms in Canada are still family-owned and family-operated (AAFC 2003); however, in 2000, 73 per cent of farm income of the average farm family came from off-the-farm. Low commodity prices are forcing farm families into the stressful existence of combining full-time jobs with farm management; many simply cannot afford to go on. Between 1996 and 2001, the number of farms in Canada declined by 10.7 per cent (Martz 2004). The following story in the *United Church Observer* (June 2004) captures the outcome of these cumulative stresses on the social fabric of prairie communities.

> *Continuing drought, low grain prices, mad-cow disease, grasshopper infestations, and flu-infected poultry: these are nail-biting times in rural Canada. Some farmers are working two or three jobs to make ends meet. The extra work means they can't volunteer for church positions and activities. And they have less money to put on the offering plate. 'People are cutting back everywhere, including the church,' says Rev. John Lea of the Assiniboia pastoral charge in southern Saskatchewan… Auctions of entire farms are routine now, but the age of the owners is creeping downward to include 40 year-olds, says Lea. The stresses are bursting the entire community and many more families are moving away from small towns to cities. In the last seven yeas more than 500 people, or about one-sixth of the population have left Assiniboia…for farmers like*

[10] See for example: http://www.hogwatchmanitoba.org and http://www.beyondfactoryfarming.org
[11] http://www.mbeconetwork.org/news.asp

Donna Zimmer, there really is no other choice but to keep on going. 'What else can you do?' she says. 'I have worked off the farm all of our married life. I'm looking again for work because we are not making it. We're just hanging on, waiting for something to turn around. (Driver 2004)

The farm income crisis is widely acknowledged in both official policy and farm advocacy circles. A background document to a June 2005 conference organized by the Canadian Agri-food Policy Institute stated, 'an indisputable fact is that at the national level, farm incomes have been decreasing in real terms, whether measured since 1970, 1960, or 1950, and whether measured as net cash income, or as net realized income after accounting for depreciation of assets' (Tyrchniewicz and Tyrchniewicz 2005). The stagnation of commodity prices relative to processed food prices explains much of the farm income crisis. In 1975, the farmer received five cents and the miller and baker 38 cents from the revenue generated from the sale of one loaf of bread. Today, the farmer still receives five cents, while the miller and baker split CAD 1.35.

The NFU goes on to suggest that Canada's export-driven agricultural trade policy[12] has failed the family farm, asserting that if one were to list areas of the agricultural sector that are most heavily focused on export (grains, oilseeds, and hogs), and areas hardest hit by the farm income crisis, one would have the same list. In contrast, the sectors that focus on supplying the Canadian market – dairy, eggs, and poultry – have largely escaped the crisis. The NFU indicates that while Canadian agri-food exports have expanded fivefold since 1979, family farm incomes have declined over the same period (Figure 6.7).

By 1989, the NFU stated that Canada no longer had an agriculture policy as such, but instead had 'a trade policy that masquerades as farm policy'[13]—a very successful trade policy nonetheless. Agri-food exports doubled in seven years from CAD 10 billion in 1989 to over CAD 20 billion in 1996.

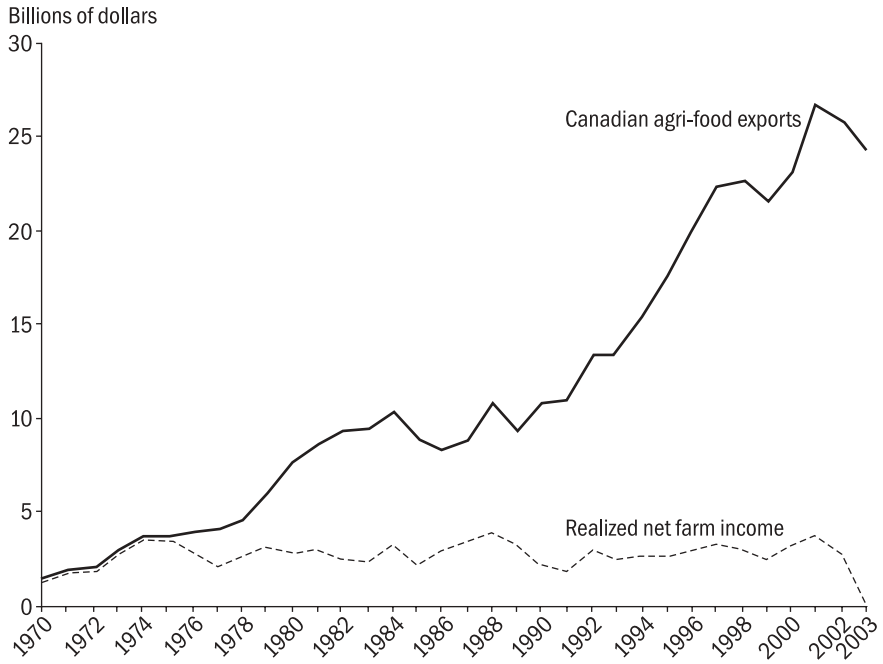

Figure 6.7 Agricultural exports versus farm income

Source Martz (2004)

[12] In 1993, federal and provincial governments set an ambitious target of doubling agri-food exports to CAD 20 billion by 2000. Having accomplished their goal by 1996, well ahead of schedule, federal and provincial ministers pledged to redouble exports to nearly CAD 40 billion (four per cent of world agri-food exports) by 2005. The National Farmers Union claims that the latter goal was actually put forward by the Canadian Agri-Food Marketing Council, a private-sector group that includes representatives of Maple Leaf Foods, Cargill and McCain Foods.

[13] 'NFU official wants a farm policy; not a trade policy,' Barbara Duckworth, *Western Producer*, February 2, 1989, p. 60

Inducements to foreign investment have worked rather well also; by 1999, one US trans-national – Archer Daniels Midland – owned almost 50 per cent of the Canadian flour milling capacity.

The stresses associated with these macro-trade policies compound climate-related stresses; we observe that a major underlying hypothesis of the MA—that human well-being is fundamentally a function of ecosystem services—is very well supported on the face of evidence from the Canadian Prairies. The Prairie socio-ecological system no longer possesses the necessary resilience to climate or economic shock, and farmer frustration with the lack of institutional support to increase their resilience is palpable. Writing in the Winnipeg Free Press on 29 October 2005, Laura Rance evokes the desperation felt by Prairie farmers after this year's harvest (Box 6.1). Rance's article also reveals however, that by sheer exhaustion of conventional options, there is a growing receptivity among farmers to new policy options that expand rural livelihood beyond traditional Prairie agriculture, which includes energy production and environmental stewardship. How those policies should be crafted to improve resilience is the substance and challenge of our ongoing 'Adaptive Policy' research.

Box 6.1 **Farmers struggle to see some light at end of the tunnel**

Discouragement in community is palpable

Laura Rance, *Winnipeg Free Press*, 29 October 2005

It was a solemn bunch of farmers who gathered in Brandon recently for a KAP (Keystone Agricultural Producers) meeting… KAP president David Rolfe could measure the level of stress in the farming community right now by the number of phone calls he is getting. 'It usually starts with someone pointing a finger at a policy or one particular thing, whether it's the high fuel prices or the education tax,' he said. They are angry with KAP for not doing enough. They are angry with governments. They are angry with consumers for wanting cheap food.

But eventually, it comes down to one common theme. In the face of poor crops, low market prices, soaring fuel prices, and taxes due at the end of the month, an unknown number of farmers in this province can no longer make ends meet. 'They say I've expanded, I've diversified, I've done everything. I possibly can—and I still can't make it,' he said.

Farmers once believed that markets would rebound—maybe next year. Even if they didn't, technology would improve their production to compensate. There have been failed efforts over the years to organize farmers to limit production in an effort to force prices higher. And there are ongoing efforts to disorganize them by getting rid of orderly marketing systems that prevent them from going broke sooner.

Farmers have traditionally believed that governments would help—especially if producers rallied before the television cameras. And they thought that if only we could get improved trade rules—that would make all the difference. Not so any more. 'All through my youth we had our bad years and the good years; but there was always a light at the end of the tunnel—things will get better. I don't see that light any more,' said John Castle, a Miniota farmer who has been going to farm meetings since before some of his fellow KAP delegates were born… There's no arguing that the production problems faced this year were unusually severe. But likewise, **there's little argument that farming has been in a perpetual state of crisis for decades because of one reason or another. Apparently, the type of farming we do here has a weak immune system; it catches a cold every time the environment changes.**

Lenders, who a few short years ago were a source of reassurance for their farm clients, are becoming less flexible, Rolfe said. 'They've run out of patience; we've run out of time.' For Castle, who had clearly spent some time pondering this problem, it

Box continues…

comes down to one fundamental shift. This part of the world was settled because governments of the day valued what the region could produce. People in other parts of Canada and in other parts of the world wanted that production badly enough that governments were willing to shoulder part of the export transportation costs. But the world has changed. 'I don't know of any products that we can raise in Western Canada that they can't raise just as well somewhere else in the world,' he said. 'We've got to be producing what is wanted by the world because it doesn't want our current production,' he said.

Some have suggested farmers have more value to society as park wardens or environmental stewards than food producers. Castle said that he, at first, thought such an idea was ridiculous. But now he openly entertains such suggestions. He's not the only one starting to think about farming in a different way. **Starbuck farmer Ed Rempel wondered whether farmers should stop thinking of themselves as food producers and start using their production capacity for things the world wants and needs. He sees high oil prices and the Kyoto accord as potential allies. '**If I can grow nothing but energy on my farm, I will be very happy indeed. If we reforest Western Canada, you won't see me crying, you'll see me learning about lumber.'

We are in the midst of a very painful and difficult transition that offers potential, yet no promise of better times ahead.

The discouragement within the farming community is palpable. People aren't kidding when they worry about a 'silent exodus' from their rural communities. *But it's not over yet*. (emphasis added)

References

AAFC–PFRA (Agriculture and Agri-Food Canada–Prairie Farm Rehabilitation Administration). 2000
Prairie Agricultural Landscapes: A Land Resource Review
Available at http://www.agr.gc.ca/pfra/pub/pallande.htm, last accessed 23 November 2005

AAFC (Agriculture and Agri-Food Canada). 2003
Sustainable Agriculture: our path forward
[Sustainable Development Strategy]
Ottawa: AAFC

Arthur L and Chorney B. 1989
Impact of the 1988 drought on recreation/tourism: Sasktachewan and Manitoba
In *Environmental and Economic Impacts of the 1988 Drought: with emphasis on Saskatchewan and Manitoba*, Vol. 1
Saskatoon: Saskatchewan Research Council.

Bootsma A, Gameda S, and McKenney D W. 2001
Adaptation of Agricultural Production to Climate Change in Atlantic Canada
Ottawa/Sault St Marie: Agriculture and Agri-Food Canada / Canadian Forestry Service.

de Loë R. 2005
Assessment of Agricultural Water Use/Demand Across Canada
[Final report for Sustainable Water Use Branch Water Policy and Coordination Directorate, Environment Canada]
Guelph, Ontario: Rob de Loë Consulting Service

Driver D. 2004.
The Farm Crisis hits the Pews
United Church Observer, June 2004: 27–29
[Available at http://www.ucobserver.org/archives/jun04_nation.htm, last accessed on 23 November 2005]

Gan T Y. 2000
Reducing vulnerability of water resources of Canadian prairies to potential droughts and possible climate warming
Water Resources Management **14**(2000): 111–135.

Goodwin R B. 1986
Drought: a surface water perspective
In *Drought: The Impending Crisis?* pp. 27–43
[Proceedings of the Canadian Hydrology Symposium no. 16, Regina, Saskatchewan, Canada. 3–6 June 1986, organized by the Canadian Meteorological and Oceanographic Society and National Research Council Canada, Associate Committee on Hydrology]

Hengeveld H G. 2000
Projections for Canada's Climate Future
Climate Change Digest CCD-00-01

Herrington R, Johnston B, and Hunter F. 1997
In *Responding to Global Climate Change in the Prairies*, Vol. III of the Canada Country Study 'Climate Impacts and Adaptation'
Downsview: Environment Canada.

IWMI (International Water Management Institute). 2005
World Water and Climate Atlas
Colombo: IWMI.
Available at http://www.iwmi.cgiar.org/WAtlas/brochure.pdf, last accessed on 21 November 2006

LWSB (Lake Winnipeg Stewardship Board). 2005.
Available at http://www.lakewinnipeg.org, last accessed on 5 January 2006

Longley R W. 1952
Measure of the Variability of Precipitation
Mon. Weather Review, **80**: 111–117
[As cited in Maybank J, Bonsal B, Jones K, Lawford R, O'Brien E G, Ripley E A, and Wheaton E. 1995
Drought as a Natural Disaster
Atmospheric-Ocean **33**(2): 195–222]

Martz D. 2004
The Farmer's Share: compare the share 2004
Saskatchewan: Centre for Rural Studies and Enrichment, Muenster
Available at www.nfu.ca/on/misc_files/CTSFINAL%202004.pdf, last accessed on 23 November 2005

Nyirfa W and Harron W R. 2001
Assessment of Climate Change on the Agricultural Resources of the Canadian Prairies
Regina: Prairie Farm Rehabilitation Administration

Ripley E A. 1988
Drought Prediction of the Canadian Prairies
[Canadian Climate Centre report no. 88-4]
Saskatoon: National Hydrology Research Centre. 137 pp.

Sauchyn D and Beaudoin A. 1998
Recent environmental change in the southwestern canadian Plains.
The Canadian Geographer **42**(4): 337–353

Sauchyn D J, Barrow E, Hopkinson R, and Leavitt P. 2002
Aridity on the Canadian Plains
Geographie physique et Quaternaire, **56**(2–3): 247–259

Sauchyn D J, Barrow E, Hopkinson R, and Leavitt P. 2003
Aridity on the Canadian Plains: future trends and past variability
[Prairie Adaptation Research Collaborative, Summary Document No 03-01]
Available at http://www.parc.ca/pdf/research_publications/earth1.pdf, last accessed on 4 Jan 2003

Schindler D W. 2001
The cumulative effects of climate warming and other human stresses on Canadian freshwaters in the new millennium.
Can. J. Fish. Aquat. Sci. **58**: 18–29

Stewart A R, Stern G A, Salki A, Stainton M P, Lockhart W L, Billeck BN, Danell R, Delaronde J, Grift N P, Halldorson T, Koczanski K, MacHutcheon A, Rosenberg B, Savoie D, Tenkula D, Tomy G, and Yarchewski A. 2000
Influence of the 1997 Red River Flood on the Contaminant Transport and Fate in Southern Lake Winnipeg
[Report prepared for the International Red River Basin Task Force. Stewart]
In *Influence of the 1997 Red River Flood on Contaminant Transport and Fate in Southern Lake Winnipeg*.
Manitoba: Fisheries and Oceans Canada
[Available at http://www.ijc.org/rel/pdf/winnipegwaterquality.pdf, last accessed October 31, 2006].

Tyrchniewicz A and Chiotti Q. 1997
Agriculture and climate change: a prairie perspective, Appendix A
In *Responding to Global Climate Change in the Prairies*, Vol. III of the Canada Country Study 'Climate Impacts and Adaptation'
Downsview: Environment Canada

Tyrchniewicz E and Tyrchniewicz A. 2005
Vision and Strategic Direction Options for the Canadian Agricultural Sector
[Prepared for the Canadian Agri-food Policy Institute]
Available at http://www.capi-icpa.ca/PapID25_Tyrncheweicz.pdf, last accessed on 5 January 2006

Wall E, Smit B , and Wandel J. 2004
Canadian Agri-food Sector Adaptation to Risks and Opportunities from Climate Change
[Position paper on climate change, impact, and adaptation in Canadian agriculture]
Available at http://www.c-ciarn.uoguelph.ca, last accessed on 23 November 2005

Wheaton E, Wittrock V, Kulshreshtha S, Koshida G, Grant C, Chipanshi A, and Bonsal B. 2005
Lessons Learned from the Canadian Drought Years of 2001 and 2002: Synthesis Report for Agriculture and Agri-Food Canada
Saskatoon: Saskatchewan Research Council. [SRC publication no. 11602-46E03]