

# The 2001-2002 Canadian Drought Experience: Lessons Learned

Invited Presentation to the North American Drought Monitor-Canadian Workshop  
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# Main Questions

?

- What were the main physical, biological and economic **impacts** of the 2001-2002 drought?
- What were the main **adaptations** and how effective were they?
- Are we **prepared** for the next major droughts?
- How can we better prepare for the **next** droughts?

# Some Economic Impacts of the 2001-2002 Drought

- 💧 Total Canadian agricultural production loss was ~\$3.6 billion
- 💧 Gross Domestic Product fell ~\$5.8 billion
- 💧 Employment losses > 41,000
- 💧 Worst year was 2002
- 💧 Alberta and Saskatchewan were hit hardest



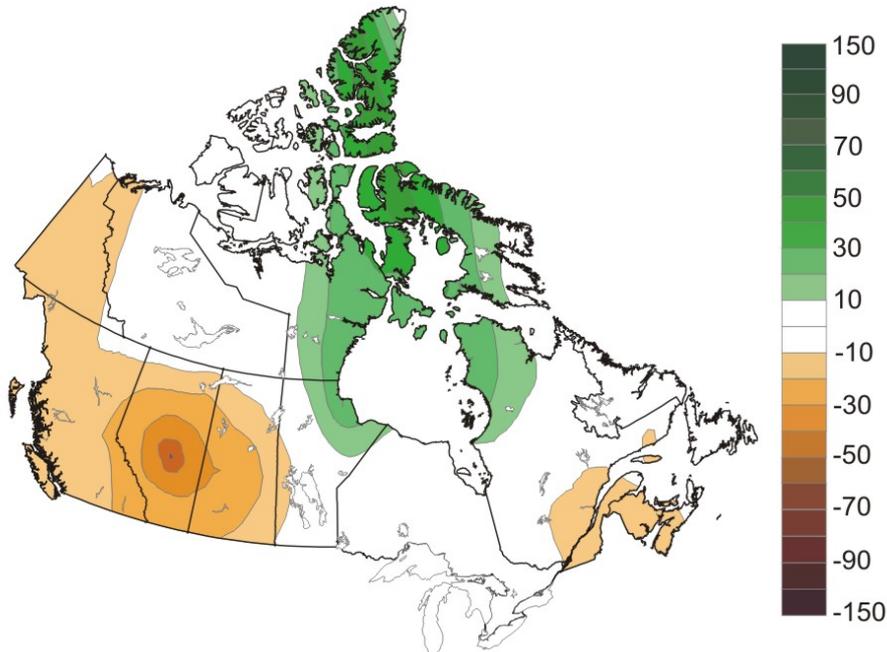
(Wheaton et al. 2005, 2008)



# 2001-2002 Canadian Drought

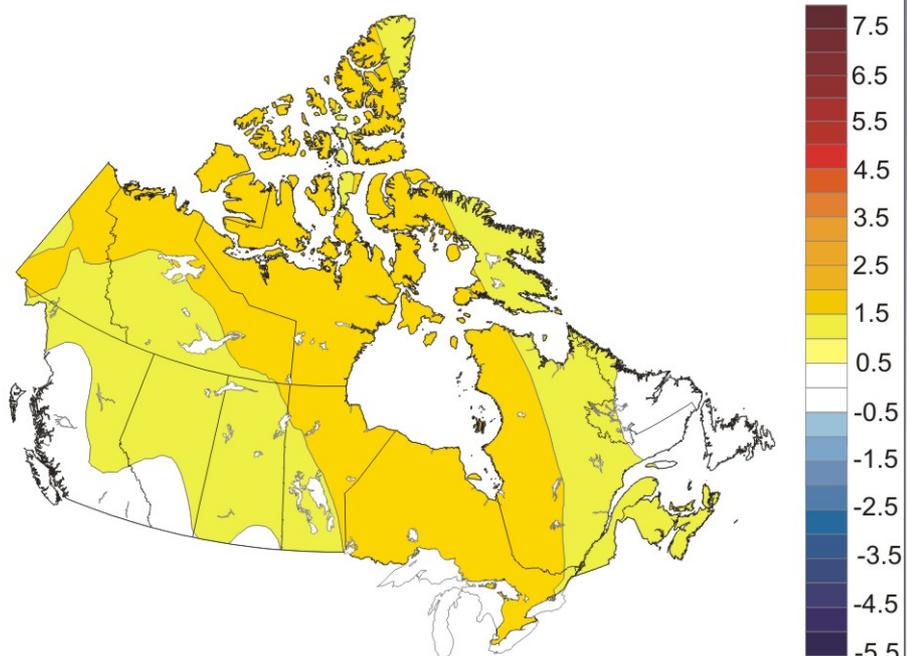
## Precipitation (%)

### Autumn 2000 to Summer 2002



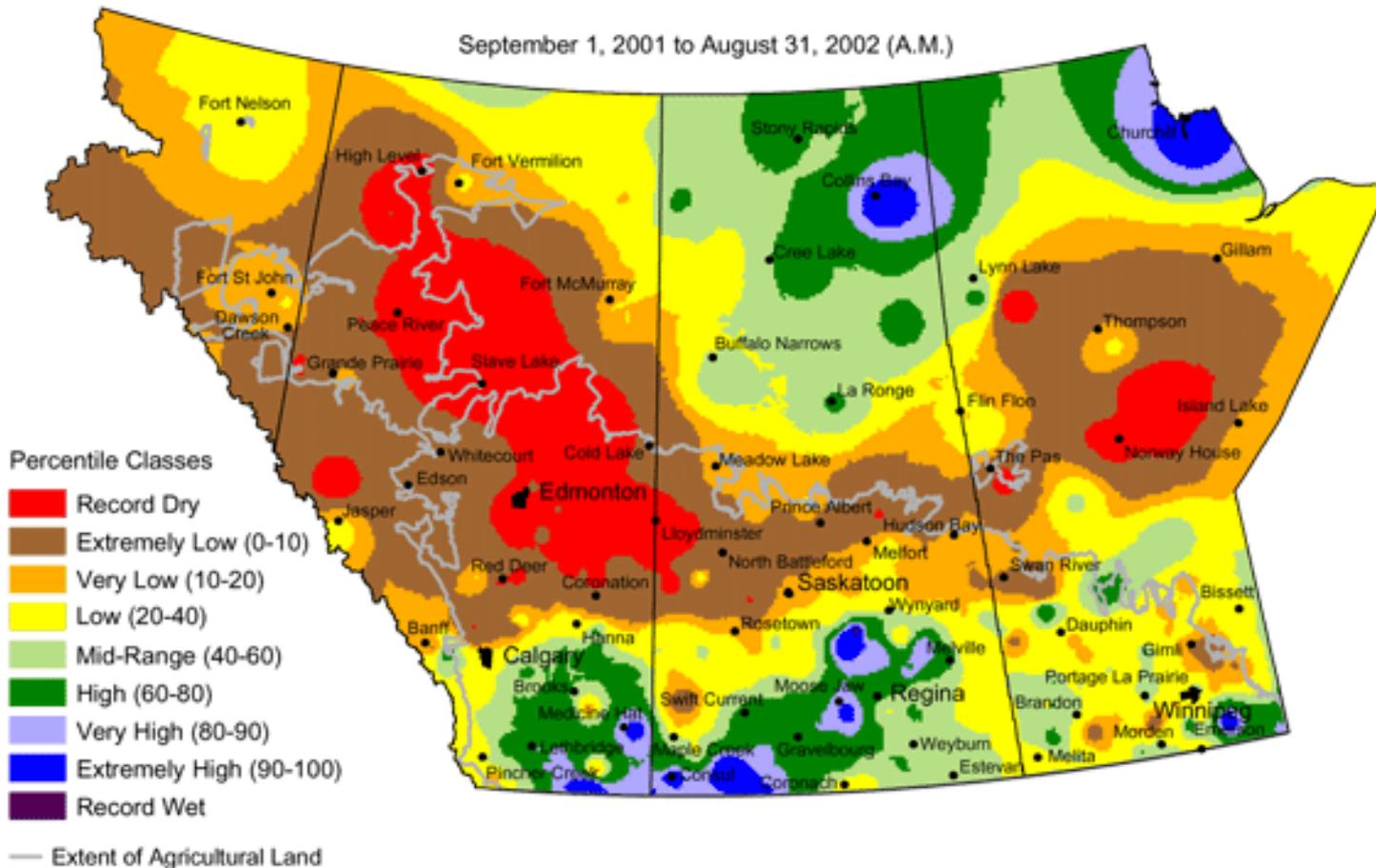
## Temperature (C)

### Autumn 2000 to Summer 2002



# Current Precipitation Compared to Historical Distribution

September 1, 2001 to August 31, 2002 (A.M.)

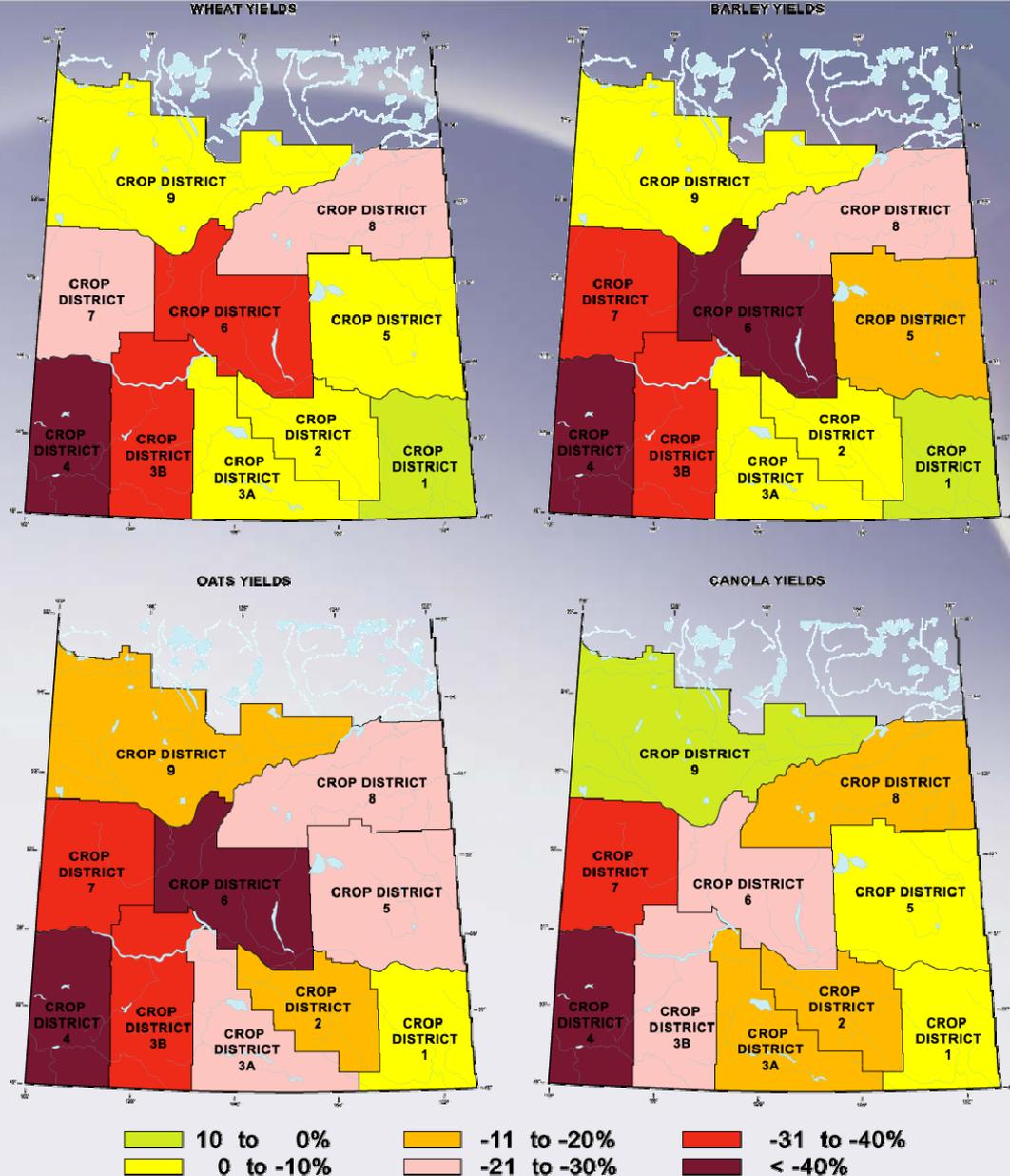


Prepared by PFRA (Prairie Farm Rehabilitation Administration) using data from the Timely Climate Monitoring Network and the many federal and provincial agencies and volunteers that support it.

(PFRA 2002 website)

# Spatial Patterns of Crop Production in 2001 Drought

(Wittrock 2001)



Data source: Saskatchewan Agriculture and Food

Percent Above / Below 10-year Average (1991 - 2000 average bu/ac)

# Impacts of the 2001-2002 Drought: Water Resources

- Previously reliable and good quality **water** supplies were severely affected, and some failed
- Records** were set; e.g., lowest water levels in the Georgian Bay Area
- The number of prairie **sloughs** was the lowest on record in May 2002



(Wheaton et al. 2005,2008)

# Agricultural Drought Adaptation (ADA)

## Project:

## Main Objectives



- ↳ Characterize the 2001-2002 droughts compared to the past and future
- ↳ Increase the understanding of the impacts and adaptation processes for the 2001-2002 drought years
- ↳ Determine the effectiveness of current adaptation options
- ↳ Use regional studies set in AB, SK, ON, NS and PEI



# Observed Short-Term Adaptation Strategies: Crop Examples (After Wittrock and Wheaton 2005)

Technology/ Research	Government Programs	Farm Management	Farm and Secondary Industry Financial	Community cooperative Support
Equipment was modified to deal with stunted crops Drought resistant crops	Crop Insurance, National Income Stabilization Account Low interest loans Disaster payment Pest control Information, e.g., future climate conditions	Cropping strategies, e.g.: <ul style="list-style-type: none"> <li>• crop rotation</li> <li>• change seeding times depending on soil moisture</li> <li>• reseeding</li> <li>• weed and insect management</li> <li>• crop diversification</li> <li>• drought tolerant species</li> </ul> Used unmarketable crops for silage or baled for use in livestock industry	Sold crops during shortages to obtain higher prices-- worked until 2003 when the inventory was low	Seed suppliers offered producers to take some of the financial risk of production due to inclement weather

# Observed Long-Term Adaptation Strategies:

## Crop Examples (After Wittrock and Wheaton 2005)

### Technology / Research

### Government Programs

### Farm and Financial Management

Drought Resistant Crop development:  
canola, winter wheat, corn, spring  
wheat, forage crops

Assessment of future  
government assistance  
programs

Expansion of minimum tillage

Long-range weather forecasts

Agriculture Policy Framework

More efficient irrigation  
systems

Weather/climate monitoring network

Agriculture Drought Risk  
Management Plan

Improved business plans

Soil moisture modelling

Diversified into production,  
processing and marketing

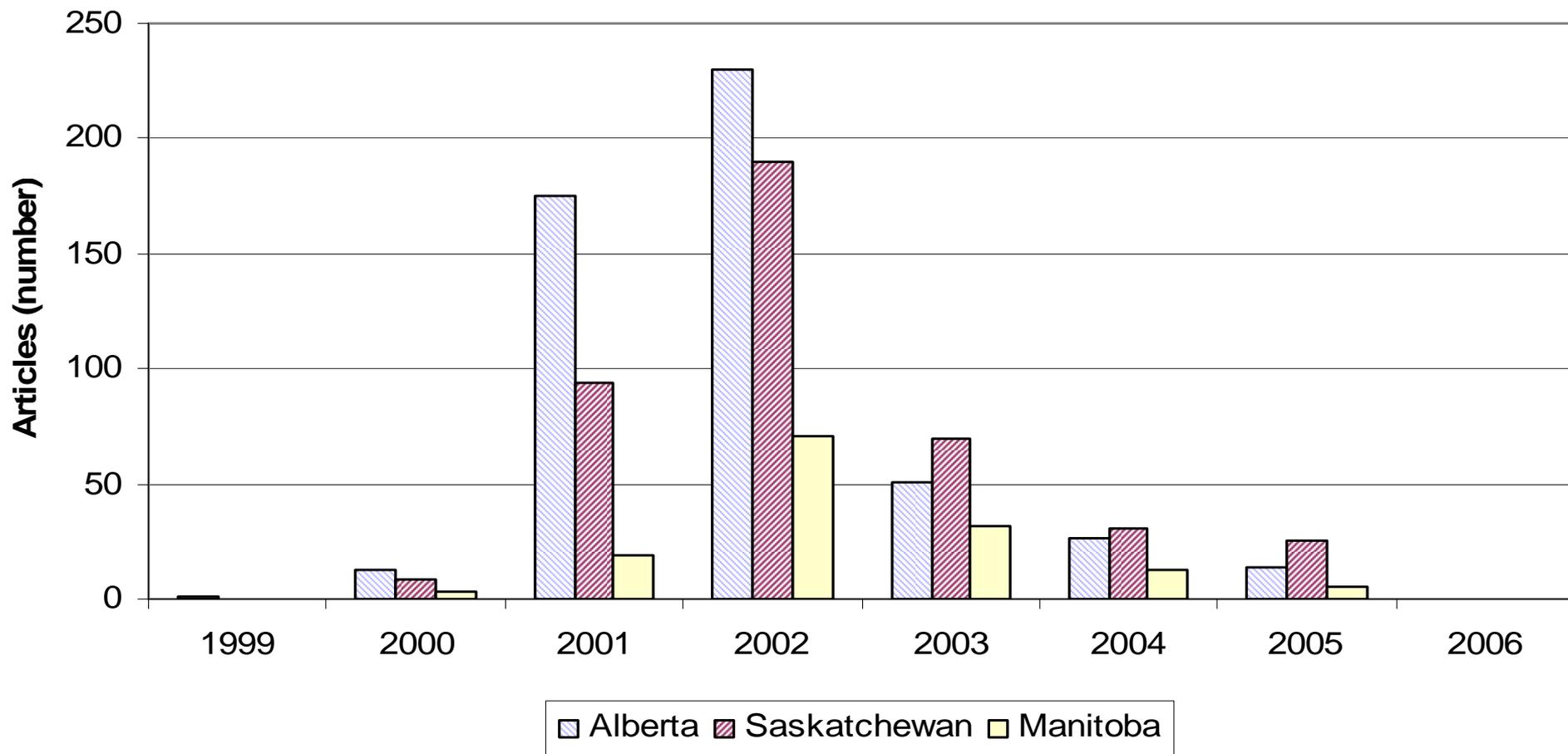
Soil moisture conservation strategies  
to reduce soil erosion and weed  
growth

Impacts and adaptation to climate  
change

# Timing of Adaptation Emphasis Prairie Provinces

(Wittrock and Wheaton 2005)

### Adaptations by Year and by Province



# Most frequently identified adaptation options for dealing with the 2001-2002 Drought



## **Eastern Canada Focus Groups (ON, NB, PEI, NS) adaptation options used:**

- Soil conservation, **no changes**, and drought-tolerant crops
- The “no change/ do nothing” option indicates continuing vulnerabilities

## **Eastern Canada - Top 10 adaptation options (print media survey):**

- **1. Irrigation**
- **2. Crop insurance**
- **3. Water Conservation**
- **4. Ontario Low Water Response Water Response Teams (WRT)**
- **5. Net Income Stabilization Account (NISA)**
- **6. Canadian Farm Income Program (CFIP)**
- **7. Water management**
- **8. Disaster Assistance**
- **9. Drought-tolerant/resistant crops**
- **10. Mulch**

# Crop production adaptations – Eastern Canada

- ↳ Where possible, an **increased reliance on irrigation** was the primary adaptation to drought, particularly for fruit and vegetable crops in Eastern Canada
- ↳ Small % of total agr land is irrigated in these provinces

## ISSUES:

- ↳ Farmers have to obtain own water supply (not centralized), shallower aquifers, wells
- ↳ Agriculture is not always the greatest water user in several watersheds (municipal, industrial) – conflicts?
- ↳ Increased irrigation resulted in higher energy and labour costs
- ↳ **Sustainable adaptation option?**



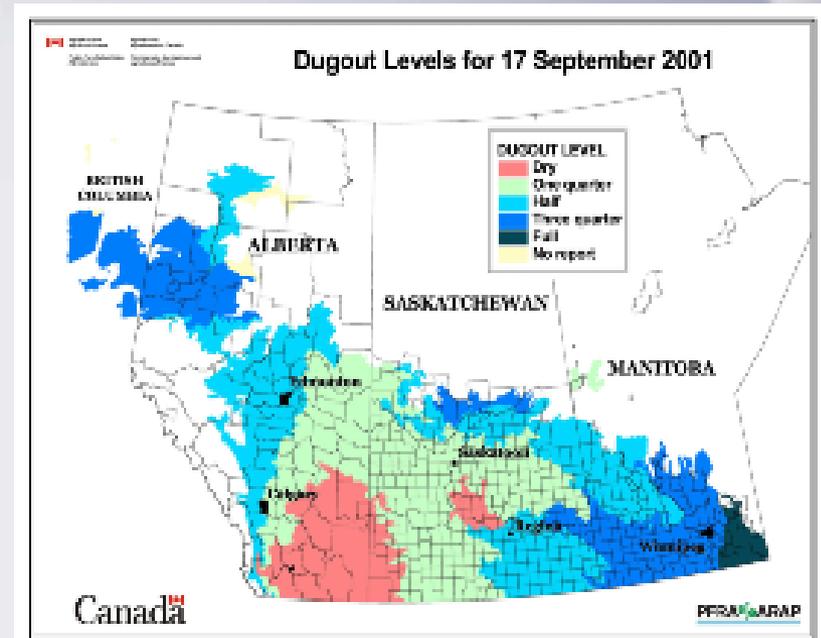


# Innovative Adaptation

- ↪ Use of Ducks Unlimited land for haying and grazing
- ↪ Growth of drought monitoring and adaptation website information
- ↪ Monitoring and mapping of pasture growth and dugout levels
- ↪ Community support



<http://www.rideaulakes.net/Haywest/>



# Maladaptation – Examples for Livestock

**MALADAPTATION** - when a strategy produces negative or inadequate results

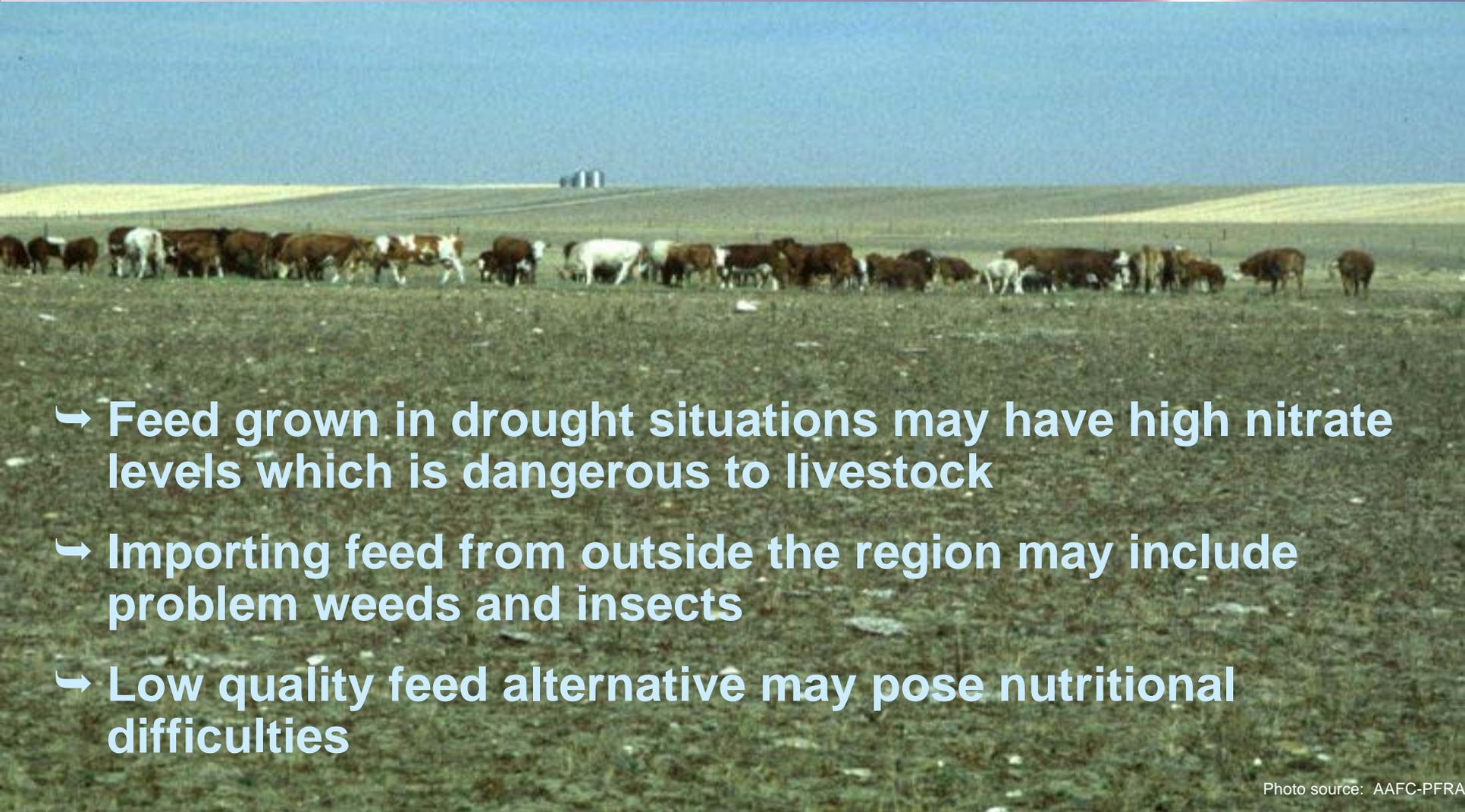
- 
- ↪ Feed grown in drought situations may have high nitrate levels which is dangerous to livestock
  - ↪ Importing feed from outside the region may include problem weeds and insects
  - ↪ Low quality feed alternative may pose nutritional difficulties

Photo source: AAFC-PFRA



# Efficiencies and Inefficiencies

- ↳ Cropping practices have greatly improved since the 1930s through improved
  - technology
  - soil conservation
  - water conservation
- ↳ Adaptation measures implemented in 2000 and 2001 were not as effective in 2002. For example, some livestock producers had enough feed for two years of drought but not enough for three.
- ↳ Dugouts were drying out by the fall of 2000, and this trend became worse in 2001.



Photo Source: PFRA - Agriculture and Agri-Food Canada Web site



# Residual Negative Impacts

Photo: Nadler 2007

**Definition:** Negative impacts that remain after adaptation measures have been applied

- ➔ **Crops** – nitrogen fertilizer not utilized during drought events
- ➔ **Livestock** – adaptive capacity for livestock and pasture management was at its limit (2004)
- ➔ **Water** – shortage problems intensified with farms becoming more intensive and government policy promoting value-added industries

# Barriers to Adaptation

- ↳ Sensitivities re water use for agriculture vs other uses
- ↳ Consistent drought thresholds are needed to trigger support for farmers
- ↳ Adaptation measures can be costly and technical
- ↳ **Long-range climate projections (drought) need improving**
- ↳ Bureaucratic difficulties in getting permits for water (ON,NB)



Photo source: AAFC-PFRA



# Drought adaptations by farmers and ranchers, 2001-2002, South Saskatchewan Basin (AB and SK)

(Johnston 2007)

- ↳ Mail-out survey
- ↳ Asked: What is the current level of drought preparedness?
- ↳ Responses:
  - ↳ Farmers and ranchers used adaptive measures
    - ↳ with multiple benefits and easy to use (e.g. time,\$)
  - ↳ They are aware of current drought and the possibility of future risks to drought
  - ↳ But, the perceived risks **do not** appear to be sufficient to prompt widespread use of specific drought adaptation options
  - ↳ Finances seem to be a major barrier to adoption of these options



# A positive...National Water Supply Expansion Program (NWSEP)

- ↳ NWSEP is a **four-year, \$60-million** Canada-wide initiative under the APF (PFRA).
- ↳ NWSEP focuses on assisting Canadian producers to **address water concerns** and **develop and enhance long-term agricultural water supplies**.

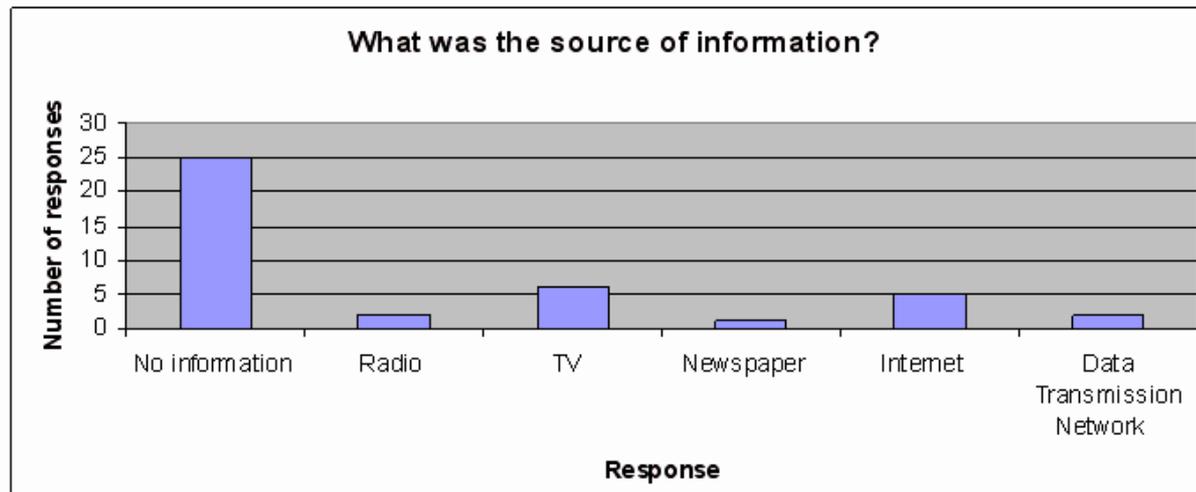


# Next Steps?

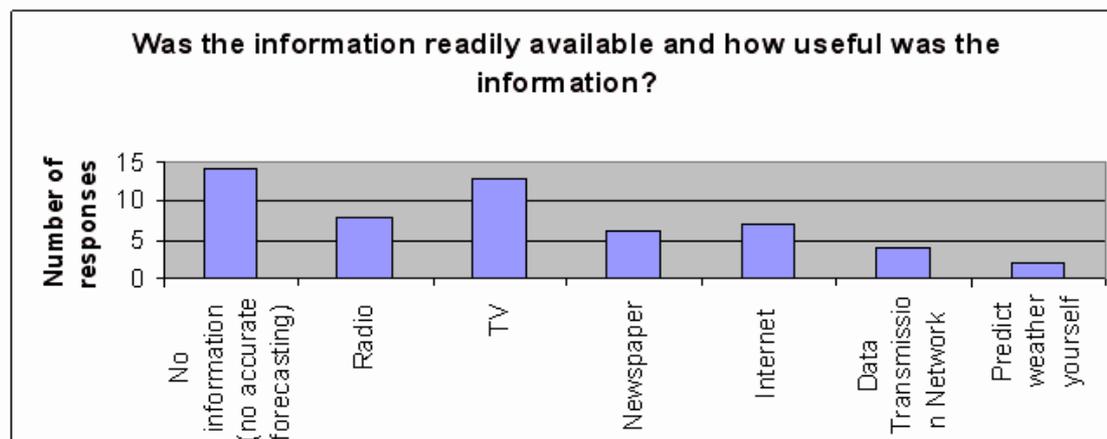
- ↳ Knowledge and learning is key to improving adaptive capacity...Don Wilhite (NDMC) says that drought monitoring and data collection systems are the first key steps towards better drought preparedness...
- ↳ **Monitoring, modeling, and prediction of drought**
  - ↳ The objective of Drought Research Initiative (DRI) is to better understand the physical characteristics of and processes influencing Canadian Prairie droughts, and to contribute to their better prediction, through a focus on the recent severe drought of 1999 - 2004/05.
- ↳ **Drought characterization** - what is the nature of the hazard?
- ↳ **Drought impact monitoring and characterization** – what is being impacted? How severe are the impacts?
- ↳ **Adaptation assessment** - how can effectiveness be enhanced (e.g. institutional aspects)
- ↳ **Adaptation modeling** - understanding the processes
- ↳ Ensure drought research **generates adaptation benefits** (e.g. drought plans)



# Sources/usefulness of drought information: Southern Ontario focus groups



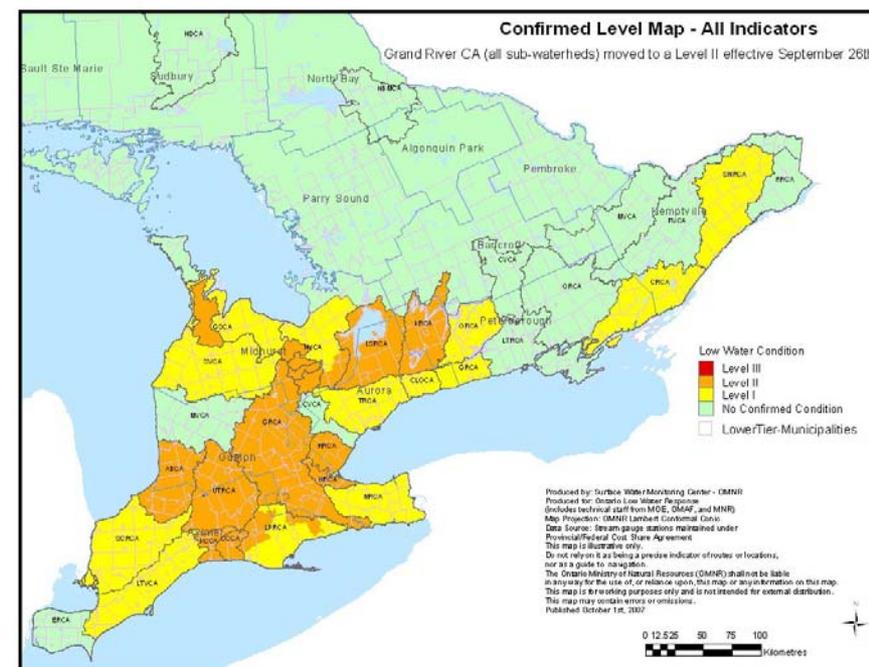
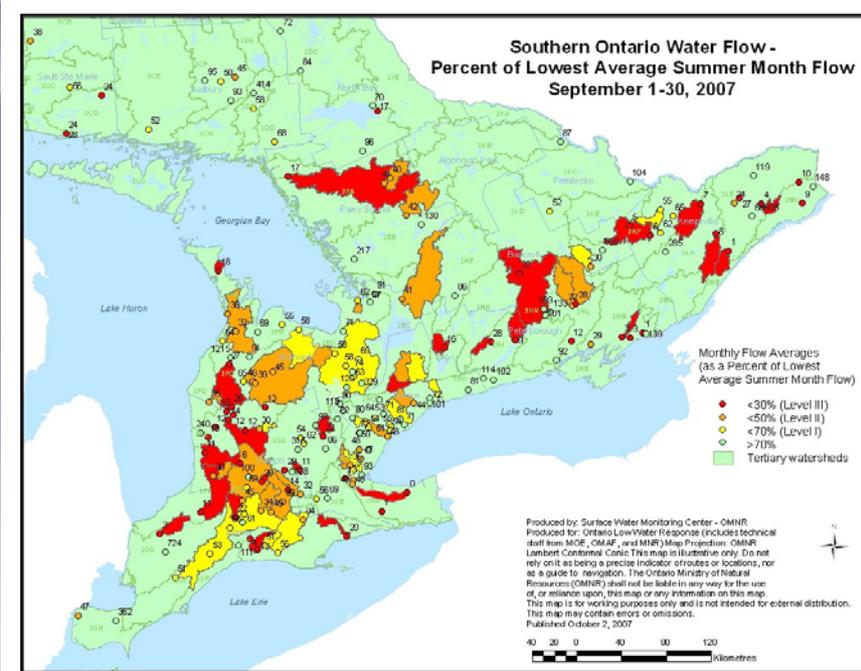
Response	Number of Responses
No information	25
Radio	2
TV	6
Newspaper	1
Internet	5
Data Transmission Network	2



Response	Number of responses
No information (no accurate forecasting)	14
Radio	8
TV	13
Newspaper	6
Internet	7
Data Transmission Network	4

# OLWR – improvements and wish lists

- ➔ OLWR has been reviewed by provincial and CA staff each year since 2000
- ➔ Some modifications have been made since ADA study period (2001-2002)
- ➔ Since 2003
  - ➔ biweekly indicator maps
  - ➔ confirmed condition level maps
- ➔ Farmers still want/wish for:
  - ➔ Weekly maps (like USDM)
  - ➔ Regional/local maps (like USDM)
  - ➔ Drought outlook/prediction products



# Water resources monitoring – Atlantic Canada

- **Annual** precipitation, streamflow runoff and groundwater levels data for New Brunswick available since late 2001 via government website
- **Monthly** data available from 2003
- No similar monitoring data available on-line for NS or PEI

The screenshot shows a web browser window with the URL <http://www.gnb.ca/0009/0371/0007/0006-e.asp>. The page title is "New Brunswick Water Quantity Information" and it is in the "ARCHIVE" section. The current year is set to 2002. The page displays the "ANNUAL SUMMARY OF WATER RESOURCES FOR 2002" with three main sections: "Precipitation", "Stream Flow Runoff", and "Groundwater Levels".

**Precipitation**  
Total annual precipitation for the year was near normal in southern areas of the Province, decreasing to well below normal in the northwest. The year began with near normal precipitation, however most of it was in the form of snow, which did little to ease the conditions of one of the driest periods in recent history for some areas of the Province. In February southern areas received some relief in the form of frequent thaws and well above normal precipitation. Monthly precipitation continued to be near normal or above in southern areas throughout the remainder of the year, with the exception of August, which was very dry over most of the Province. Northern areas however did not receive as many winter thaws and eight months of the year received below precipitation in this region. By the end of the year some areas had accumulated an annual precipitation deficit of over 200mm.

**Stream Flow Runoff**  
Runoff for the year was well above normal in southern areas of the Province while the northern areas were below normal. The year began with very low runoff in all areas of the Province, as a result the extremely dry conditions of the previous year, and no January thaw. February saw a dramatic change in runoff conditions in the southern half of the Province with frequent winter thaws, while northern areas received much less runoff as the winter thaws did not extend into these areas. Even though the snow pack in southern areas was light, the spring runoff was still above normal as a result of the above normal precipitation received during the spring months. The above normal runoff continued throughout the remainder of the year in southern areas. While spring runoff in northern areas managed to reach normal for the month of April, the freshet period was short and runoff for the remainder of the year was below normal except for the month of July.

**Groundwater Levels**  
Levels were at record lows until late February, when they recovered to near normal and remained there until June. After several months of abundant rainfall and above normal stream flows in southern areas, it was evident that ground water aquifers however had not fully recovered from the previous years drought. At New Brunswick and Nova Scotia levels dropped quickly after the spring and were below normal throughout most of the year. Levels at Dresden fell and



<http://www.gnb.ca/0009/0371/0007/0006-e.asp>

# Drought indices / forecasting / prediction needs

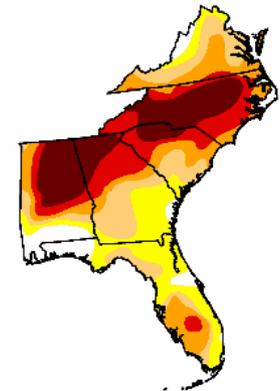
- ➔ Farmers, water managers:
  - ➔ Real-time drought information
  - ➔ Regional/local drought indices
  - ➔ Drought outlook info (e.g. USDM text, NOAA maps)
  - ➔ Seasonal forecasts

## U.S. Drought Monitor Southeast

February 12, 2008  
Valid 7 a.m. EST

*Drought Conditions (Percent Area)*

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	8.0	92.0	73.2	54.8	36.3	19.8
Last Week (02/05/2008 map)	8.0	92.0	71.8	54.8	36.3	19.8
3 Months Ago (11/20/2007 map)	11.3	88.7	75.6	55.4	41.7	27.2
Start of Calendar Year (01/01/2008 map)	9.6	90.4	74.3	58.5	41.0	22.0
Start of Water Year (10/02/2007 map)	10.1	89.9	77.9	63.8	45.2	24.0
One Year Ago (02/13/2007 map)	62.6	37.4	8.7	0.0	0.0	0.0



*Intensity:*



The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements

<http://drought.unl.edu/dm>



Released Thursday, February 14, 2008  
Author: J. Lawrimore/L. Love-Brotak, NOAA/NESDIS/NCDC

## U.S. Seasonal Drought Outlook Drought Tendency During the Valid Period Valid January 3 - March, 2008

Released January 3, 2008



**KEY:**

- Drought to persist or intensify
- Drought ongoing, some improvement
- Drought likely to improve, impacts ease
- Drought development likely

Depicts large-scale trends based on subjectively derived probabilities guided by short- and long-range statistical and dynamical forecasts. Short-term events — such as individual storms — cannot be accurately forecast more than a few days in advance. Use caution for applications — such as crops — that can be affected by such events. "Ongoing" drought areas are approximated from the Drought Monitor (D1 to D4 intensity). For weekly drought updates, see the latest U.S. Drought Monitor. NOTE: the green improvement areas imply at least a 1-category improvement in the Drought Monitor intensity levels, but do not necessarily imply drought termination.

**Looking Ahead:** For February 14-February 18, an active pattern across the southern tier of the nation is expected to bring much needed precipitation to some drought-affected areas. Early in the period a deep trough over the western U.S. and a developing storm system over the Southwest are projected to produce rain and snow in New Mexico and Texas. Slow movement is expected as the storm system becomes separated from the main upper level flow. The potential also exists for central Gulf coast storm development as the upper level trough moves eastward in the middle of the period with parts of the Deep South and Ohio River Basin benefitting from additional precipitation. While eastward movement of the upper level pattern brings cooler than average temperatures to much of the East, warmer and drier conditions will return to the Southwest and southern Plains during the latter half of the period.

For the ensuing 5 days (February 19-23), projections favor a ridge over the West and a trough over the eastern U.S. This pattern is expected to bring warmer than average temperatures to western areas of the nation while the central and eastern U.S. are projected to be generally cooler than average. Drier than average conditions are expected to stretch from the West coast to the southern Plains and Midwest, while wetter than average conditions are more likely in the Southeast and along the eastern seaboard. Southern Alaska and the Panhandle are also projected to be wetter than average, while a pattern of drier than average conditions is more likely to influence central and northern areas of the state.

Author: Jay Lawrimore, NOAA's National Climatic Data Center

# US Drought Impact Reporter

- ➔ Print Media Survey was a one-time intensive data collection effort for the ADA project (autumn 2000-winter 2003)
- ➔ Since 2005, the National Drought Mitigation Center (NDMC) has an on-line collection of US drought **impacts** at a state and county level using media sources/newspaper articles:  
<http://www.drought.unl.edu/dm/monitor.html>
- ➔ But the Drought Impact Reporter **does NOT collect data on drought adaptations used**
- ➔ Operational drought impact and adaptation data collection system for Canada?

**Drought Impact Reporter**  
National Drought Mitigation Center

View Drought Impacts | Add A Drought Impact | Time-Lapse Animation | About | Help | User Login

**Map Options**  
Impact Categories:  
 Agriculture  Fire  
 Water/Energy  Social  
 Environment  Other  
Source: All Sources  
Time Period: Last Month  
Submit

Show Drought Monitor Layers

**Legend**

- No reported impacts
- 1 - 6 reported impacts
- 7 - 11 reported impacts
- 12 - 17 reported impacts
- 18 - 22 reported impacts

Sources: All Sources, Categories: All Categories  
Date Range: October 27, 2006 to November 27, 2006

10 reported drought impacts for Dallas County, Texas:

1. [The U.S. Small Business Administration \(SBA\)](#) announced that federal disaster... (click to read more)  
Categories: Other  
Source: Media  
Dates of Impact: 2006-01-01 to 2006-11-07  
External URL: <http://www.thepampanews.com/articles/2006/04/20/n...>
2. [The North Texas Municipal Water District](#) is still in Stage... (click to read more)  
Categories: Other  
Source: Media  
Dates of Impact: 2006-06-01 to 2006-11-12  
External URL: <http://www.courier-gazette.com/articles/2006/11/1...>
3. [Throughout Texas certain transportation](#) restrictions have been lifted to allow... (click to read more)  
Categories: Agriculture  
Source: Media  
Dates of Impact: 2006-08-14 to 2006-10-31  
External URL: <http://www.kwes.com/kwes/newsstories/newsAPhav...>
4. [Agriculture Secretary Mike Johanns](#) has lengthened the time allowed for... (click to read more)  
Categories: Other  
Source: Media  
Dates of Impact: 2006-09-15 to 2006-11-30  
External URL: <http://www.farmandranchguide.com/articles/2006/09...>
5. [Residents and business owners](#) are requested to voluntarily conserve water... (click to read more)



# Conclusions



**Impacts** of the 2001/2002 drought on the Canadian environment, economy, and society were severe

**Adaptations** were undertaken--several were difficult, costly, disruptive and failed  
**Improvements** in many areas are vital to reduce vulnerability

# References

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# Project contacts

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## **ADA Project Web site:**

[http://www.src.sk.ca/html/research\\_technology/environment/climatology/Agricultural\\_Adaptations/index.cfm](http://www.src.sk.ca/html/research_technology/environment/climatology/Agricultural_Adaptations/index.cfm)